



Annual Report

2012-13



CENTRE FRANCO-INDIEN POUR LA
PROMOTION DE LA RECHERCHE AVANCEE

INDO-FRENCH CENTRE FOR THE
PROMOTION OF ADVANCED RESEARCH



Indo-French Centre for the
Promotion of Advanced Research

Annual **Report**
2012-13

From the Director's Desk



Bonjour!

With the excitement of completing the journey of 25 years of catalyzing the Indo-French S&T cooperation, we report the activities for the year 2012-13. The role of CEFIPRA in bringing the two nations closer through science and technology was appreciated during the state visit of the Honorable President of France, Mr. François Hollande to India during February 2013.

The successful existence as the longest bilateral S&T supporting organization of the world and the corollary accolade received by the CEFIPRA has given a new resolve for its future journey. During this voyage we would like to strengthen the knowledge bridge between the two nations for creating social common goods. Our new logo is an expression of that vision which adequately represents the philosophy and goal of CEFIPRA's existence.

While celebrating this silver jubilee year, we take this opportunity to convey our heartfelt gratitude to all the stakeholders whose contributions and guidance have made this journey possible. I would especially like to mention the contributions of the former directors of the CEFIPRA, Mr. P.G.S. Mony, Prof. Shiva Prasad and Dr. A. Amudeswari.

In this year's report, the spectrum of knowledge generated by CEFIPRA supported projects across the domains of Basic Science, Applied Science and Industrial Research have been presented. The 11 and 10 projects completed during this year in Basic and Applied Science areas respectively have resulted in 139 publications in SCI journals. These papers have been published in high impact factor journals like Cell, Physical Review, Journal for Immunology, Journal for Material Chemistry, etc. and have received 855 citations. This testifies the high quality of knowledge generated through CEFIPRA supported projects. These 21 projects have resulted into 6 products, 16 designs, 31 processes and 2 new instruments. Human Resource supply chain has been strengthened through training of 51 students in India and France. Also, 74 Indian scientists/students visited France and 42 French scientists/students visited India during the period. Efficiency of these completed projects has been analyzed and reported.

42 Basic Science projects and 23 Applied Science projects under implementation are strengthening the Indo-French S&T knowledge generation chain.

For enabling knowledge sharing and knowledge forward chaining, 6 bilateral seminars and



workshops have been supported during this period in the areas of Mathematics, Ceramics, Energy, Water Management, Embedded system and smart system integration based on Micro and Nano Technology.

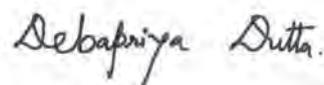
For improving the competitiveness of industry through leveraging knowledge generated by academia of both the nations, 6 industrial projects are under implementation in the areas of Ceramic Engineering, Air Pollution Monitoring, Information Technology, Catalysis and Cancer.

Celebrations being in the air, this year we have also reached out to wider stakeholder community through seminar on Success Story, showcasing CEFIPRA during the 100th Indian Science Congress and in many other fora. In order to motivate the next generation by the best minds from both the nations, we have launched the CEFIPRA lecture series. We proudly acknowledge the impact of Prof. Jules Hoffmann, French Noble laureate (Physiology

and Medicine, 2011) delivering the first CEFIPRA lecture series in 5 Indian cities, which had reached out to 2500 young minds. Our Newsletter “ENSEMBLE” has been launched during this period, which has surely brought CEFIPRA known to many members of the Indian and French scientific community whom we have not met during this journey of 25 years.

At the end of the celebration, we gratefully acknowledge the constant support and encouragement provided by both the Governments. We are confident that the passage beyond 25 years will be more exciting, meaningful and useful by catalyzing across the knowledge innovation chain under the guidance of the Governing Body and the able steering of the Scientific Council and Industrial Research Committee.

We are at the service of the Indo-French Scientific Community.



Dr. Debapriya Dutta
Director, CEFIPRA

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Overview

Year at a Glance

Moving forward from its celebration of 25 years of service to the scientific communities of both the nations, CEFIPRA is now geared to meet the newer challenges of the changing global S&T environment. The Centre is now at the threshold of evolving itself for catering to the changing environment while retaining its core strengths of bringing together scientists of the two countries. In this context the Centre has initiated interactions with stakeholders to contribute across the knowledge innovation chain through new programmes.

The Centre is obliged to the members of Scientific Council, Industrial Research Committee and everlasting support of its Governing Body.

Progress

The core programmes of the Center sustaining collaborative research between scientists of the two countries have been actively taken forward with the Council focusing on inter-disciplinary areas for support under this programme. A total of 18 projects have been supported with new stakeholders in the form of institutes being included under the fold of CEFIPRA.

During the period under report, nearly 120 peer reviewed publications in scientific journals have resulted from the projects. The Centre has so far, brought out 19 volumes of compilations of journal publications resulting from the collaborative projects. These volumes have been disseminated amongst the scientific community and officials of the two countries. The 20th volume of compilation of research papers has been prepared along with this report. Many of the research publications from CEFIPRA projects received large number of citations and

are published in high impact factor journals, reflecting the high quality of research being done through the support of CEFIPRA.

Industrial research projects form an important component of CEFIPRA activities. During the period under report, three Industrial Research Projects are in various stages of implementation in the areas of Ceramics, Catalysis and Air Pollution. The programme was further strengthened with three new projects in the areas of IT, Catalysis & Biotechnology, being initiated.

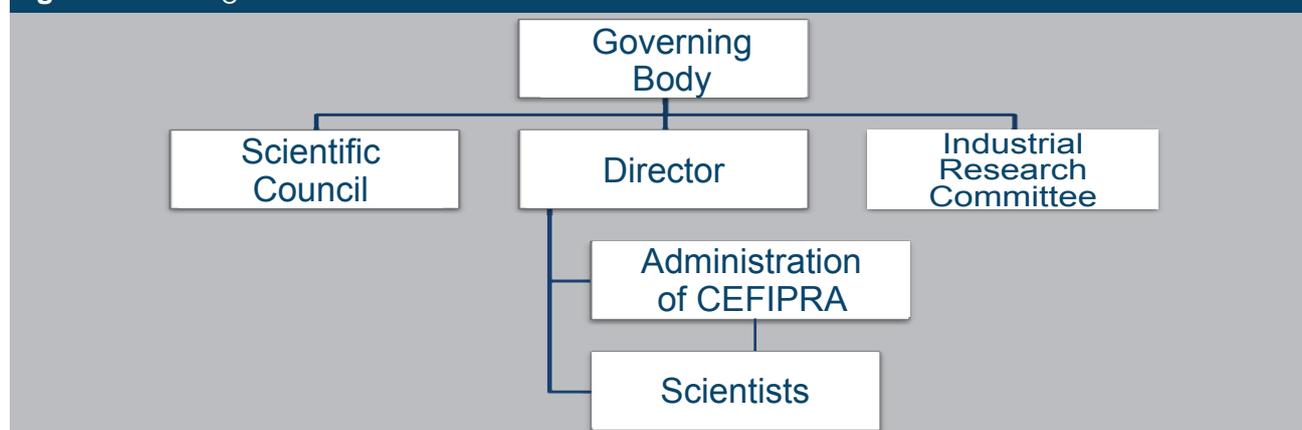
For expanding its industrial outreach, the Centre conducted a meeting in Mumbai, with Indian industries covering the areas of Manufacturing, Biotech, Vaccines, and Automotive ancillaries. French companies present in India like Total Oil India, Areva India and Air Liquide also participated in the meeting. The efforts are expected to bear fruit in the coming days.

Events

As part of the 25th year celebrations, CEFIPRA organised Seminars on “Successful Indo-French S&T Cooperation: CEFIPRA” where PIs of scientifically successful projects were invited to share their experiences.

The Centre started the CEFIPRA lecture series in the year 2012 with an intent to increase the interactions between the best of minds and young students and researchers of science of the two countries. The first of the CEFIPRA lecture series was organized in October 2012 in India with Prof. Jules Hoffmann, French Noble laureate (Physiology and Medicine, 2011) delivering lectures in five cities of India. The audience in each of these

Figure 1: Management Structure Of CEFIPRA



cities, comprising students, young researchers, senior professors and faculty benefitted from the interactions with Prof. Hoffmann during these lectures.

CEFIPRA participated in the “Pride of India” exhibition at the 100th Indian Science Congress held at Kolkata in January 2013. In this exhibition the CEFIPRA stall was visited by a number of interested students, scientists and young researchers. The stall showcased the highlights of Indo-French collaborative efforts in science and technology. On this occasion, the Centre also launched “ENSEMBLE”, its first Newsletter. The newsletter is a quarterly magazine being brought out regularly by the Centre and distributed to various stakeholders of India and France.

Recognising the importance of the mobility of students between the two countries as a pillar of S&T Cooperation, Governments of India and France have launched the “Raman – Charpak Fellowship” during the recent state visit of the Honourable President of France to India in February 2013. Under this initiative, on behalf of DST, Government of India and French Embassy in India, Ministry of Foreign Affairs and Government of France CEFIPRA has invited applications from PhD students of India and France for awarding the Raman-Charpak Fellowship 2013.

Stakeholder Outreach

For CEFIPRA’s Outreach Strategy, the Centre has established relations with Chamber of Commerce & Industry, Paris, Indo-French Chamber of Commerce and Confederation of Indian Industry (CII), In this context, efforts were made to involve new stakeholders to initiate joint events that could be sustained in the long run. A Workshop on “Embedded Systems in Aerospace” was organised with the help of the Society for Aeronautical Engineers (SAE) and the SYSTEM@TIC cluster from Paris. IT companies from India, like INFOSYS, TCS, Mahindra Aerospace, NAL, MultiTech and CISCO participated in the meeting.

Centre has also established links with governmental agencies on both the sides like Ministry of Earth Science (MOES), Ministry of Non-Conventional & Renewable Energy (MNRE), Department of Electronics

& Information Technology (DeitY), Jamia Milia Islamia, Karnataka State Council for Science and Technology, Society for Aerospace Engineering on the Indian side and CEA, Saclay, the Carnot Institute Grenoble, and the Institut de Physique du Globe (IPGP at Paris) on the French side. Getting these new stakeholders into the fold of the Centre sets the platform for the forward trajectory of the Centre.

Initiatives

Centre has established itself with new stake holders like Ministry of Earth Science (MOES), Ministry of Non-Conventional & Renewable Energy (MNRE), Department of Electronics & Information Technology (DeitY), Jamia Milia Islamia, Karnataka State Council for Science and Technology, Society for Aerospace Engineering in India, Institute of Physics, CEA Saclay, and Carnot Institute Grenoble in France. The joining of the new stake holders to the centre marks the growing network and expanding outreach of the centre.

Fostering Dialogue

The Centre supported six seminars during the year, on Advanced Glasses and Glass-ceramics, Mathematics, Water Management, Energy, Micro and Nano Technology and Embedded systems for Aeronautics. These seminars provided a platform to the scientific community of the two countries to exchange ideas and come forth with collaborative proposals that could be supported by the Centre. The results of this effort was already seen with a few proposals being received in the areas of mathematics and water management. The effort involved can be seen by the fact that a total of 130 scientists of the two countries interacted in these seminars.

Outreach Strategy

For CEFIPRA’s Outreach Strategy, the Centre has established relations with Chamber of Commerce & Industry, Paris, Indo-French Chamber of Commerce and Confederation of Indian Industry (CII), etc. Workshop on “Embedded Systems in Aerospace” was organised with industries of the SYSTEM@TIC cluster from Paris and IT companies from India, like INFOSYS, TCS, Mahindra Aerospace, NAL, MultiTech and CISCO.

Scientific Activities

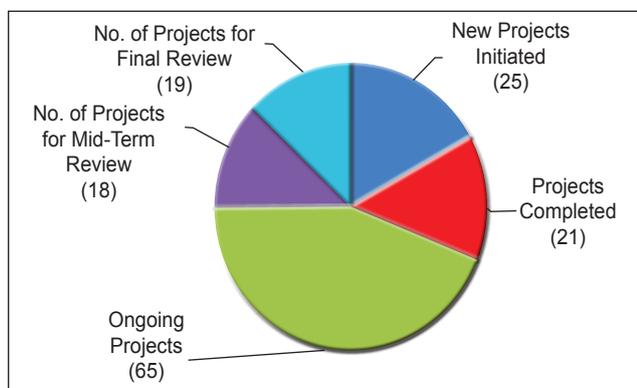


Figure 2 : Status of the Projects

(March 2013)

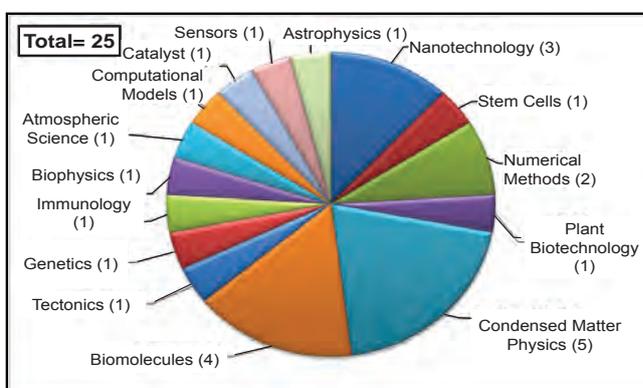


Figure 3: Sub-Area Wise Distribution of New Projects Initiated

The Annual Report (April 2012 - March 2013) of CEFIPRA at hand highlights the research activities, seminars/workshops/training schools conducted under aegis of CEFIPRA's support during the year under review.

During the year, CEFIPRA initiated 25 new projects. This was done on the basis of the recommendations of CEFIPRA's Scientific Council. Figure 3 represents the new projects initiated sub-area wise.

Out of the 21 CEFIPRA supported projects that were completed during the year 2012-13, five were rated as Excellent and 8 as Very Good. These projects ranged from domains of Material Sciences, Cell Biology, Catalysis, Proteomics, Applied Physics, Spintronics, Instrumentation, Theoretical Physics, Wireless Communication Networks, and, Applied Chemistry.

CEFIPRA received 56 new S&T research proposals during the year which were reviewed by CEFIPRA's Scientific Council in its 49th and 50th meetings. The Scientific Council recommended 18 of them for consideration of financial support by CEFIPRA.

The projects recommended by the Scientific Council, as referred above, are in the areas of Computer Science, Life and Health Science, Pure and Applied Physics, Pure and Applied Chemistry, Earth and Planetary Science, Material Science, Information and Communication Technology. The domain-wise distribution of new project proposals received and accepted during the year 2012-2013 is given in figures 4A and 4B. While the area of life sciences continues to have a higher share of the proposals accepted, areas of Pure and Applied Physics and Pure and Applied Chemistry have seen a significant increase in the success rate.

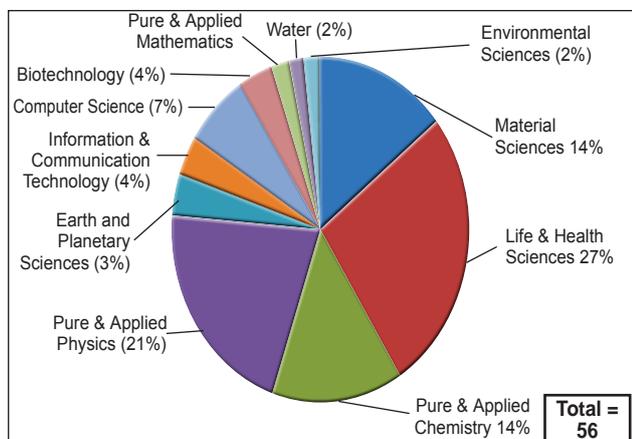


Figure4a : Thrust Area Wise Distribution of Proposals Received

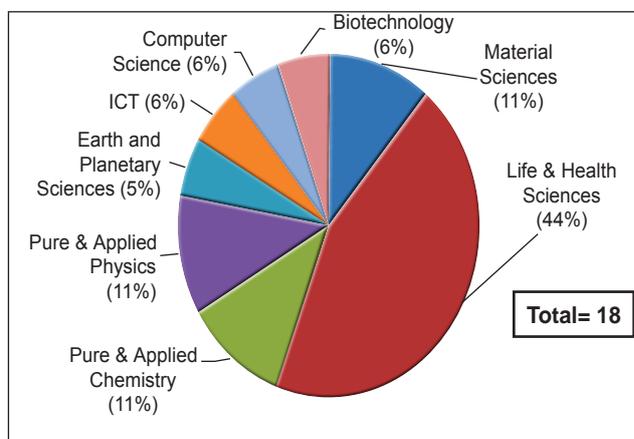


Figure4b: Thrust Area Wise Distribution of 18 Proposals Recommended by Scientific Council

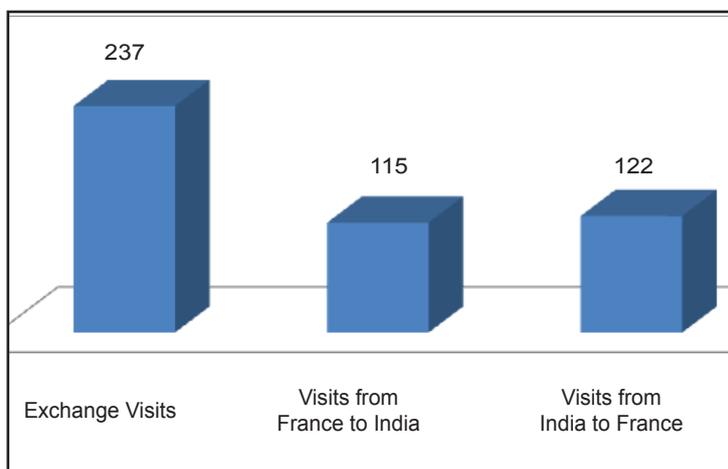


Figure 5: No. of Exchange Visits

In addition to supporting S&T research projects, CEFIPRA also lays significant emphasis on supporting information exchange and dialogue between various constituents of the S&T community of India and France. Continuing its efforts in this context, CEFIPRA supported 237 Exchange Visits for Indian and French scientists and students during the year. (Figure 5). Going by this number, one can say that CEFIPRA has supported an exchange visit every 2nd day of the year!

During the period April 2012 and March 2013, a total of 21 projects were completed. The thrust area-wise

distribution of the completed projects is given in Figure 6.

In the domain of advanced research where, theoretical sciences are also involved, publications are the true measure of evaluation of the quality of research being carried out. A total of 139 publications emanated out of these 21 projects, which got 855 citations (Source: Web of Science). A total of 51 young scientists/students were trained comprising of 11 PhDs and 18 Post-Doctoral students. Out of these 26 students were trained in France and 25 students in India. Out of 116 exchange visits, 74 visits were from India to France and 42 were from France to India (Figure 7).

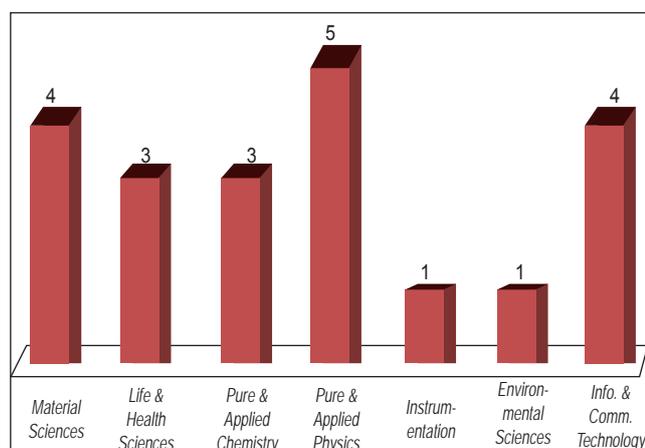


Figure 6: Thrust area-wise distribution of Projects Completed during April 2012 to March 2013

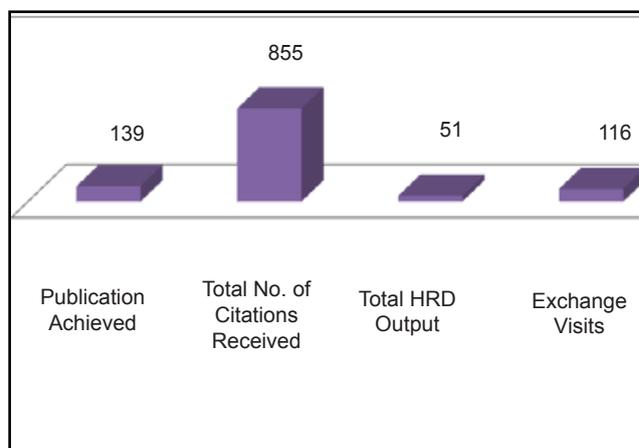


Figure 7: Publications, Citations, HRD & Exchange Visits from 21 Completed Projects during April 2012 to March 2013

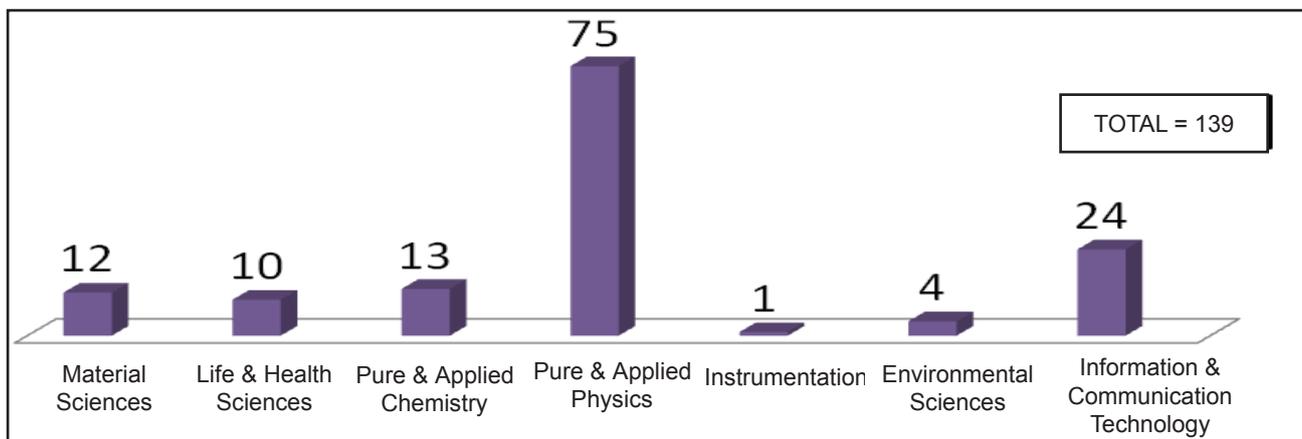


Figure 8: Thrust Area Wise Publications Resulted from 21 completed projects during April 2012 to March 2013

Figure 9 is showing the thrust area-wise publications resulted from the projects which were completed during the year. The publications have been in reputed peer-reviewed journals such as Cell, BLOOD, Phys Rev., J. Immunology, J. Mater Chem, Nuclear Phys, etc.

Quality of these publications is indicated by the citations received by them as indicated in Figure 10 below.

Several projects have resulted in technological outputs like products, process, instruments and designs (Fig. 10).

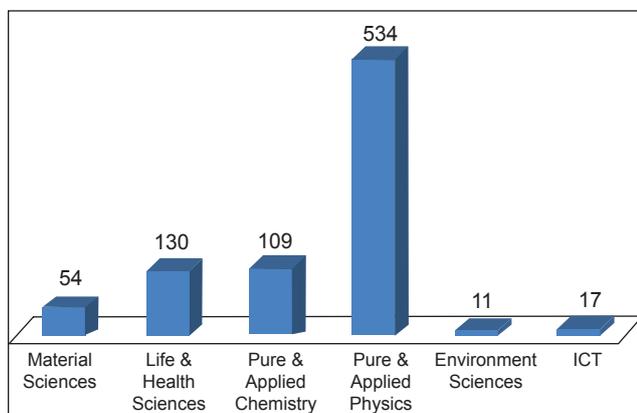


Figure 9: Thrust Area Wise Citations received from publications of 21 completed projects during April 2012 to March 2013 (Source: Web of Science)

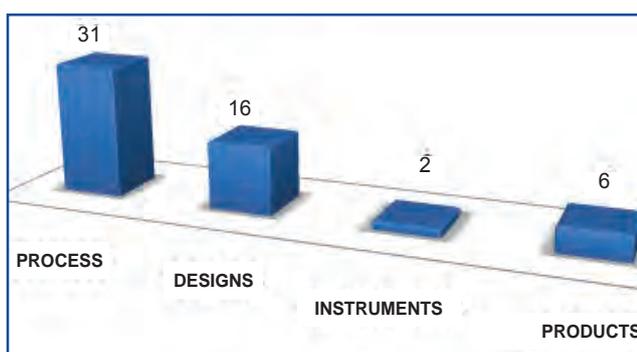


Figure 10: Distribution of Technological outputs Generated from 21 completed projects during April 2012 to March 2013

Largest number of designs and products have been developed under the Information & Communication Technology projects. Significant development & improvement at process level have been brought under the projects supported in the areas of material science, life and health science and pure and applied physics (Figure 11). Some of the significant achievements in development of technological outputs are mentioned below:

Process Developed

- Development of proteomics and lipidomics process that was little explored and that is critical for the toxins' pathological effects;
- Analysis of glycosphingolipid clustering by Shiga toxin and cellular proteins by fluorescence anisotropy measurements.
- Developed efficient procedure for separation of iron oxide from red mud.
- Four systems developed to avoid the negative effect of P205 on sealing properties of glass.
- Generated a nano/microstructure in the FeSi2 thermoelectric compound.

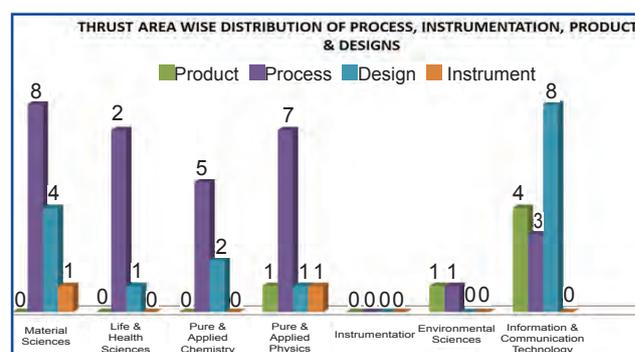


Figure 11: Thrust area-wise distribution of Process, Instrumentation, Products and Designs from 21 completed projects during April 2012 to March 2013

- A lamellar pattern of PbTe/GeTe at the nano- and microscale was produced in (Pb,Ge)Te alloy.
- Asymptotic techniques developed for the modelling, optimisation, and control of wireless networks.
- Identification of a method to measure the potential between kaons and nuclear matter.
- Developed a novel experimental technique to measure the film thickness.

Design Developed

- Design of a protein A chip
- SAW sensor for gas sensing designed.
- A tilt sensor for use in the vitro-retinal surgery.
- Low power and fast adder implementation with sub-32-nm Double Gate MOSFETs.
- Novel Differential Sensing for 0.5-V sub-32 nm UTBB FD-SOI SRAMs.
- A 110 MHz rail-to-rail opamp architecture.
- An attenuated total reflection mode tribometre.

Instrument Designed

- An experimental set-up to form liquid sheets from impinging jets.

Products Developed

- Geofiber reinforced clay, evolution of strengthening measure for improving the deformation behavior of clay-based landfill covers/cap covers of low-level radioactive waste containment systems.
- A membrane type double cavity vacuum sealed piezo-resistive, absolute pressure micro sensor was developed.
- Novel Ultra-Low-Voltage 5-T SRAM cell and boosted word-line array architecture with reduced power dissipation and increased performance was developed.

Efficiency Of Completed Projects

The Volume vs Value Index was constructed to understand the relationship of input provided to and the output produced in 21 research projects across 7 thrust areas. The Volume is defined as the Input (Total expenditure and per project investment in a particular thrust area) and the value (RoI) is the output obtained in the thrust areas in relation to the input. The technological output is measured by taking into account the processes, patents, designs, instruments and products generated from these projects in each thrust area.

$$\text{Technological output} = \frac{[\text{Patj} / \text{NPat}] + (\text{Proj} / \text{NProd}) + (\text{Proj} / \text{NPro}) + (\text{Desj} / \text{NDes}) + (\text{Insj} / \text{NIns})}{5}$$

The value (V) signifies the weighted value of the output measured in terms of technological outputs, research publications, citations received by these publications and human resource developed out of the CEFIPRA funded projects.

The weights are decided based on the activities of CEFIPRA. CEFIPRA is an organization for scientific research and thus a higher weight is given to scientific publications as compared to technological output and human resource developed. The value of (V) is calculated as below:

$$V = \text{Technological output} * 0.3 + (\text{Pubj} / \text{NPub}) * 0.25 + (\text{Sum of Avg. Citation of jth thrust area} / \text{Total Avg. Citation}) * 0.25 + 0.2 * (\text{HRj} / \text{NHR})$$

The efficiency of CEFIPRA supported projects is depicted in Figure 12:

The thrust area which has a higher rate of return (V), but, less per capita investment and has smaller bubble size has performed well. Pure and Applied Physics & Information & Communication Technology has the highest rate of return with low investment per project. On the other hand per project expenditure is high for Pure and Applied Chemistry with low rate of return.

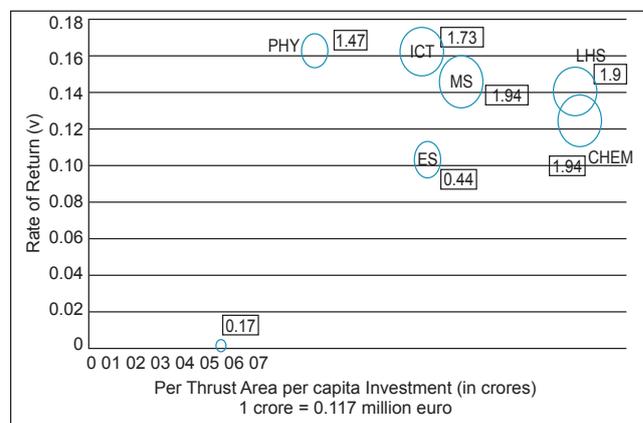
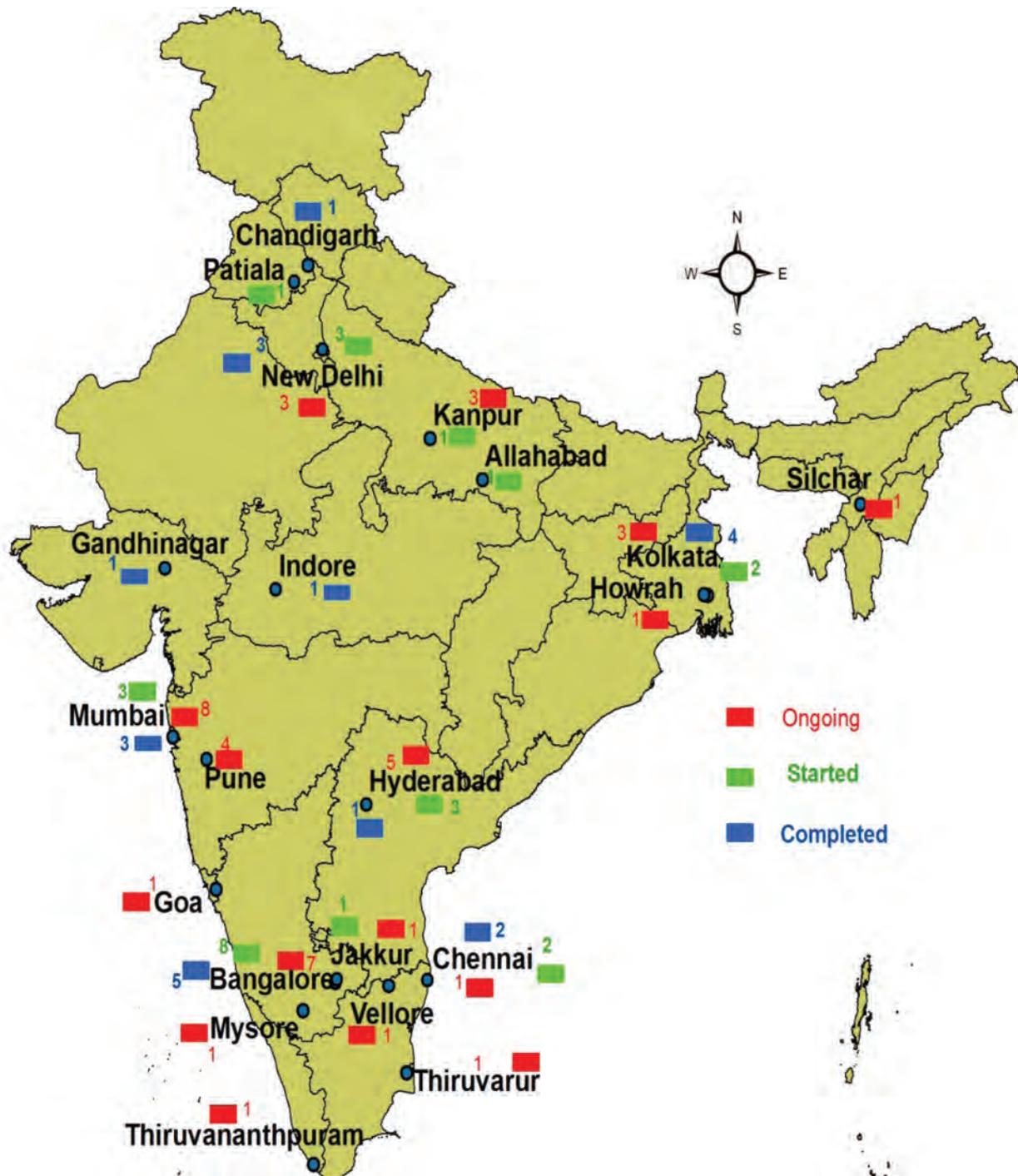


Figure 12 : Volume Value Index of Completed Projects during 2012-13.

CEFIPRA supported projects are spread across different S&T institutions in various geographical regions of India and France (see Map 1 & 2)

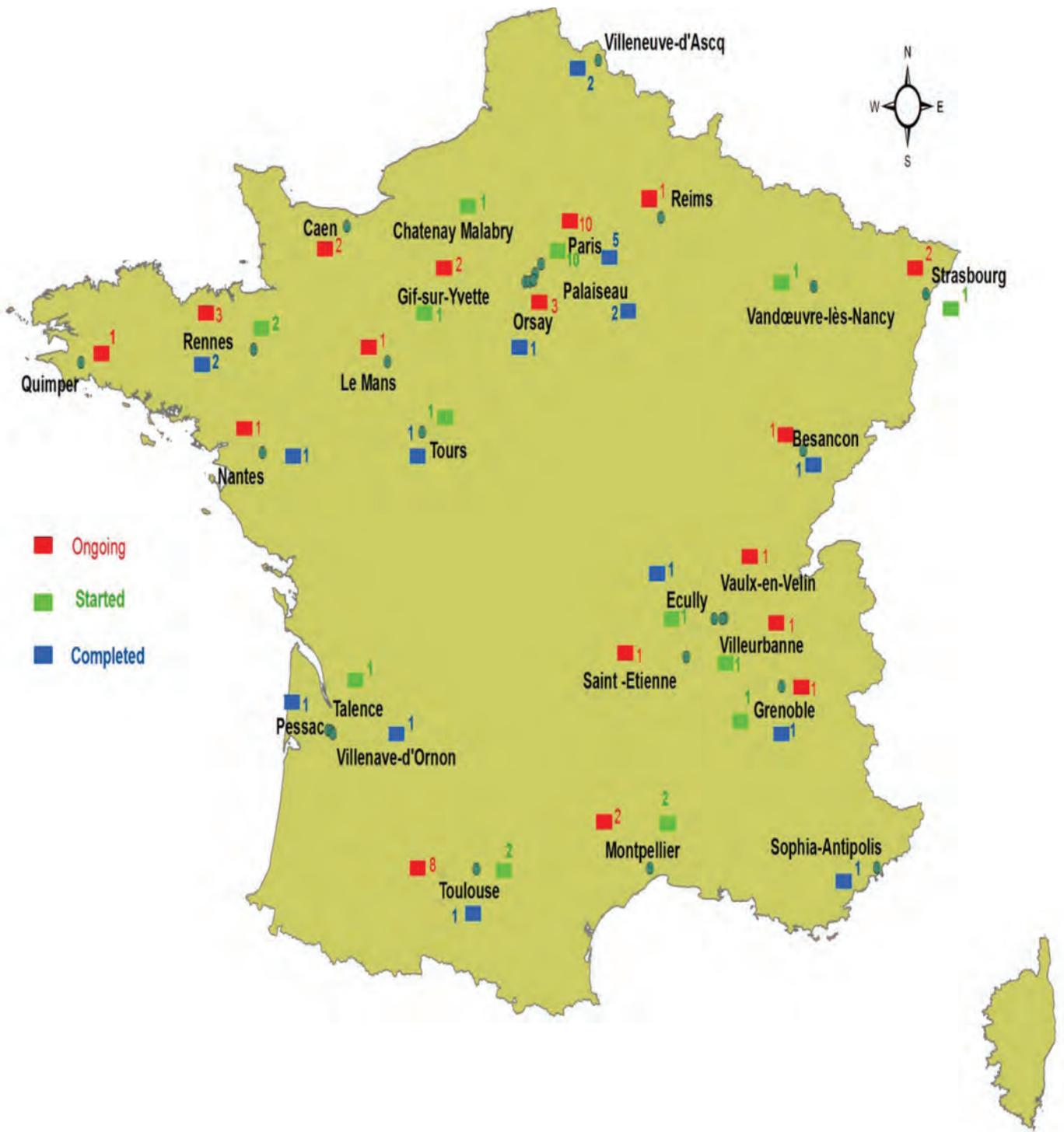
Map 1

Geographical Distribution of Projects in India



Map 2

Geographical Distribution of Projects in France



Map 3

Geographic co-location of completed projects and Pôles de Compétitivités in France



The map depicts the geographic co-location of completed projects supported by CEFIPRA during the year and Pôles de compétitivités in France, signifying the contribution of CEFIPRA supported projects in strengthening the French S&T ecosystem.



Governance & Guidance

Governing Body

CEFIPRA is managed by a Governing Body consisting of five Indian members and five French members, nominated by the respective Governments. The Secretary, Department of Science and Technology, Government of India and the Directeur de la Direction du Développement de la Coopération Scientifique et Technique at the French Ministry of Foreign Affairs, are the Co-Chairpersons of the Governing Body. The current composition of CEFIPRA's Governing Body is as under :

Indian Side	French Side
Dr. T. Ramasami Secretary to the Government of India Department of Science & Technology Government of India	Madame Hélène Duchêne Directrice Direction des Politique de Mobilité et d'attractivité, DGM/ATT, Gouvernement de la République Française, Paris
Prof. Samir K. Brahmachari Director General, CSIR & Secretary Department of Scientific & Industrial Research New Delhi-110 001	Mme Christine Gavini-Chevet Directrice des Relations Européennes, Internationales et de la Coopération -DREIC Ministère de l'Education Nationale Paris
Ms. Anuradha Mitra Joint Secretary & Financial Adviser Department of Science & Technology Government of India	Monsieur Roger Genet Directeur de la Recherche et de l'Innovation Ministère de l'Enseignement Supérieur et de la Recherche, Paris
Mr. Ashok Thakur Secretary Department of Higher Education Ministry of Human Resource Development Government of India, New Delhi	Mme. Anne Laurent Ministère du redressement productif Direction Générale de la Compétitivité, de l'Industrie et des Services DGCIS - SDEPI, Paris
Ms. Ruchi Ghanashyam Joint Secretary (Europe West) Ministry of External Affairs Government of India, New Delhi	Monsieur Pascal Le Deunff Ministère des Affaires étrangères Direction générale de la mondialisation et des partenariats, Paris



Scientific Council | Industrial Research Committee

A Scientific Council (SC), with five eminent scientists from each of the two countries as its members, identifies thrust areas of research, selects research themes for support by the centre and evaluates proposals for joint research and other scientific activities as may be desired by the Governing Body. The Industrial Research Committee consists of illustrious scientists with long experience of association with Indian and French industries. The Director, CEFIPRA is also a member of the Industrial Research Committee (IRC).

Scientific Council

Indian Side	French Side
Prof. Sanjay Puri School of Physical Sciences Jawaharlal Nehru University, New Delhi	Prof Alain Fontaine FondationNanosciences Grenoble
Prof V Kumaran Chemical Engineering Department Indian Institute of Science, Bangalore	Prof. Gérard Huet INRIA, Centre de Recherche, Paris Rocquencout, Le Chesnay
Prof. D. D. Sarma Indian Institute of Science Bangalore	Prof. Franc Pattus Institut des Sciences Biologiques CNRS, Paris
Prof. Sujatha Ramdorai School of Mathematics Tata Institute of Fundamental Research Mumbai	Prof Marc Beneditti Laboratoire de Géochimie des Eaux Université Paris Diderot Paris 7 Institute de Physique du Globe de Paris, Paris
Prof. K. Dharmalingam DBT Distinguished Research Professor School of Biotechnology Madurai Kamaraj University, Madurai	Prof. Erick J. Dufourc Institute of Chemistry & Biology of Membranes & Nanoobjects CNRS - Université Bordeaux Institut Polytechnique Bordeaux, Pessac

Industrial Research Committee

Prof. R. Kumar Department of Chemical Engineering Indian Institute of Science, Bangalore	Prof. Bernard Heulin 10, rue Henri Giessenbier, Agde
Dr. G. Sundararajan International Advanced Research Centre for Powder Metallurgy & New Materials, Hyderabad	Dr Jeanne Jordanov Institut Polytechnique de Grenoble Grenoble
Prof. V. Krishnan Jawaharlal Nehru Centre for Advanced Scientific Research, Bangalore	
Director, CEFIPRA Dr A. Amudeswari Dr. Debapriya Dutta <i>(Upto August 30, 2012) (From September 1, 2012)</i>	

Guidance of the Governing Body

The 26th meeting of the Governing Body was held in Paris, France on February 7, 2013. Dr. Debapriya Dutta, Director, CEFIPRA presented report on the activities of the Centre to the Governing Body. The Annual Report for the period 2011-2012, the annual statement of accounts and the annual budget were also presented during the meeting.

The Governing Body approved the Annual Report for the period 2011-12, the minutes of the 49th and 50th meetings of the Scientific Council, the 20th and 21st meetings of the Industrial Research Committee and Annual Accounts for 2011-12 and Annual budget for Revised Estimate for the year 2012-13 and Estimated budget for 2013-14.

The French Co-Chair, Mme. H el ene Duch ene welcoming the delegation from India, elaborated how important CEFIPRA's role is as one of the important platforms of cooperation between the two countries, remembering the major role of CEFIPRA in Indo-French S&T Cooperation highlighted during the visit of Minister for Science & Technology, Dr. Ashwani Kumar and also during the meeting of the forum for S&T cooperation of France with India organised by MAE in November, 2012. She mentioned the discussions on the role of CEFIPRA ahead of the state visit of Honourable French President H.E Mr. Francois Hollande to India in February 2013.

Dr. T Ramasami, Indian Co-Chair while expressing his happiness at the participation of the representatives of various French agencies, mentioned that this is a special year for Indian Science as the 100th Indian Science Congress was held under the Presidency of the Prime Minister of India. Noting that India's S&T

cooperation with France was the first among all bilateral S&T cooperation programs that India has set-up, he mentioned CEFIPRA as the benchmark for all Indian bilateral S&T organizations. With India's New ST&I Policy (2013) giving priority to innovation with Public-Private Partnership, the trajectory of CEFIPRA should go beyond research towards solution science, he said.

The Indian Ambassador to France, His Excellency, Mr. Rakesh Sood, recalled the recognition CEFIPRA had received in the joint statement during the visit of previous Honourable French President Sarkozy to India in 2010. He emphasised the fact that while retaining its core strength of supporting collaborative research projects, it needs to be examined how CEFIPRA could enhance the cooperation through PPP mode, establishing virtual network Centers and enhancing mobility of scientists and students between the two countries.

Prof. Erick Dufourc, Member of Scientific Council of CEFIPRA presented the activities of the Scientific Council to the Governing Body. The Governing Body appreciated the efforts of the Scientific Council and advised that it examines the possibility of linking successful groups on both sides supported by respective national agencies.

Prof. Bernard Heulin, Member of industrial Research Committee informed the Governing Body status of various projects under the programme and the initiatives of the Committee for greater outreach. Governing Body advised the Committee to ensure that the projects are industry centric and solution sciences need to be supported with care so as not to replicate known methodologies and by



shifting the focus to demand side.

Director, CEFIPRA presented progress in scientific activities under various programmes, including the newly commenced targeted programmes of Indo-French Centre for Applied Mathematics (IFCAM), INRA-DST, ANR-DST. He presented the New initiatives planned for, such as targeted programme between INRIA and DST, Raman-Charpak Fellowship programme. He explained the role of CEFIPRA in the forthcoming Tech-Summit-2013. Governing Body desired CEFIPRA should showcase a success theme pavilion highlighting Indo-French S&T cooperation. Governing Body discussed and welcomed the initiatives proposed under CEFIPRA-SGRI and



Launch of CEFIPRA's new logo

TDB-OSEO collaborations.

New LOGO and Newsletter of CEFIPRA were launched during the meeting.

Broader Vision | New Identity

Institutional logo is one of the key fundamental elements of visual identity building process for an organization. A corporate logo with its graphical properties can communicate what the organization is and what it stands for. Having completed 25 years on the ground CEFIPRA felt the need for a logo that adequately represented its culture, antecedents and objectives. The quest has resulted in a new logo for CEFIPRA that shall now be at masthead of all CEFIPRA's endeavours.

Overall Visual Identity reflects two country's collaborative approach in various aspects of Science and Technology through letter form I for India and F for France in abstract form.

The Top circular form of the Letter 'I' and 'F' depicts Human form in abstraction. This concept denotes the collaboration of two countries' scientific community coming together for social common good.

The formation of this form using various tonalities of blend colour using triangular shapes depicts the networking and coming together on the cutting edge science and technology research in multiple areas. Colour in this visual identity have specific connotation representing two countries flag colours and beyond flag colours.

Letter form 'I' consists of Orange merging into Green. Orange colour denotes creativity and enthusiasm for the S & T applications which is developed considering global challenge in sustainability aspects using colour Green. Letter form 'F' consist of transition from Blue to Red, which denotes Limitless opportunities in the S & T research for Life and vitality.

Dispersed dots denotes the spread of knowledge and building knowledge bridge between two countries. ●



Guidance of the Scientific Council

The 49th meeting of the Scientific Council was held from May 10 to 15, 2012 in Arcachon and Bordeaux, France.

- Out of twenty proposals received in the areas of Computer Science, Life and Health Science, Pure and Applied Physics, Pure and Applied Chemistry Material Science and Biotechnology, seven proposals were recommended in the areas of Life and Health Science(4), Pure and Applied Chemistry(1), Material Science(1), Biotechnology(1).
- Final review of twelve projects has taken place. Four were graded Excellent and three Very Good.
- Mid-term review of nine projects has taken place.
- Out of three seminar proposals received, one seminar in Advanced Mathematics, initiated by the Scientific Council, was recommended.

The 50th meeting of the Scientific Council was held from November 17 to 21, 2012 at Aurangabad, India.

- Out of thirty six proposals received, eleven projects were recommended in the areas of Computer Science(1), Life and Health Science(4), Pure and Applied Physics(2), Pure and Applied Chemistry(1), Earth and Planetary Science(1), Material Science(1) and Information Technology (1).
- Final review of eight projects had been carried out. One was graded Excellent and five Very Good.
- Mid term review of ten projects were carried out.
- Out of eight seminar proposals, four proposals were recommended in the topics of Dynamics of earth and planetary cores, Recent trends in Proteomics, Nano-optics and Nano magnetism and Fungal Pathogens.
- The Council also approved two seminars initiated by the members themselves in the areas of Atmospheric Sciences and Information Technology.



49th (above) and 50th (below) meetings of CEFIPRA's Scientific Council

During the year 2012-13, three projects have been recommended for support by the Committee. Eight projects were reviewed and decision taken for closure of two projects. As on date, five projects are on-going. Three projects which were recommended for support are expected to start before March 2013.

Efforts have been made to meet new stakeholders through associations/bodies, both in France and India. Two cluster workshops involving industries from France and India have been organized in "Embedded Systems for Aerospace and allied sectors" with the help of Chamber of Commerce and Industry, Paris and the Indo-French Chamber of Commerce and Industry, Mumbai.

The interactions with Pôle de Compétitivité in France continued during the year. The Committee has recommended for the visits to clusters in France and India in the areas of Biotechnology, Drugs and Pharmaceuticals, Automotive, Textiles and Aerospace materials.

Guidance of the IRC

The twentieth and twenty first meetings of the Industrial Research Committee were held during the year in Bordeaux in May 2012 and Aurangabad in November 2012 respectively.



Special
Events

First CEFIPRA Lecture by Prof. Jules Hoffmann, Nobel Laureate

Prof. Jules Hoffmann, Nobel Laureate (Physiology/Medicine 2011) visited India from 6-14 October 2012 at CEFIPRA's invitation to deliver lectures in five cities to commemorate the 25 years of CEFIPRA. Dr. Hoffman's visit took off with a welcome meeting at New Delhi which was attended by Prof. N.K. Ganguly, Advisor, Translational Health Science & Technology, National Institute of Immunology, New Delhi; Prof. Sudhir Kumar Sopory, Vice Chancellor, Jawaharlal Nehru University, New Delhi; Prof. Sanjay Puri, School of Physical Sciences, Jawaharlal Nehru University, New Delhi; Dr. V.S. Chauhan, Director, ICGEB; Dr. Chandrima Shah, National Institute of Immunology; Dr. A. Mitra, Head, International Cooperation-Bilateral, Department of Science & Technology, New Delhi and Dr. Harigopal, Head SERC, Department of Science and Technology, New Delhi.

Apart from Delhi, Dr. Hoffman visited Pune, Hyderabad, Chennai and Bangalore to interact with faculty, researchers and young students at various institutions. The institutions visited by Dr. Hoffman included Delhi University and Jawaharlal Nehru University at New Delhi; National Centre for Cell Sciences and Indian Institute of Science Education & Research at Pune; Centre for Cellular and Molecular Biology and Indian Institute of Chemical Technology at Hyderabad; Anna University at Chennai and Jawaharlal Nehru Centre for Advanced

Scientific Research, Indian Institute of Science and Bangalore University at Bangalore.

At all the institutions, Prof. Hoffmann delivered a lecture on "The Antimicrobial Defense of *Drosophila*: A paradigm for Innate Immunity from Flies to Humans" and engaged with the audience



through lively Q&A sessions focusing his area of research related to innate immunology in human beings, cancer, fungal infections and infectious diseases.

In addition to visiting institutions across the country, Dr. Hoffman met several senior officials of Indian S&T establishment, including a breakfast meeting with Dr. T. Ramasami, Secretary, DST, Govt. of India.





Concluding Ceremony of CEFIPRA's 25th Anniversary

The Centre has emerged as a role model for international bilateral cooperation in S & T. In Year 2102 CEFIPRA completed 25 years of its existence which is a significant milestone for any organisation.

CEFIPRA's Silver Jubilee Year celebrations were launched on March 7, 2012 at New Delhi. Commemorating this important milestone a number of events had been organized by CEFIPRA through the year in various parts of India and France.

The Concluding Ceremony of the 25th Year events was planned to coincide with the visit of Hon'ble French president Mr. Francois Holland to India. Hon'ble French Minister for Science & Technology, Mme Genevieve Fioraso and the Hon'ble Indian Minister for Science & Technology and Earth Sciences, Mr. S. Jaipal Reddy graced the occasion and expressed their encouraging views on the need for and prospects of Indo-French S&T cooperation.

Meeting the Stakeholders

On December 18, 2013, a dinner conclave was organised at Bnaglaore by CEFIPRA to interact with Investigators/Stakeholders of CEFIPRA supported projects to know about their experience and how CEFIPRA can help achieve them in the times to come.

The interactive session resulted in several useful suggestions for the enhancement of present programmes of CEFIPRA. The meeting highlighted the importance of increasing calls for proposals under each core programme of CEFIPRA each year. It also suggested more emphasis on establishment of Virtual Network Centres.

100th Indian Science Congress

The Centenary Celebrations of Indian Science Congress were hosted by the University of Calcutta at Kolkata from 3 to 7 January 2013. With its theme "Science for shaping the future of India"



the centenary celebrations and the congress were inaugurated by the President of India, Shri Pranab Mukherjee.

CEFIPRA displayed its achievements, stake holders & its success story during its participation in 100th Science Congress.

Other Initiatives

Raman – Charpak Fellowships

Recognising the importance of the mobility of students between two countries as a pillar of S&T Cooperation, Governments of India and France have launched the “Raman – Charpak Fellowship” during the recent state visit of the Honourable President of France to India in February 2013. The fellowship programme is in honour of Sir C.V. Raman and Prof. Georges Charpak, the two great Nobel laureates in Physics from India and France whose scientific contribution have greatly influenced the advancement of science. The programme aims at further strengthening Indo-French scientific cooperation through close collaboration between Indian and French laboratories, by supporting the mobility of highly qualified PhD students registered in an Indian or French research institute / university, to offer them an excellent opportunity to carry out a part of their doctoral research work in France / India.

ESONN 2013 Session

In an effort to enhance the outreach to the students community, CEFIPRA, in collaboration with European School on Nanosciences and Nanotechnologies (ESONN) in Grenoble, France has launched a program to support Indian doctoral students to participate in the ESONN training programme-Session 2013. ESONN is a three week course emphasizing on laboratory courses and structured to highlight fundamental and technological advances in Quantum Nanoelectronics and the interface between Physics and Biology.

Successful Indo-French S & T Cooperation

The Seminar on “Successful Indo French S & T



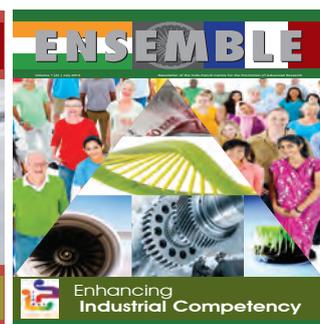
Cooperation: CEFIPRA” was held at Chennai on June 23, 2012 to commemorate 25 years completion of the Indo French Centre. The Collaborators from India and France of Ten selected projects had been invited to present their experience and success stories of the collaboration through CEFIPRA. Dr.T. Ramasami, Secretary, DST and Co-Chair, CEFIPRA was the chief guest and delivered the inaugural address. Around 80 scientists from various institutes like IIT, Mandi, IIT, Ropar, IISER, Chandigarh, Bangalore University, IIT Indore, Assam Agricultural University etc. participated in the seminar.

The collaborators presented their work conducted with CEFIPRA support and shared their views on various modalities of CEFIPRA to facilitate their efforts.

Reaching Out

In order to connect with its stakeholders on a regular and proactive manner, CEFIPRA launched ENSEMBLE, its bi-monthly newsletter.

The newsletter is available in printed and electronic formats and has been appreciated for its content and quality in a short span of time.



Nurturing Knowledge



Completed Projects
Basic Sciences

siRNAome of Toxin Endocytosis and Retrograde Transport

Project No. : 3803-2

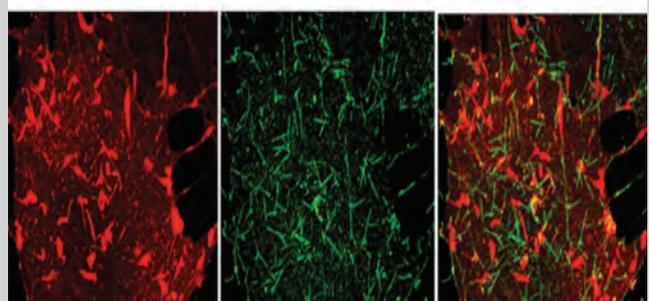
Dec. 2008 - April 2012

Background

Recent evidence suggests that the uptake of bacterial Shiga toxin and of GPI-anchored proteins requires construction of a lipid domain. The mechanisms that lead to the construction of this domain appear to be different in both cases, and the molecular events that follow after the initial invagination of the plasma membrane are still unknown. We will use genome-wide siRNA and expression screens to establish the list of gene functions required for Shiga toxin (and ricin) uptake. By making a detailed comparison to results on GPI-anchored proteins, we expect to arrive at general principles underlying clathrin-independent endocytosis. We will also analyze the mechanisms of retrograde Shiga toxin and ricin transport to the endoplasmic reticulum that is critical for the toxins' pathological effects.

Objectives

- Establish the list of all genes (genome-wide coverage) whose siRNA-mediated downmodulation affects the endocytosis and retrograde transport of Shiga toxin (defined as Shiga siRNAome) in a *Drosophila* cell line, and validate targets in a human cell line.
- Establish the list of genes (genome-wide coverage) whose siRNA-mediated downmodulation affects the endocytosis and retrograde transport of ricin (defined as ricin siRNAome).
- Comparison of the siRNAomes of Shiga toxin and ricin, establish common principles and specific differences for the retrograde transport of these protein toxins.
- Through both: i) identification of key regulators of Shiga toxin and ricin entry into cells, and ii) the development of a functional working relationship between NCBS and Institut Curie around the screening platform, as proposed in this project, lay the groundwork for the development of toxin inhibitors (small molecules) that would respond to medical needs in infectious disease (hemolytic-uremic syndrome) and protection against bioterrorism.



Shiga toxin B subunit (STxB) and endogenous human protein form distinct tubules.

Knowledge Products Developed

- Development of proteomics and lipidomics process that was little explored and that is critical for the toxins' pathological effects (hemolytic-uremic syndrome, bioterrorism) approaches on transport intermediates of clathrin-independent endocytosis.
- Analysis of glycosphingo lipid clustering by Shiga toxin and cellular proteins by fluorescence anisotropy measurements; labeling of cells with synthetic glycolipids to obtain conditions optimum for Shiga intoxication

Principal Collaborators



Satyajit Jitu Mayor
National Centre for Biological Sciences
Bangalore



Ludger Johannes
Institut Curie
Paris

Publications

SCI Journal Publication : 5
Papers Presented in Conferences : 15

Analysis of Protein Flexibility in Biological Recognition

Project No. : 4003-2

June, 2009 - Dec. 2012

Background

To gain an insights into the process of molecular recognition and protein-protein interaction one needs to understand not only the static interface formed between the two molecules, but also the changes that result in the structure as the two components associate. To analyze the physicochemical changes that occur in an isolated protein structure as it forms a complex, the collaborators have used the Protein-Protein Docking Benchmark (currently at version 4.0) [Hwang H., et al (2010) Protein-protein docking benchmark version 4.0, Proteins; 78:3111-3114] and mapped the interface residues and atoms as seen in the complex to those in the isolated state.



Objectives

To study structural and dynamic aspects of molecular recognition in proteins, which underlies much of biology. This work involved creating datasets containing structures of protein-protein complexes and their individual components. The collaborators analyzed each structure to delineate flexible regions and determine what concerted movements they undergo upon biological complex formation.

The interface region was compared between the free, or unbound (U), and the bound (B) forms of proteins to identify changes in secondary structure, side-chain conformation, crystallographic temperature factors, accessible surface areas, etc. Project also targeted novel strategies to assist in computer docking of proteins and small molecules to proteins.

Potential for Knowledge Forward Chain

- More extensive mining of structural data
- Better data (crystallization processes)
- Understanding particular biological pathways
- Flexible protein docking: structure prediction
- Drug design: predicted structures as targets

Knowledge Products Developed

- Homologous NDP kinases and their complexes with NDPs (71 complexes)
- The Structure Affinity Benchmark includes KD values (148)
- Permanent and transient homodimeric protein complexes along with KD's (315)
- Database of human hemoglobin tetraners (165)
- Flexbase: Systematic analysis of paired component structures

Publications

SCI Journal Publications : 9

Papers Presented in Conferences : 6

Mobility Support

India to France : Collaborators-4

France to India : Collaborators-3

Principal Collaborators



Pinak Chakrabarti
Bose Institute
Kolkata



Charles Robert
Institut de Biologie Physico Chimique
Paris

Fuzzy Approach to Quantum Field Theory and Gravity

Project No. : 4004-1

July 2009 - June 2012

Background

When studying the quantum structure of space-time which may exist at the Planck scale, it arises naturally that space time position may become uncertain. One nice way to describe this uncertainty is by assuming that space-time is noncommutative at short scales.

Black holes are one of the few known objects where this Planck-scale structure of space-time may arise in nature and are therefore the main "laboratory" to test these models.

Quantum field theory for a black hole must be studied nonperturbatively. We did it by performing numerical simulations on a fuzzy space, which is the discretization to a noncommutative space that a lattice can be to a classical space.

Objectives

The objective was to study the nonperturbative properties of noncommutative quantum field theories.

One way is through fuzzy (i.e. finite dimensional matrix) approximations. These approximations can then be analysed theoretically and numerically. In particular, the collaborators want to derive a fuzzy approximation for the noncommutative cylinder which can be seen as a noncommutative 2+1 BTZ black hole. A numerical study of the properties of a field theory on this space (its entropy for instance) could in turn give insight into the quantum properties of this noncommutative BTZ black hole.

Another way is through graphene sheets experiments whose low energy excitations are described by the 2d massless Dirac equation. In some parameter range, there is a self-adjoint extension parameter which labels the different inequivalent quantizations. The collaborators wanted to simulate this (discrete) problem to figure out through which observables and in what way the inequivalent quantizations could manifest experimentally.



Knowledge Products Developed

This was the very first study of scalar field theories in the background of a non-commutative BTZ black hole. It gives important clues about the behaviour of quantum fields at the Planck scale where quantum effects of gravity dominate the dynamics.

Principal Collaborators



Kumar Sankar Gupta
Saha Institute of Nuclear Physics
Kolkata



Xavier Martin
Université de Tours
Tours

Publications

SCI Journal Publication : 1
Papers Presented in Conferences : Nil

Mobility Support

India to France : Collaborators - 6
France to India : Collaborators - 4

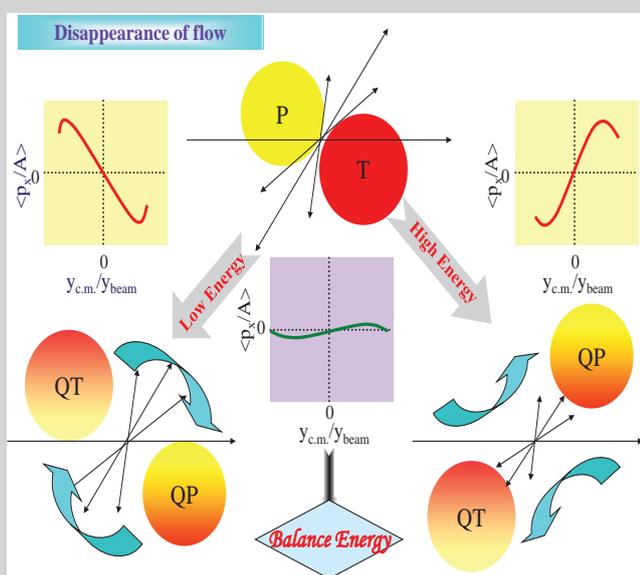
Dynamics of Multifragmentation

Project No. : 4104-1

Jan. 2010 - Dec. 2012

Background

Bimodality has triggered a great interest. We will develop a tool that allows finding out whether bimodality is a sign of a first order phase transition in a finite system or whether the system shows non-thermal critical behaviour. For this, we will make use of simulated annealing and employ different strategies including techniques which allow analysis of fragment creation in the Quantum I Molecular Dynamics approach. This model has in the recent past transition and vortex dynamics, have revived the interest for investigating stable and appropriately designed gravitational backgrounds successfully simulated nuclear reactions on an event-by event basis. Applied to multi fragmentation data, this approach will reveal many details of the reaction mechanism and allow interpretation of many observed experimental results.



Objectives

The discovery of bimodality, the fact that at the same transverse energy of light charge particles two completely different fragmentation patterns are observed, has triggered a great interest in this field. The collaborators proposed to develop tools which will allow the finding out the origin of this observation, in particular whether bimodality is a sign of a first order phase transition in a finite system or whether the system shows non-thermal critical behaviour. For this different strategies including the use of simulated annealing techniques were to be employed which allow to analyse fragment creation in the Quantum Molecular Dynamics approach. This model has in the recent past successfully simulated nuclear reactions on a event by event basis but it has to be extended to include the symmetry energy if one would like to study isotope yields. The symmetry energy is known only at normal nuclear matter density. To fix their unknown density dependence other observables like balance energy, in-plan and elliptical flow can help. Applied to multi-fragmentation data this approach will reveal many details of the reaction mechanism and will allow to interpret many of the observed experimental results. Production of sub-threshold kaons was also a part of the work program.

Knowledge Products Developed

- Showed that IQMD can reproduce isospin effects correctly.
- Suggested a stronger role of the neutron rich matter in reaction dynamics.
- Analysed role of model ingredients. Identified method to measure potential between kaons and nuclear matter.

Publications

SCI Journal Publication : 12

Papers Presented in Conferences : 15

Mobility Support

India to France : Nil

France to India : Collaborators-2

Principal Collaborators



Rajeev K. Puri
Punjab University
Chandigarh



Joerg Ulrich Aichelin
Ecole des Mines de Nantes
Nantes

Moduli Stabilization, Magnetized, Branes and Particles

Project No. : 4104-2

Jan. 10 - Dec. 12

Background

String compactifications share a set of caveats. First is the issue of super-symmetry breaking. The second is that of moduli stabilization. Giving vacuum expectation values to antisymmetric-tensor fields provides a tool for a better control of the situation. This was recognized long ago and has been re-examined extensively, leading to progress on string-theory applications to particle physics. Progress in moduli stabilization is useful while one addresses the problem of time evolution in string backgrounds. In the absence of a stabilization mechanism, runaway scalars ruin any attempt to robust cosmological features. Finally recent developments in holographic applications of string theory have revived the interest for investigating stable and appropriately designed gravitational backgrounds.

Objectives

Recently, interesting particle physics applications of string theory have emerged due to the developments of moduli stabilization techniques. The aim of the project was to extend these developments to unravel diverse properties of flux compactifications in relation with four-dimensional physics, particle spectrum and interactions. Objectives also included cosmological applications. Finally, hydrodynamic approximation of fundamental quantum field theory at non-zero temperature and chemical potential has attracted attention from the holographic perspective. From the gravitational side this calls for solution-generating techniques that are related with those used in supergravity and flux compactifications, and fit naturally into the framework of the present project.

Knowledge Products Developed

- Understanding of the role played by stringy corrections to the $N=2$ supergravity theory in the stability of non-supersymmetric attractors. Finding stable non-supersymmetric attractors in string theory.
- Embedding Bianchi attractors in gauged supergravity and studying their stability.
- Computation of the primordial power spectrum in multi-field inflation.
- Generalization of the Geroch group in presence of cosmological constant.

Potential for Knowledge Forward Chain

Understanding of the role played by heavy fields (possibly stringy in origin) on the dynamics of cosmic microwave background observables.

Publications

SCI Journal Publication : 23

Papers Presented in Conferences : 2

Mobility Support

India to France : Collaborators -3

France to India : Collaborators-1

Principal Collaborators



Prasanta Tripathi
Indian Institute of Technology
Chennai



Marios Petropoulos
Ecole Polytechnique
Palaiseau

High Accuracy Gravitational Waves from Black Hole Binaries

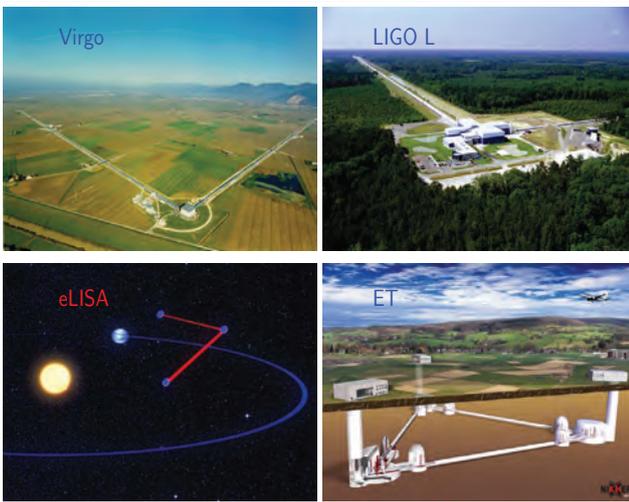
Project No. : 4204-2

Mar 2010 - Feb 2013

Background

The search for Gravitational Waves (GW) has crossed a significant milestone with the commissioning of large baseline laser interferometric GW detectors like LIGO and VIRGO. Plans are to move on to Enhanced LIGO with twice the initial LIGO sensitivity and VIRGO+ with similar goals. In these detectors double neutron star inspirals will be visible out to 300 Mpc and neutron star black hole inspiral to 650 Mpc. Associated with this exciting path breaking experiment is a plethora of requirements related to the high accuracy modelling of sources of the GW. The multipolar-post-Minkowskian formalism that we are developing has dealt with the problems of equation of motion and radiation field to the full 3PN accuracy. h22 and h33 modes we are intending to compute are the best diagnostics for the match. We will also re-validate codes based on MathTensor with newer codes based on the software xTensor that we are developing.

GW detectors



Objectives

Inspiral, merger and ring-down of binary black holes provide the most exciting source of Gravitational Waves (GW) for the GW detectors like LIGO, VIRGO and LISA. Numerical relativity (NR) has achieved breakthroughs that have made possible the computation of GW from the final merger and ringdown of binary black holes but cannot compute accurately the early inspiral. NR must be complemented by high accuracy analytical post-Newtonian computations of inspiral for matching, calibration and comparison. The major objective of this project is the construction of the dominant spherical harmonic modes h22 and h33 to 3.5PN and 3PN orders respectively. All this will pave the way to 3.5PN accurate templates for numerical relativity and GW data analysis.

Knowledge Products Developed

- Developed a new and efficient PNComBin package based on xTensor for PN computations and validated it systematically with all relevant available results based on MathTensor .
- Identified an efficient strategy to obtain the dominant mode of the waveform at 3.5PN order.
- Computed the 3.5PN accurate mass quadrupole and the (2,2) mode of GW polarization.
- Computed tail terms in canonical and source moments up to 3.5PN for general sources.
- Computed tail-of-tail integrals and their contributions to the mass octupole and current quadrupole at 3.5PN.
- Checks in progress for the computation of the mass octupole. This will allow subsequent computation of the l=3 modes.

Publications

SCI Journal Publication : 1
Papers Presented in Conferences : 1

Mobility Support

India to France : Collaborators-2
France to India : Collaborators-2

Principal Collaborators



B. R. Iyer
Raman Research Institute
Bangalore



Luc Blanchet
Institut d'Astrophysique de Paris
Paris

Breakup of Moving Liquid Sheets Under Acoustic Excitation

Project No. : 4204-1

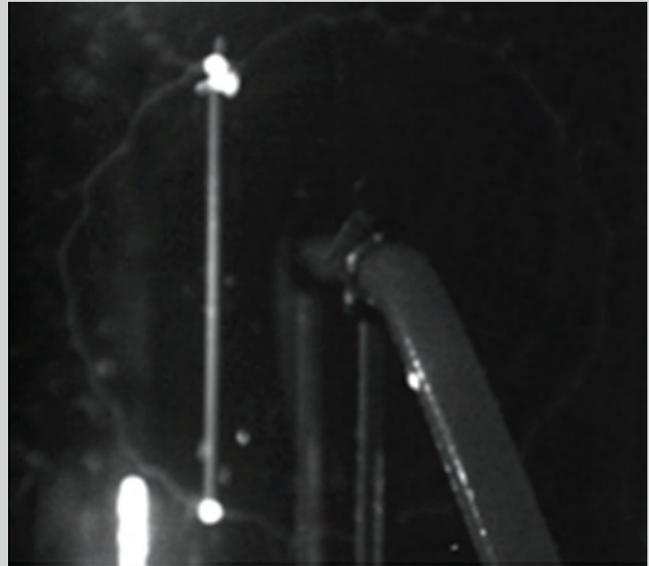
April 2010 - Mar. 2013

Background

The project aimed at understanding the stability of liquid sheet produced by head-on impingement of liquid jets, a technique used in high-density combustors to atomize fuel into tiny droplets. Evidence suggests that unsteady atomization is the cause of pressure oscillations inside a combustion chamber. If these pressure oscillations in turn influence the primary atomization process, the resulting heat release may occur in phase with the existing pressure fluctuations causing them to amplify (combustion instability). In order to avoid combustion instability, it is important to understand the coupling of the atomization process with the surrounding pressure oscillations. An understanding of the break-up and subsequent drop formation is also important in other areas such as spray coating and in biomedical devices such nebulizers.

Objectives

The collaborators proposed to study the stability of thin moving liquid sheets to external acoustic field. The goal would be to determine the mechanism and identify the parameters that control the process with the eventual goal of controlling the drop size and distribution. A fundamental understanding of the break-up and subsequent drop formation is important in areas as diverse as spray coating, combustion, biomedical devices such as nebulizers etc. Radial liquid sheets, generated by laminar jet impingement, would be subject to acoustic forcing of controlled sound intensity and frequency to identify regimes of accelerated and more violent sheet break-up. On the theoretical front, stability equations would be derived while accounting for inertial, surface tension and viscous.



Fluorescent emission from the liquid sheet containing rhodamine dye when the laser sheet slices the liquid sheet.

Knowledge Products Developed

- An experimental set-up to form liquid sheets from impinging jets.
- A novel experimental technique to measure the film thickness variation down to a few microns.
- A new stability theory to show that a radially expanding liquid sheet is unstable even in the absence of the surrounding gas.
- A preliminary computer code using the boundary

element method to simulate liquid sheet formation and sheet break-up

- A Preliminary code using Gerris® software to simulate the sheet formation and sheet break-up.
- A vortex-particle based method to track the interface explicitly under the effects of induced velocity and surface tension.

Principal Collaborators



Mahesh Tirumkudulu

Indian Institute of Technology-Bombay
Mumbai



Peter J Schmid

Laboratoire d'Hydrodynamique
Palaiseau

Publications

SCI Journal Publication : 1

Papers Presented in Conferences : Nil

Mobility Support

India to France : Collaborator-1

France to India : Nil

Studies on Bulk, Thin Film and Nanostructured Forms of Co Based and other Oxide Materials for Solid Oxide Fuel Cell (SOFC) Applications

Project No. : 4008-1

July 2009 - June 2012

Background

Though Solid Oxide Fuel Cells (SOFC) have demonstrated high energy conversion efficiency, extremely low pollution, and fuel flexibility, they need $>800^{\circ}\text{C}$ to run effectively. We need to explore new materials with high oxide-ion conductivity at lower temperatures and better understand fundamental aspects of the low temperature oxygen diffusion mechanisms. We planned and succeeded in synthesis and characterization of Brownmillerite- $\text{CaFeO}_{2.5}$ compound in bulk and in nano-structured forms. Brown millerite is an oxygen-deficient perovskite material with ordered oxygen vacancies. We found much lower onset temperatures for oxygen diffusion in nano- $\text{CaFeO}_{2.5}$ compound compared to bulk. High Resolution Transmission Electron Microscopy confirmed that presence of high density of extended defects is responsible for low onset temperature for oxygen diffusion in Brownmillerite nano- $\text{CaFeO}_{2.5}$ compound.

Objectives

- Prepare solid solutions of $\text{La}_{1-x}\text{Sr}_x\text{CoO}_3$, $\text{LaSrCo}(1-x)\text{MxO}_3$ ($x=\text{Fe, Mn}$), SrCoO_{2+x} and other Brownmillerite materials in bulk, thin film and nano forms for systematic fundamental physical properties and structure-property correlation study.
- Inelastic neutron spectroscopy and quasielastic neutron scattering to better characterize oxygen diffusion.
- Oxygen isotope exchange reactions in special reaction chambers and under TGA coupled MS analysis.
- Various characterization techniques will be carried out on such as XRD (microstructural characterization and temperature variation), Morphological studies (Using HRTEM/ HRSEM/ MFM/ AFM), XPS, Raman and high magnetic field magnetometry.
- Check the applicability of suitable oxides for SOFC applications.

Knowledge Products Developed

These studies on oxygen isotope exchange measurements will contribute for a more general understanding of oxygen mobility in solid electrolytes which can be directly used for optimizing and tuning the effect of particle sizes in oxygen membranes in SOFCs along with helping in understanding the fundamental physics and chemistry aspects of oxide systems and in realizing new oxides for SOFC



Mirror furnace used for the synthesis of single crystals and the quenched $\text{Ca}_{1-x}\text{Sr}_x\text{FeO}_{2.5}$ phases from the melt.

applications. Study has clearly shown that oxygen mobility can be achieved in nano-form at reduced temperature which is a good step in technological development of SOFCs.

Principal Collaborators



M. S. R. Rao
Indian Institute of Technology
Chennai



Werner Paulus
Université de Rennes 1
Rennes

Publications

SCI Journal Publication : 1
Papers Presented in Conferences : Nil

Mobility Support

India to France : Collaborators-2; Student -1
France to India : Collaborators-1; Student-1

Boundary Lubrication Using Metal Nanoparticles In Aqueous Suspension

Project No. : 4208-2

Mar. 2010 - Feb. 2013

Background

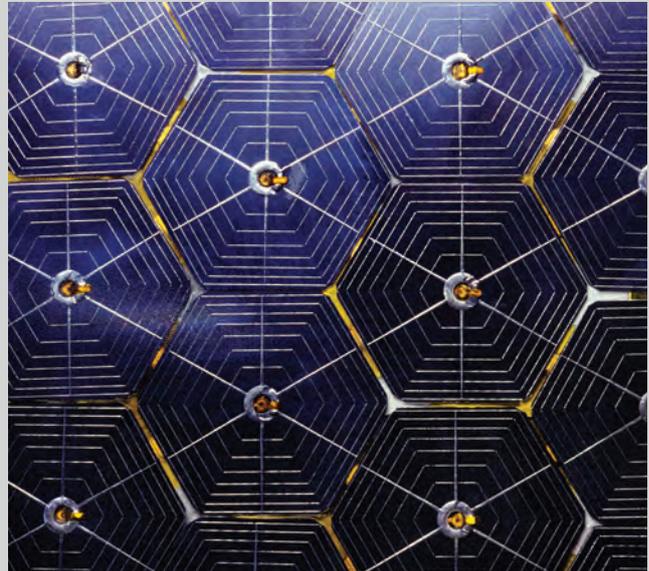
Focusing on use of inorganic particles in aqueous suspensions to provide low friction in tribological applications, a number of advances were made to understand the influence of deformation/ aggregation of particles of solid lubricants on tribology in various situations. An Attenuated Total Reflection mode of Raman tribometer was designed to yield high resolution, in-situ dynamic images to observe early phases of tribofilm formation. Layered single particles of MoS₂ were found to deform by inter-layer slip that led to a coherent 30-50 nm film that exhibited low friction. When the particles were allowed to agglomerate the mechanism of deformation changed to plowing with increased coefficient of friction. A new dispersant with free amine groups was found to prevent agglomeration over a 12 days period yielding a coefficient of friction significantly lower than the same from a standard industrial dispersant.

Objectives

The project investigates the mechanisms which gives rise to unique tribological properties of inorganic nanoparticle in aqueous suspension. The particles are analyzed in situ in terms of their mechanical and fracture properties and in terms of their inter-molecular force regimes vis-à-vis the fluid and surfactant. This information is coupled with transport and phase change data collected in situ at a very fine scale. Such coupling provides a unique opportunity to understand the tribology of this next generation of lubrication.

Knowledge Products Developed

- Layered MoS₂ single particles deform by interlayer slip, registering a low coefficient of friction. When the particles are allowed to agglomerate the mechanism of deformation is by plowing where the response is isotropic plasticity.
- Single (crystal) MoS₂ particles when slid in reciprocating tribology form a coherent 30-50 nm tribofilm on steel substrate which aids in yielding a low coefficient of friction. Such a tribofilm does not form if the particles used are agglomerates, the coefficient friction is high in the case.
- All Attenuated total Reflection mode of Raman tribometer was designed, fabricated and commissioned to yield high resolution dynamic Images and phase shifts in situ (during tribo-experiments). The early phases of tribofilm formation was observed for the first time in high resolution.
- Cold rolling mills were modeled using classical mechanics and Finite element Analysis. Friction maps to set the limitations of the mills in rolling with nanoparticles in aqueous suspension were constructed to help industry to exploit aqueous lubrication in metal working.
- Dispersion and stability of nanoparticle suspension in liquid lubricant.



Principal Collaborators



Vikram Jayaram
Indian Institute of Science
Bangalore



Fabrice Dassenoy
Ecole Centrale de Lyon
Ecully

Nanostructured Thermoelectric Materials for Power Generation

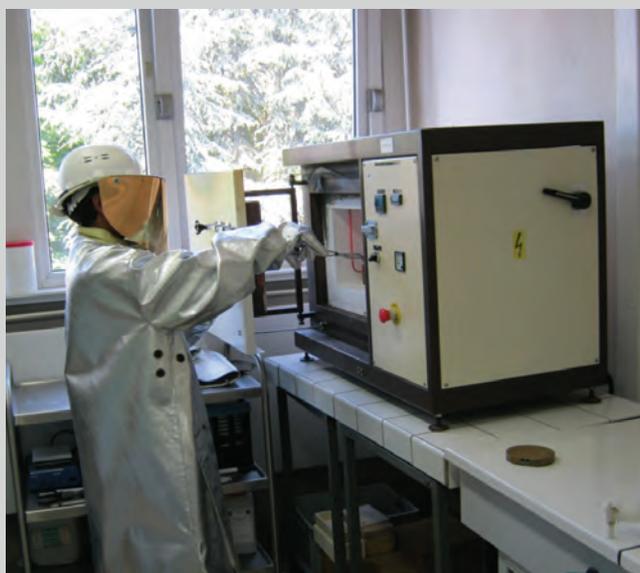
Project No. : 4008-2

Oct. 2009 - Sept. 2012

Background

The waste heat from power plants, heavy industries and transports represents an enormous amount of lost energy (estimated at 520 million tons of oil equivalent in Europe). Thermoelectric Energy Harvesting offers a reliable means to directly convert this waste heat into electricity and can contribute to reduce the global CO₂ footprint of these activities.

Nanostructured thermoelectric materials overcome the poor conversion efficiency of earlier bulk materials but the remaining hurdles to the uptake of a competitive industrial energy harvesting technology are the technology cost, the abundance and the toxicity of the constituting materials. This project aims at the development of efficient thermoelectric nanomaterials, compatible with industrialization in large volume (low cost production processes, abundant materials) and the rules of Hygiene, Health and Environment (HSE).



Objectives

The performance of a thermoelectric material depends upon a combination of properties termed figure of merit, $ZT = S^2\sigma T/\kappa$ where S is the Seebeck coefficient, σ the electrical conductivity, T the temperature and κ the thermal conductivity. It has to be stressed that increasing the so-called figure of merit, ZT , is a particularly difficult task, since for instance in many materials an increase in electrical conductivity comes with an increase in thermal conductivity, and an increase of electrical conductivity leads to a decrease of the seebeck coefficient. The approach that is taken in this work is the nanostructuring in order to modify independently the scattering features for electrons and phonons. Nanostructuring is accomplished by using non-conventional processes (such as ball milling, melt-spinning and spark plasma sintering) and the application of metallurgical concepts. Two different materials families are studied: lead telluride and silicides (CrSi₂, FeSi₂ and MnSi_{1.7}). The goal of this project is to evaluate different strategies to generate nano/microstructures in thermoelectric materials and evaluate their effects on the thermoelectric properties and performance.

Publications

SCI Journal Publication : 4

Papers Presented in Conferences : 4

Mobility Support

India to France : Student -1

France to India : Collaborators-2

Principal Collaborators



Arun M Umarji
Indian Institute of Science
Bangalore



Stéphane Gorsse
Université Bordeaux 1
Pessac

Practical Methods for Surface Biofunctionalization

Project No. : 4105-1

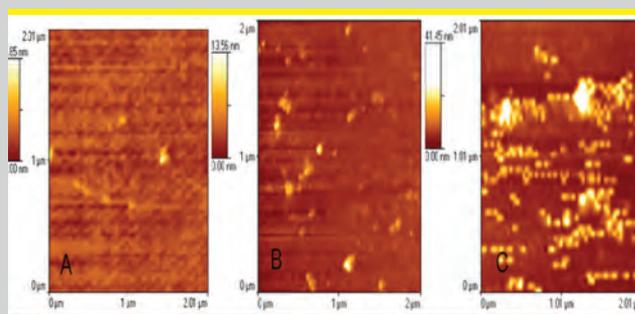
Sept. 2009 - Aug. 2012

Background

Grafting of bioactive functions on solid surfaces has nowadays become a tremendous challenge for biosensors and surface protection applications. We propose here a new way to attach a variety of functional groups at the surface of metallic and oxide materials, via (a) the cross-metathesis reaction of terminal alkenes, and, (b) [3+2]-cycloaddition reaction between an azide and an alkyne ('click chemistry') – both under near ambient condition. Once linear alkyl chains of controlled length and structure with terminal alkene or azido function are immobilized as densely packed, self-assembled monolayer on gold or silica surfaces, we propose to fine-tune the cross-metathesis reaction (for alkene terminus) or 'click chemistry' protocol (for azido terminus) at the solid-liquid interface so that covalent grafting of synthetic molecules, biologically active molecules or biomacromolecules on surface becomes a convenient practice.

Objectives

Grafting of bioactive functions on solid surfaces has nowadays become a tremendous challenge for biosensors and surface protection applications. The project was aimed at exploring a new way to attach a variety of functional groups at the surface of metallic and oxide materials, via (a) the cross-metathesis reaction of terminal alkenes, and, (b) cyclo-addition reaction between an azide and an alkyne ('click chemistry') – both under near ambient conditions. Once linear alkyl chains of controlled length and structure with terminal alkene or azido function are immobilized as densely packed, self assembled monolayer on gold or silica surfaces, the projects goal was to fine tune the cross-metathesis reaction (for alkene terminus) or 'click chemistry' protocol (for azido terminus) at the solid liquid interface so that covalent grafting of synthetic molecules, biologically active molecules or bio-macro molecules on surface becomes a convenient practice.



(1) Surface with immobilized protein A (2) Surface with rabbit IgG attached with protein A, and (3) Surface with protein A, rabbit IgG and goat anti-rabbit IgG

Potential for Knowledge Forward Chain

The objectives of the project, efficient methods to immobilize biomolecules on surfaces like gold or silica, for eventual adaptation in bio-sensing, has been successfully accomplished. Fabrication of bio-chips rely on efficient, selective and mild methods to immobilize especially through covalent bond formation that leads to much greater stability and control of density of loading useful biological molecules that sense primarily through their bio-recognition/affinity attributes.

Principal Collaborators



Amitabha Sarkar
Indian Association for the Cultivation
of Sciences, Kolkata



Michèle Salmain
Chimie ParisTech
Paris

Publications

SCI Journal Publication : 2
Papers Presented in Conferences : 4

Mobility Support

India to France : Collaborators-2; Student -1
France to India : Collaborators - 1

Nurturing Knowledge



Completed Projects
Applied Sciences

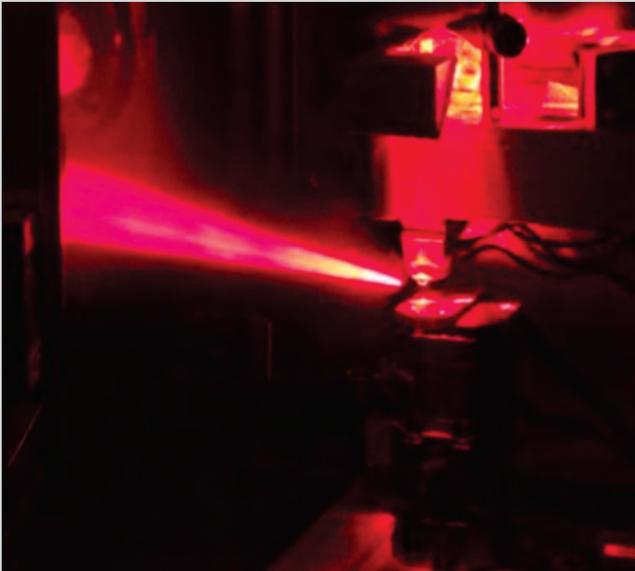
Terahertz Free Electron Laser

Project No. : 3706-1

Jan. 2009 - Sept. 2012

Background

The goal of the project is to take advantage of the planned extension of the CLIO free-electron laser into the spectral region of long wavelength ($\lambda > 120 \mu\text{m}$), also called Terahertz domain, to establish collaboration between teams of LCP and RRCAT. This will allow the scientists of RRCAT to gain experience with an already running free-electron laser and, for those of CLIO, to participate in the commissioning of the CUTE-FEL project. In addition, the measurements necessary for characterization of CLIO beam will benefit from the experience of RRCAT scientists in THz spectral region.



Objectives

The aim of the project was to achieve lasing in the terahertz region ($> 120 \mu\text{m}$) by collaboration with the CLIO FEL operating in France, and the CUTE-FEL being built in India. The CLIO FEL typically operates at shorter wavelengths, and the CUTE-FEL (designed to lase in the terahertz) is still being built. The project was designed to pool the expertise of both these groups in the area of FELs, and move rapidly towards operating a free-electron laser in the exciting new regime of the terahertz.

Publications

SCI Journal Publication : 1
Papers Presented in Conferences : 8

Mobility Support

India to France : 3
France to India : 3

Principal Collaborators



Srinivas Krishnagopal
Raja Ramanna Centre for
Advanced Technology, Indore



Jean-Michel Ortega
UMR-CNRS-Université Paris Sud
Orsay

Risk of Cracking of Clay Liners for Landfill Capping and Environmental Hazard

Project No. : 3809-1

Feb. 2009 - July 2012

Background

Across the world landfills are the most widely used modality for solid waste disposal. These landfills are encapsulated with lining systems (Compacted Clay Liner or CCL) that serve as a barrier between landfill waste and the surrounding environment. One of the failures associated with CCLs is the occurrence of non-uniform settlements. Excessive non-uniform settlements can affect the integrity of the whole lining system. We aim to understand the deformation behaviour of clay liners of landfill capping systems and to arrive at recommendations for strengthening clay liners in order to retain efficiency of clay liner to prevent environmental contamination. We will be using modern and special facilities like large beam centrifuge facility, inclined plane tests, cells for compression of waste, etc to achieve project objectives.

Objectives

The primary objective of this research project were as under:

- To evaluate characteristics of different compacted clay liner materials in France and compare with equivalent materials in India and to develop and characterize two types of model clay liner materials.
- To develop a new landfill capping system for in the field using soil reinforcement technique, and to understand the influence of fiber type, content and length on permeability of clay barrier materials and, on tensile strength-strain characteristics of clay barrier materials.
- To study the hydro-mechanical behavior of clay barriers with and without geo-membrane layer through centrifuge model tests, and to examine the beneficial effect of discrete and randomly distributed geofiber reinforcement inclusions on the hydro-mechanical behavior of clay barriers.
- To understand the effect of flexural distress on the gas permeability of clay beams through custom designed and developed Gas Permeability-Beam bending tests.



View of large scale container for compressing the waste

Knowledge Products Developed

- Demonstrated use of centrifuge model testing to understand the hydro-mechanical behaviour of landfill cover barriers at the onset of differential settlements.
- Explored the behaviour of composite barriers at the onset of differential settlements and significance of geo-membrane in imparting a downward thrust on the clay barrier (retaining the sealing efficiency) could be brought out through centrifuge model tests for the first time.

Publications

SCI Journal Publication : 4
Papers Presented in Conferences : 4

Mobility Support

India to France : Collaborators-1
France to India : Collaborators-2

Principal Collaborators



B. V. S. Viswanadham
Indian Institute of Technology
Mumbai



J. P. Gourc
Université Grenoble 1
Grenoble

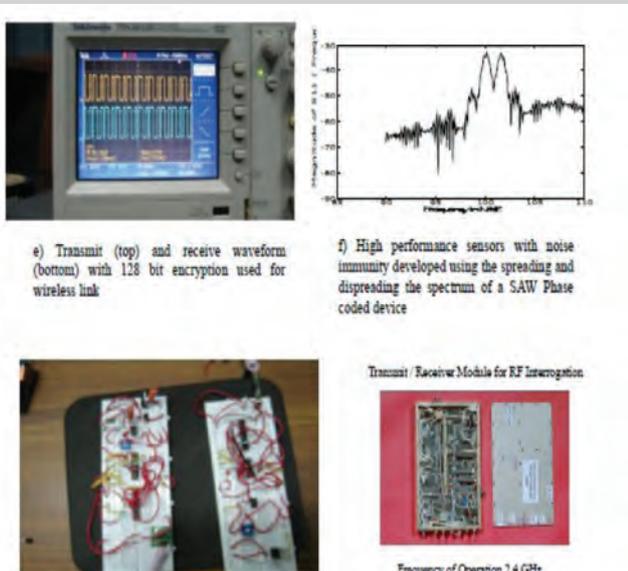
Wireless Network Sensors Using SAW Devices

Project No. : 3900-IT-1

Dec. 2008 - Nov. 2012

Background

An important class of emerging networked systems for commercial, telemedicine /diagnostic,space and military applications is wireless distributed micro-sensors networks. These networks consist of a collection of communicating nodes, where each node incorporates a) sensors for measuring the environment, b) capability to process sensor data into high value information, and c) a wireless link to communicate information to / from neighboring nodes and eventually to external users. On a global scale Wireless Network Sensors (WINS) permit monitoring of land, water, and air resources, at national level these can be used in transportation systems, and at a metropolitan scale these can be used for emergency and disaster recovery. In the present work it is proposed to develop WINS for connecting the patients to the clinical laboratory, ambulatory outpatient services and other sensing and monitoring control. The offspring of these studies will be explored for oil explorations, WINS for hazardous environment and space shuttles.



e) Transmit (top) and receive waveform (bottom) with 128 bit encryption used for wireless link

f) High performance sensors with noise immunity developed using the spreading and dispreading the spectrum of a SAW Phase coded device

Transmit / Receive Module for RF Interrogation

Frequency of Operation 2.4 GHz

Objectives

The project had following objectives:

- Develop the System Architecture of Wireless Integrated Networks Using Passive SAW Sensor
- Randomized rf interrogation of passive SAW sensors and position identification/ signal detection based on orthogonal coding and matched filtering operation.
- Design and development of ISM band transceiver.
- Resolve design and technological issues in development of sensors for identification (ID-sensor),
- Development of miniaturized high gain interface antenna
- Transmission of data on a secured link for accessibility to the user (doctor / environmental expert) even when he is on the move.
- Characterisation of wave propagation in fluids having different pH values.
- Sensor interface living organisms for in-vivo measurements, while adhering to international standards in diagnostics, EMI/RFI interferences and signal levels.

Potential for Knowledge Forward Chain

- Designed a tilt sensor for use in the vitro-retinal surgery has been designed.
- Developed a membrane type double cavity vacuum sealed piezo-resistive absolute pressure micro sensor.
- Developed a wireless transmitter-receiver pair for wireless transmission of sensor data.

Publications

SCI Journal Publication : 2

Papers Presented in Conferences : 5

Mobility Support

India to France : Collaborators-3

France to India : Collaborators-2

Principal Collaborators



B. S. Panwar
Indian Institute of Technology Delhi
New Delhi



Sylvain Ballandras
Département Temp
Besancon

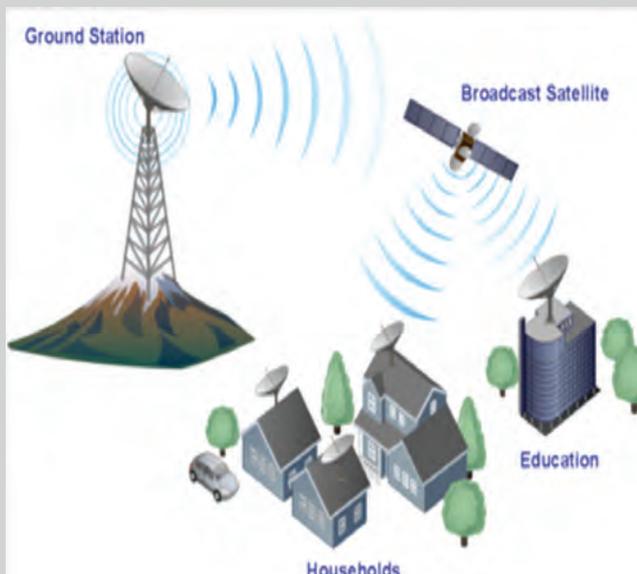
Emerging Strategies for Wireless Communication Networks

Project No. : 4000-IT-1

Nov. 2009 - Oct. 2012

Background

Wireless access networks have become a major success since their availability for wide-spread public utilisation since the 1980s. The most visible impact has been on mobile communication via the so-called cellular networks. Increasing traffic demand on these networks has led to new questions related to the design, management, and control of these networks. In mid-1990s emerged the idea of embedded sensing of the world around us, with the sensors and the computing connected by multi-hop wireless networks. This emerging technology of the Internet of Things has led to a resurgence of interest in wireless sensor networks. This project explores various issues (performance analysis, design, and control) in cellular wireless networks and multi-hop ad hoc wireless networks via mathematical modeling and analytical techniques.



Objectives

The overall research objective was to explore emerging strategies for wireless communications and networking via the application of techniques of mathematical modeling, analysis, optimisation, and control. The systems the project team worked on include multi-hop ad hoc wireless networks, both static and mobile, as well as cellular networks. A significant part of the effort has been made in the application of non-cooperative game models in the context of wireless cellular systems. Stochastic control techniques have been applied to forwarding problems arising in delay tolerant networking (mobile opportunistic networks, and sensor networks with sleep-wake cycling). The collaborators have also explored the use of continuum or fluid limits of stochastic processes, in several problems of analysis and design of mobile opportunistic networks; the limits serve as useful approximations, and in some cases it has been found that an optimal control designed for the deterministic fluid limit model serves as a provably accurate control for the original stochastic process. In addition they have aimed to contribute to the theory of such limits as well.

Publications

SCI Journal Publication : 13
Papers Presented in Conferences : 27

Mobility Support

India to France : Collaborators-4; Student-1
France to India : Collaborators-4

Principal Collaborators



Anurag Kumar
Indian Institute of Science
Bangalore



Eitan Altman
INRIA Sophia Antipolis
Sophia-Antipolis

Robust Ultra-Low-Power Double-Gate MOSFET Design of Analog, Digital and SRAM Memory Circuits

Project No. : 4100-IT-1

Oct. 2009 - Sept. 2012

Background

Reducing the power dissipation of Integrated circuits (IC), especially power of the Analog, Digital and Memory array, is a key to low-power microprocessors and system-on-chip. The power of the ICs comprises a standby power and an active power. The standby power mainly comes from sub threshold leakage current generated from a huge number of non-active circuits. The active power comes from simultaneous charging and discharging of large parasitic capacitance. To reduce power dissipation, solve noise and leakage problems, VDD reduction is especially vital but is prevented by the lowest allowable average threshold voltage of MOSFETs in the ICs. So, the reduction in VDD is a key challenge while maintaining performance and voltage margin as much as possible. We focus on novel device structures along with novel circuit design techniques needed to address these issues.



Objectives

The project's aim was to explore alternative device and circuit structures to the present bulk-CMOS for the 22nm technology node and beyond. The specific objectives in this context were:

- Explore the applicability of the new DG MOS devices to analog and digital circuit blocks,
- Develop a design methodology based on existing EDA tools, design
- Low-voltage, ultra-low-power, digital and analog circuit blocks.
- The basic circuit blocks targeted were the SRAM cell, the operational amplifier and basic logic gates.

Knowledge Products Developed

- Low power and fast adder implementation with sub-32-nm Double Gate MOSFETs
- Novel Differential sensing for 0.5-V sub-32 nm UTBB FD-SOI SRAMs
- A 110 MHz rail-to-rail opamp architecture
- A 0.7-V rail-to-rail voltage buffer
- Three novel SRAM cells and four different architectures supporting low voltage operation down to less than 0.5V (working for silicon proof with 28FD)
- Low Power and High Speed comparator with DG-MOSFET

Publications

SCI Journal Publication : 1
Papers Presented in Conferences : 7

Mobility Support

India to France : Collaborators-3
France to India : Collaborators-2

Principal Collaborators



Dipankar Nagchoudhuri
DAICT
Gandhinagar



Amara Amara
Institut Supérieur
d'Electronique de Paris, Paris

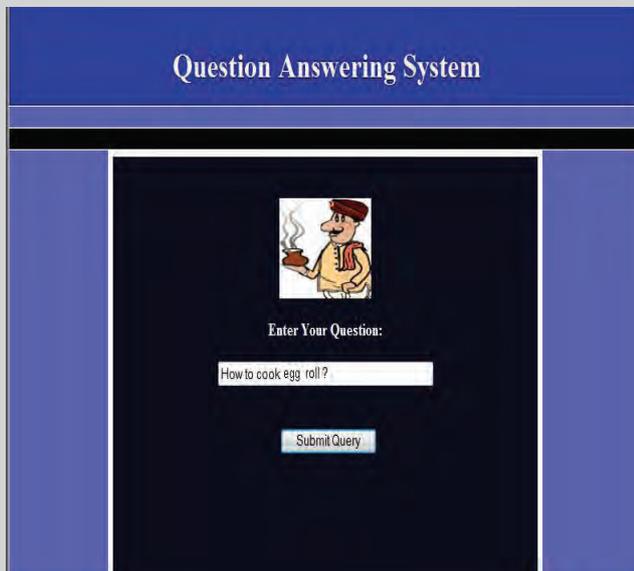
An Advanced Platform for Question-Answering Systems

Project No. : 4200-IT-1

Feb. 2010 - Jan. 2013

Background

The project is related to the knowledge domain of information retrieval. In the present era of information explosion, it is important and necessary to efficiently and accurately deliver the right and relevant information to the information seekers in a language that is as natural as possible. Current search engines can handle multiword query words and provides a ranked list of relevant documents which have to be further checked to identify the actual information needed. There are some question answering systems available on the web that provide specific answers to factoid questions. Information need cannot be satisfied by factoid questions only but it includes a variety procedural, causal, comparative and evaluative questions as well which are much more complex to answer. The present project attempted to propose an advanced platform for question answering systems that is equipped to address these advanced questions.



Objectives

The objective of the project was to create a Q&A platform, with parameters that can be customized to suit the requirements of a variety of domains. Built on top of search engines, the platform should be able to allow users to ask questions, and get responses, in their own language. In particular the project concentrated on:

- Querying – for procedural, causal, comparative and evaluative questions,
- Response cooperation and intelligence – to develop data fusion and basic text integration techniques, summarization techniques to provide a synthetic answer and investigations on user-friendly nature of navigation tools.
- Multilingual aspects – to reuse or adapt existing resources for handling the multilingual aspects
- Applications, implementation and testing – to develop a prototype systems for applications in tourism and agriculture.

Publications

SCI Journal Publication : 5
Papers Presented in Conferences : Nil

Mobility Support

India to France : Collaborators-2; Student -1
France to India : Nil

Principal Collaborators



Sivaji Bandyopadhyay
Jadavpur University
Kolkata



Patrick Saint-Dizier
Institut de Recherche en
Informatique, Toulouse

Ripening of Fleshy Fruits Species and their Adaptation to Stress

Project No. : 4003-3

Nov. 2009 - Oct. 2012

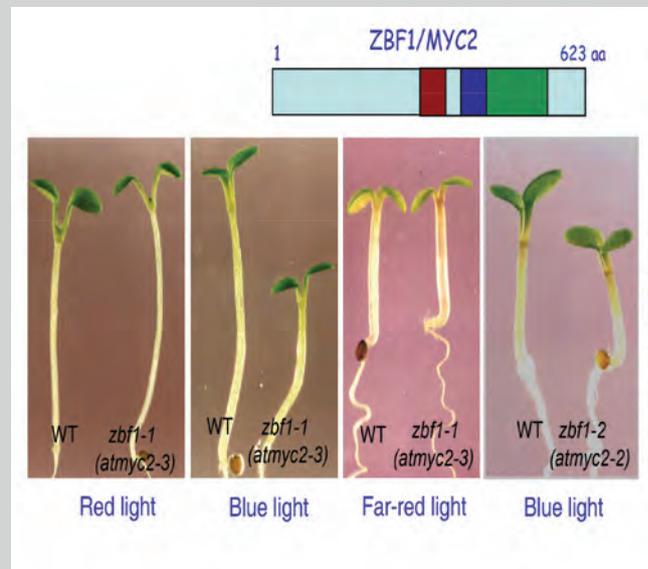
Background

Both tomato and grape berry are fleshy fruits with a major economical importance. Their ripening exhibits several similarities, but also some marked differences which make cross experiments promising to understand the metabolism of their fruits, and their tolerance to water and salt stress. Furthermore, the use of Arabidopsis mutants (available in Delhi) and tomato mutants (available in Bordeaux) is also a tool that speed up the deciphering of gene function. The grape genome is completely sequenced, and the tomato genome will be released in 2008-2009. We will focus on a gene family (MYC2) that may affect both the process of fruit ripening, and the tolerance of the plant to drought and salt stress.

Objectives

The project was designed to achieve the following objectives:

- Cloning of ZBF1 and its close homologues from grape plants, and study of their expression.
- Transformation of Arabidopsis, Tomato and Grape plants with ZBF1, or other selected homologues, and generation of the transgenic lines.
- Characterization of the transgenic plants in normal, water-stressed and salt-stressed conditions respectively.



Knowledge Products Developed

- Cloning of VvZBF1 genes and their use in transformation of Vitis.
- Expression studies in various Vitis samples in France.
- Use of VvZBF1 gene to transform Tomato/ Arabidopsis and generation of transgenic plants in India.
- Use of VvZBF1 gene to transform Arabidopsis and generation of transgenic plants in India.
- Characterization of transgenic plants in India and France.

Principal Collaborators



S. Chattopadhyay
National Institute for Plant Genome Research
New Delhi



Prof. Serge Delrot
Université de Bordeaux 2
Villeneuve de Ornon

Mobility Support

India to France : Student - 1
France to India : Nil

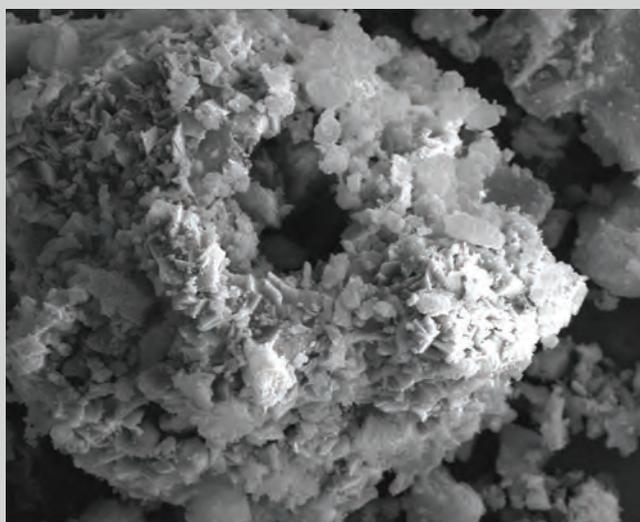
Development of Waste Derived Activated Carbon Supported Oxide Catalyst for Low Temperature VOC Oxidation

Project No. : 4005-1

July 2009 - Sept. 2012

Background

Volatile organic compounds (VOCs) are detrimental to both environment and health. This has prompted widespread research interest in their adsorption and catalytic removal. Activated carbon can be used as adsorbent or catalyst support for VOC removal where their hydrophobic nature prevents deactivation in the presence of moisture. Biomass is an important source for activated carbon, especially unburnt carbon in fly ash from bagasse based boilers in the sugar industry. Commonly used catalysts for VOC removal are precious metals, pure or mixed metal oxides. Iron is inexpensive and present in wastes like red mud generated by the aluminium industry. We focus on utilizing these two industrial wastes to prepare catalysts suitable for VOC removal using a combination of adsorption and catalytic oxidation.



EHT = 20.00 kV VP Target = 10 Pa Signal A = SE1 Date :30 Oct 2012
WD = 7.0 mm Mag = 3.55 K X Time :11:47:41



RM7-HCI

Objectives

The primary objectives of the project are listed below:

- Develop an activated carbon supported oxide catalyst from waste biomass ash and red mud, respectively.
- Characterize the developed catalyst in terms of surface area, composition, thermal behavior
- Assess the catalytic performance during VOC oxidation.

Knowledge Products Developed

The project has contributed towards modification of wastes to obtain catalysts with high performances in Volatile Organic Compounds (VOC) removal. The separated carbon from bagasse fly ash has been imparted high surface area and good thermal stability. Red mud leached with oxalic acid offered a suitable iron rich solution for impregnation of the carbon support.

Potential for Knowledge Forward Chain

The project has successfully developed catalysts from two different wastes namely unburned carbon from bagasse fly ash and red mud waste produced during enrichment of bauxite ore. The project has contributed towards modification of wastes to obtain catalysts whose performance is comparable to commercial activated carbon.

Publications

SCI Journal Publication : 1

Papers Presented in Conferences : 2

Mobility Support

India to France : Collaborators-1; student-2

France to India : Collaborators -3

Principal Collaborators



Vidya S. Batra
The Energy and Resources Institute
New Delhi



Jean-François Lamonier
Lille University of Lille 1
Lille

Mechanism based lead generation in cancer chemotherapy from natural products

Project No. : 4105-2

Oct. 2009 - Mar. 2013

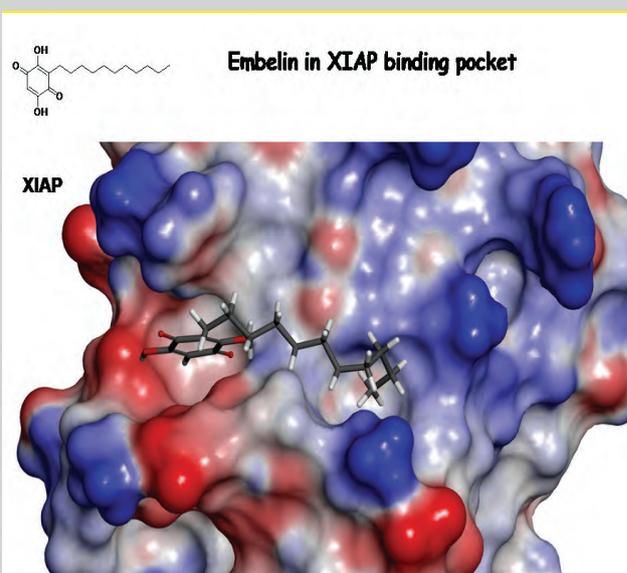
Background

Cancer is now a major diseases worldwide and besides the classical treatments (surgery, chemo- and radiotherapy) it is important to search for novel therapies. The discovery of new chemical entities able to restore apoptosis selectively on cancer cells is a very promising new approach to anticancer drugs. It is central to our project combining two chemistry groups with one biology group, inside a larger cooperation network. Towards this goal, we will develop a fully integrated strategy targeting proteins of the two most important families in this apoptosis pathway (Bcl-2 and IAP) and we will use both the total synthesis of designed molecules and the screening of products from the new Combinatorial Natural Products Library to discover new activators of apoptosis for cancer cells which will be used as novel hits for the synthesis of potent bioactive analogues.

Objectives

The core objectives pursued under the project are listed as under:

- To conduct highly interdisciplinary project between chemistry and biology in India and France and develop novel anticancer compounds.
- Identify new selective apoptosis inducers for cancer cells, with special attention paid to NCEs.
- Synthesis and lead optimization of natural products with apoptosis restoring capacity for cancer cells.
- Develop new methodologies for screening compounds using HTS/MTS.
- Identify at least three lead compounds for further development as anticancer drugs.
- Conduct in vivo studies for selected compounds.



Knowledge Products Developed

- Efficient strategised to access the target molecules in different series.
- Small chemical libraries of designed compounds.
- Preliminary biological screening validated some of our working hypotheses, affording first series of active analogues.

Potential for Knowledge Forward Chain

The discovery of new chemical entities able to restore apoptosis selectively on cancer cells in a very promising new approach to anti-cancer drugs.

Principal Collaborators



J. S. Yadav

Indian Institute of Chemical Technology
Hyderabad



René Grée

Université de Rennes 1
Rennes

Publications

SCI Journal Publication : 6
Papers Presented in Conferences : 9

Mobility Support

India to France : Collaborators-3
France to India : Collaborators-3

Study and development of high temperature sealants for solid oxide fuel cells (SOFCs) based on phosphate - containing glass and glass-ceramics

Project No. : 4008-1

July 2009 - June 2012

Background

The project relates to harnessing hydrogen energy through solid oxide fuel cells (SOFCs). In the production of SOFCs there is a very important role of high temperature sealant. Under the frame of a post doctoral work by the students under the principal collaborations some initial study on the phosphate system was conducted and published two papers based on the MAS-NMR studies on phosphate based lithium zinc silicate glass and glass-ceramics, which gave encouraging results to optimise flow characteristics required for fabrication of seals. With this background both the research groups (BARC, Mumbai and UCCS-Lille France) formulated this project. The project deals with new phosphate system and Ba-Zn/Mg-phosphosilicate system in the context of high temperature sealing glass and glass-ceramics. While most of international projects dealt with the optimisation of thermal properties of the sealant, the project aimed to propose a solution for modifying the interfacial reactivity, which leads to the formation of detrimental chromate compounds.

Objectives

The project goal was to develop high temperature sealants for planar solid oxide fuel cells (SOFCs), based on phosphate-containing glass and glass-ceramics. Specific objectives were as under:

- To investigate various glass compositions based on phosphate-containing RO-BaO- SiO₂ (R=Mg, Zn, ...) systems.
- To outline the processing modalities for converting them into glass-ceramics,
- To study different phases of formation/separation, microstructure and their chemical reactivity in operational conditions and to limit chromium diffusion.
- Develop suitable process for preparing seals
- Study the behavior of the sealant with regard to chemical reactivity, degradation and structural transformation in the longer run



Photograph showing exploded view of furnace with job mounted for testing of graph showing exploded view of furnace with job mounted for testing

Potential for Knowledge Forward Chain

The largest disadvantage of SOFC is the high operating temperature, longer start-up times and mechanical and chemical compatibility issues. The glass-ceramic seals synthesized show excellent compatibility with Crofer-22APU alloy for long term use at high temperature. They showed good tightness under vacuum and under pressure load.

Publications

SCI Journal Publication : 7
Papers Presented in Conferences : 12

Mobility Support

India to France : Collaborators-4
France to India : Collaborators-3

Principal Collaborators



G. P. Kothiyal
Bhabha Atomic Research Centre
Mumbai



Prof. Lionel Montagne
Université des Sciences
et Technologies, Lille

Nurturing Knowledge



Ongoing Projects
Basic Sciences

Numerical Treatment of Integral Operators with Non-smooth Kernels

Project No. : 4101-1

Sept. 2009 - Aug. 2013

Background

Many important physical phenomena are governed by differential and integral operators. With the advent of computers, it is possible to find sufficiently accurate solutions for integral equations of the second kind and for eigenvalue problems associated with differential or integral operators. There is a need for efficient algorithms that are iterative, have optimal rates of convergence, are stable and cost-efficient. Such algorithms are available for spectral approximation and approximation of operator equations associated with unidimensional integral operators with smooth kernels. It is not the same for integral operators with non-smooth kernels. The focus of this project is numerical treatment of integral operators with Green's type kernels as well as kernels having algebraic or logarithmic singularities. In addition we plan to prepare software packages for solving operator equations and eigenvalue problems involving integral operators with non-smooth kernels.

Objectives

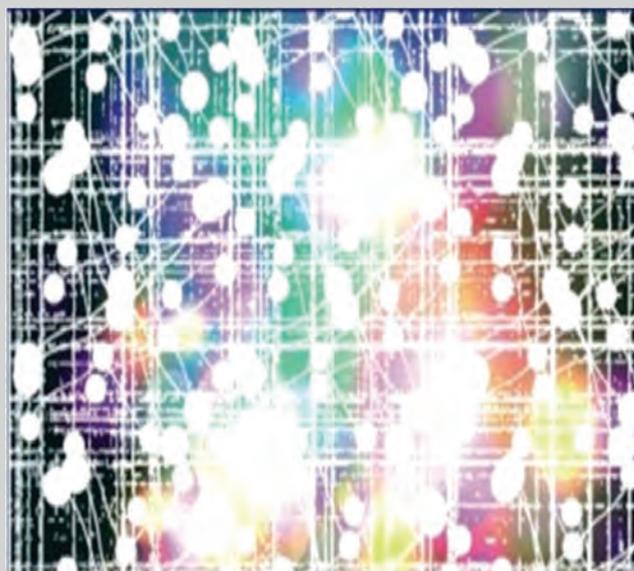
We are interested in numerical solution of the Fredholm integral equations of the second kind and of the companion eigenvalue problem. The focus of this project is on integral operators with non-smooth kernels such as Green's function type kernels and weakly singular kernels.

In the Nyström method, a continuous finite rank operator approximation is obtained by replacing the integral by a composite numerical quadrature formula. In the case of Green's function type kernels, a careful choice of the subintervals in the composite numerical quadrature is needed in order to retain the order of convergence. If the right hand side has logarithmic singularities, then a graded mesh may be needed. We intend to investigate these issues and validate the theoretical results by numerical experiments.

We would like to compare the singularity subtraction and product integration techniques for numerical solutions of weakly singular integral equations.

We are also interested in the eigenvalue problems for non-smooth kernels.

We want to consider approximate solutions of multivariable integral equations over planar regions, or more generally, over surfaces.



Principal Collaborators



Rekha P. Kulkarni
Indian Institute of Technology-Bombay
Mumbai



Prof. Mario Ahues
Université de St. Etienne
Saint-Etienne

Publications

SCI Journal Publication : 2
Papers Presented in Conferences : Nil

Mobility Support

India to France : 4
France to India : 4

Kleinian Groups: Geometrical and Analytical Aspects

Project No. : 4301-1

Sept. 2010 - Aug. 2013

Background

Kleinian groups are discrete subgroups of the group of automorphisms of the Riemann sphere. Their study leads to questions in analysis, geometry, group theory, topology, etc. Our project contains 3 themes. Thema 1 is centred around Cannon-Thurston maps. We will use them to obtain a topological picture of the limit set. We will also study the analytical, metric/measure theoretic properties of these maps. With Thema II, we intend to make progress on an old question : does the bending of the boundary of the Nielsen core allow one to recover the hyperbolic metric on the manifold? Thema 3 is devoted to "symmetric patterns" and rigidity.

Objectives

- Describe the Cannon-Thurston map in terms of the ending laminations
- Consider Cannon-Thurston maps in terms of their analytical properties.
- When (M,P) is the product of a surface S with boundary by an interval, the set of the closed geodesics for a hyperbolic on (M,P) which are shorter than the Margulis constant form a link (that we suppose infinite) in M . We plan to study this link and try to relate it to the end invariants. Cannon-Thurston maps for higher rank symmetric spaces. Existence of combinations theorems.
- Study the lines of minima of Steven Kerckhoff
- Extend the Theorem of Bonahon on the Quasi-Fuchsian space to the space of metrics on an acylindrical hyperbolic manifold M .

Knowledge Products Developed

- Described the structure of Cannon-Thurston maps in details in terms of the ending laminations
- Proved the existence of combinations theorems.
- Studied the lines of minima of Steven Kerckhoff.
- Extended the Theorem of Bonahon on the Quasi-Fuchsian.
- Pattern Rigidity theorems for Hyperbolic groups, Pattern rigidity in lattices in Real Hyperbolic Space

Publications

SCI Journal Publication : 9
Papers Presented in Conferences : 6

Mobility Support

India to France : Collaborators-4
France to India : Collaborators-2

Principal Collaborators



Mahan Mj
Ramakrishna Mission Vivekananda University
Dt Howrah



Jean Pierre Otal
Université Paul Sabatier
Toulouse

Discontinuous Galerkin Method for Nonlinear Acoustics

Project No. : 4601-1

Dec. 2011 - Aug. 2015

Background

Weak shock waves are one of the most intense and spectacular features of nonlinearities in acoustics. They are characterized by sudden pressure variations, separating smooth parts of the waveform. Acoustical shock waves can be observed in various domains of acoustics, with either applications to geophysics (sound produced by the thunder), engineering (as the sonic boom produced by supersonic aircrafts) or medicine (as the shock waves produced by a trauma on a skull). A numerical solver would be a useful tool to understand and discriminate physical mechanisms responsible for these phenomena. To obtain high fidelity simulations, one has to reproduce the physical mechanisms involved in nonlinear acoustics such as the harmonics generation and the generation of shock waves and their interactions, and to reproduce these phenomena in situations where the mesh is adapted to complex geometries.



Nonlinear acoustics events

Objectives

The direct numerical simulation of shock waves in realistic configurations is still a challenging issue. Kuznetsov's nonlinear wave equation is known to be well suitable for understanding the acoustical shock wave propagation. An extensive literature survey done by us shows that no numerical method has been developed in complex geometries. Only 2D simulations using finite differences in simple geometries (regular cartesian meshes) have been developed. The objective of the project is to fill that gap by using the Discontinuous Galerkin method. The literature review also shows that this method has been proven to be able to handle shock waves, complex geometries and nonlinear waves. However, no combination of these three advantages has ever been made. Hence, the project aims at developing a Discontinuous Galerkin method for the advanced numerical simulation of nonlinear shock waves in 2D complex geometries with applications to acoustical problems.

Mobility Support

India to France : Nil
France to India : Collaborators-1

Principal Collaborators



Baskar Sambandam
Indian Institute of Technology Bombay
Mumbai



Régis Marchiano
Université Pierre et Marie Curie
Paris

Epigenetics of Transcription by RNA polymerase

Project No. : 4103-1

Oct. 2009 - Sept. 2013

Background

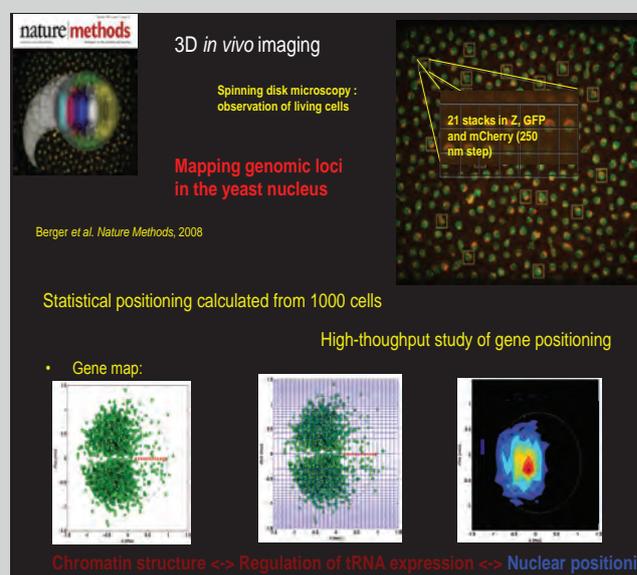
In eukaryotes, genes are transcribed by three nuclear RNA polymerases (pols), each transcribing a specific subset of genes. Pol I synthesises the precursor of large ribosomal RNA, pol II transcribes all protein-coding genes and many non-coding(nc) RNAs. Pol III is specialized in expression of small ncRNAs generally involved in translation. Recent studies have established the central role of pol III in the expression of many nc-RNAs but their transcriptional regulation is still unknown. Packing of DNA as chromatin generates gene-specific architectures that are instrumental in poising genes for/against immediate or eventual expression. Chromatin is generally repressive for transcription, but this can be overcome by epigenetic mechanisms like Chromatin remodelling, histone modifications, histone variant incorporation and gene positioning inside the nuclear space.

Objectives

- To investigate the link between local chromatin structure and expression level of the genes transcribed by the yeast RNA polymerase III at global scale.
- To characterize epigenetic regulation of local chromatin structure, under different conditions affecting pol III transcription.
- To explore the role of local chromatin structure and transcription activity in determining the gene locations in the nuclear space.

Knowledge Products Developed

- (A unique arrangement of nucleosomes is found near the yeast pol III-transcribed genes. The genes reside in a nucleosome-free region (NFR), bordered by positioned nucleosomes.
- These nucleosomes change positions under repressed state, pre-dominantly at 3'-ends of the genes. Expression of different genes shows

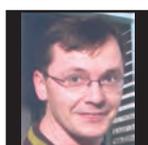


- different response to nutrient starvation.
- Different pol III-transcribed genes were found in different locations within the nucleus.
- Nuclear location of different genes shows different response to nutrient deprivation.
- However, gene expression does not show correlation with location in nuclear space.

Principal Collaborators



Purnima Bhargava
Centre for Cellular and Molecular Biology
Hyderabad



Olivier Gadai
Université Paul-Sabatier
Toulouse

Publications

SCI Journal Publication : 3
Papers Presented in Conferences : 1

Mobility Support

India to France : Collaborators-1
France to India : Nil

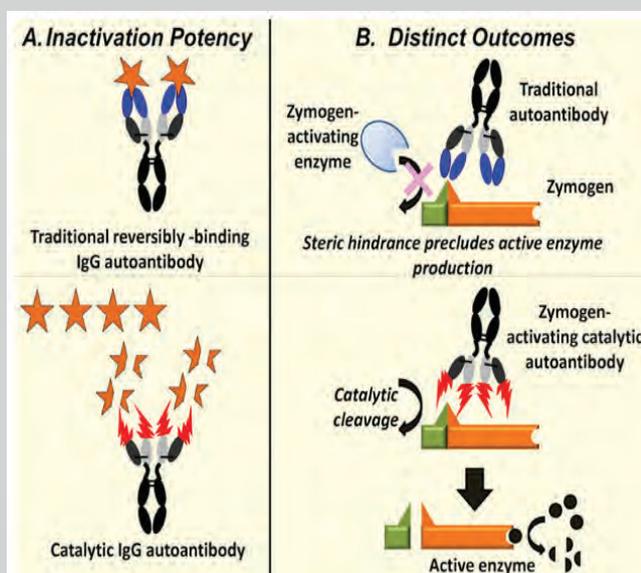
Catalytic Antibodies in Immune-Mediated Disorders

Project No. : 4103-2

Aug. 2009 - April 2014

Background

The molecular mechanisms responsible for emergence and progression of autoimmunity and inflammation, have remained obscure. We address the role of antibodies that are capable of hydrolysing the target antigen. Previously we documented the importance of antibodies with catalytic activity in hemophilia A and in sepsis. In the ongoing project, we pursue the characterization of factor VIII-hydrolyzing IgG (FhIg). We also extend our description of hydrolyzing IgG to additional antigen targets. In particular, we are characterizing DNA hydrolyzing IgG in patients with systemic lupus erythematosus, and investigate the presence of topoisomerase-hydrolyzing IgG in patients with scleroderma. We strongly believe that identifying the role of hydrolyzing antibodies would help in better understanding the molecular pathogenesis and conceiving improved therapeutics.



Objectives

I. FVIII-hydrolyzing IgG

- Prevalence FVIII-hydrolyzing IgG in patients with acquired hemophilia and follow-up during progression of the disease
- Follow-up of FVIII-hydrolyzing IgG in patients with congenital hemophilia A who have developed FVIII inhibitors and are under protocols of 'immune tolerance induction'
- Generate monoclonal anti-FVIII antibodies with proteolytic activity to FVIII
- Screen for specific inhibitors of FVIII-hydrolyzing antibodies

II. DNA-hydrolyzing IgG in patients with systemic lupus erythematosus

- Longitudinal follow-up of DNA-hydrolyzing IgG in patients with SLE
- To generate murine monoclonal anti-DNA antibodies with hydrolytic activity to DNA
- Topoisomerase I-hydrolyzing IgG in patients with scleroderma
- To investigate the presence of topoisomerase I-hydrolyzing IgG in patients with scleroderma

Knowledge Products Developed

Discovery of factor IX-hydrolyzing IgG in the plasma of patients with acquired hemophilia A

Demonstration of presence and prevalence of topoisomerase-hydrolyzing IgG and DNA-hydrolyzing IgG in patients with scleroderma

Publications

SCI Journal Publication : 8

No. of Papers Presented in Conferences : 5

Mobility Support

India to France : Collaborators - 2

France to India : Collaborators - 3

Principal Collaborators



Valakunja Nagaraja
Department of Microbiology and Cell Biology
Indian Institute of Science, Bangalore



Srinivas V. Kaveri
Immunopathologie et
Immunointervention
Thérapeutique, Paris

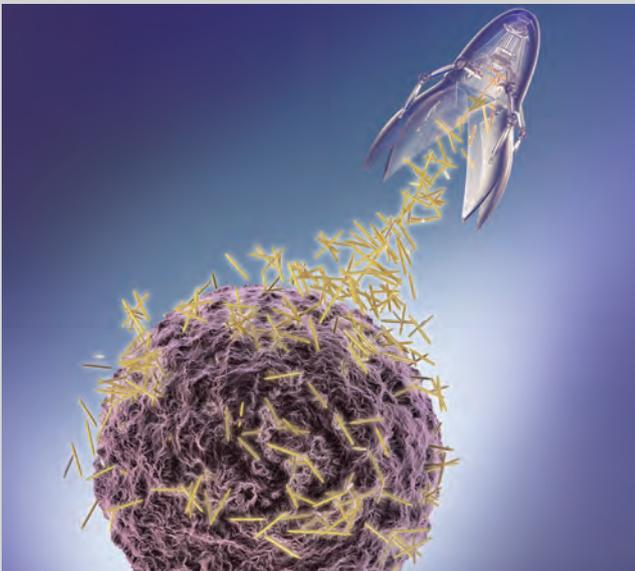
Collective Migration in the Fly Nervous System

Project No. : 4403-1

April 2012 - Mar. 2015

Background

Metastasis is the prime cause of deaths in most of the cancer patients. Cell migration is one of the most important aspects of cancer cells during metastasis. To invade, cancer cells interact with the surrounding healthy cells and migrate along the body. Because of its occurrence deep inside the body of a patient, it can be very difficult to study this issue. What scientists already know is that cancer cells migrate to metastasize but how does this process take place and what can be done to prevent still makes the object of intense investigation. Using a simple model organism to study cell migration we are trying to decipher some of the salient aspects of cancer metastasis, with a focus on molecular and cellular mechanisms of cancer invasion and collective migration.



Objectives

Collective cell migration is a widely conserved process that plays a key role in several physiological processes, from development to homeostasis. It requires a higher degree of complexity than single-cell migration since cells must coordinate their movements to maintain their reciprocal positions in order to reach their final destination. Initially, the project aimed at characterizing the molecular cascade involved in collective glial migration using the *Drosophila* model system. By the time I joined the project, much advancement had been made from the initial sanction. This fortunate situation allowed me to move further and rapidly show that *Glide/Gcm* plays a key role in glia migration, a rather unexpected finding for an early factor that is involved in fate determination. In particular, my data indicate that this determinant must accumulate at threshold levels to ensure proper migration. The current project aims at understanding how is the stability of *Glide/Gcm* controlled and which are the direct targets that regulate glial migration.

Publications

SCI Journal Publication : Nil
Paper presented in conference: 3

Mobility Support

India to France : Collaborators - 1
France to India : Collaborators - 1

Principal Collaborators



K. VijayRaghavan
National Centre for Biological
Sciences, Bangalore



Angela Giangrande
Institut de Génétique et de Biologie
Moléculaire et Cellulaire, Brologie

Dynamics of Serotonin 1A Receptors by Single Particle Tracking

Project No. : 4603-2

Dec. 2011 - Nov. 2014

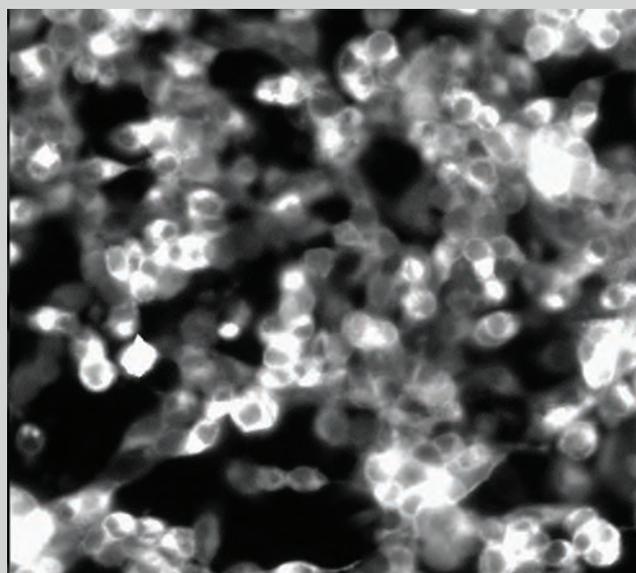
Background

The serotonin 1A receptor is an important member of the G protein-coupled receptor (GPCR) superfamily and is implicated in depression and anxiety. Deciphering membrane organization and dynamics of the receptor will be crucial in the future development of better therapeutics. The project synergises complementing expertise of project partners [analysis of organization, dynamics and function of the serotonin 1A receptor (India) and single molecule diffusion analysis of GPCRs (France)] to address this important issue. We will compare the effects of chronic vs. acute membrane cholesterol depletion, which induce distinct pharmacological responses, on receptor dynamics. We will also analyze the role of actin cytoskeleton in the functional dynamics of the receptor. The results are likely to provide novel insights on GPCR signaling and dynamics, and help in designing better therapeutics.

Objectives

Although ~50% genes in higher eukaryotes code for membrane proteins, progress in understanding membrane protein function has been slow. This is partly due to the enormous difficulty in the crystallization of membrane proteins. In addition, it is becoming increasingly clear that for deciphering membrane protein function, it is important to appreciate and understand characteristic membrane dynamics since a static structure alone is not enough for a comprehensive understanding of membrane protein function. It is in this overall backdrop that measurements of live cell membrane dynamics with a goal of correlating with cellular function assume relevance. Measurement of membrane dynamics is often challenging due to intrinsic noise associated with cellular systems.

The overall objective of the proposed project is to understand the interplay between membrane organization (dynamics) and function of the human serotonin 1A receptor by single molecule analysis of its diffusion (single particle tracking) in live cells. In addition, we plan to explore the role of membrane cholesterol and the actin cytoskeleton on dynamics and function of the receptor.

HEK-293 cell lines expressing His-Myc-5-HT_{1A}

Principal Collaborators



Amitabha Chattopadhyay
Centre for Cellular & Molecular Biology
Hyderabad



Laurence Salomé
University Paul Sabatier
Toulouse

Mobility Support

India to France : Collaborators: 2
France to India : Nil

Role of Chromatin Architecture in Cellular Senescence

Project No. : 4003-1

April 2010 - Mar. 2014

Background

The project involved studying cellular senescence, or study of aging at cellular level. One hallmark of senescent cells is a prominent reorganization of chromatin structure. However, virtually nothing is known about the epigenetic changes in senescent cells and how higher-order chromatin organization is important for the execution as well as maintenance of the senescence phenotype. The main objective of the proposed work was to obtain a deeper understanding of how epigenetic changes are important for the establishment and maintenance of the senescence phenotype and how an aberrant higher-order chromatin organization could provide an environment conducive for tumorigenesis. Genomic occupancy profile of SATB1 and histone modifications in replicating as well as senescent cells provided insights into the chromatin organization of these two phenotypes of fibroblasts.



JRF working in the lab at IISER Pune.

Objectives

- Isolation and Identification of genomic regions in open and closed chromatin in senescent cells.
- Histone modification status of open and closed chromatin domains.
- Generation of primary fibroblast silenced for SATB1 expression; Preparation of RNA samples and transcriptional profile of SATB1-silenced cells.
- Involvement of SATB1 in tumorigenesis.
- Identification of gene targets of SATB1 in senescent and tumor cells and genomic map of SATB1-binding sites.
- Stable knock-down and silencing of identified gene targets; transformation potential of identified targets.

Knowledge Products Developed

- Generation of primary fibroblast stably silenced for SATB1 expression, and, transcriptional profile of SATB1-silenced cells
- SATB1 expression profile in tumor cell lines and primary tumor samples
- Expression of SATB1 and SATB2 in primary and senescent fibroblasts at RNA and protein level;
- Expression of repressive histone modification mark H3K27(me)3 in primary and senescent cells
- ChIP (Chromatin Immunoprecipitation) analysis of primary and senescent cells for occupancy of SATB family proteins

Publications

SCI Journal Publication : Nil

Papers Presented in Conferences : 1

Mobility Support

India to France : Collaborators-2; Student -1

France to India : Collaborators -1

Principal Collaborators



Sanjeev Galande
Indian Institute of Science Education
and Research (IISER), Pune



Oliver Bischof
Nucléaire et Oncogénèse
Institut Pasteur, Paris

Protection by New Arecoline Derivatives in Alzheimer's Disease

Project No. : 4303-1

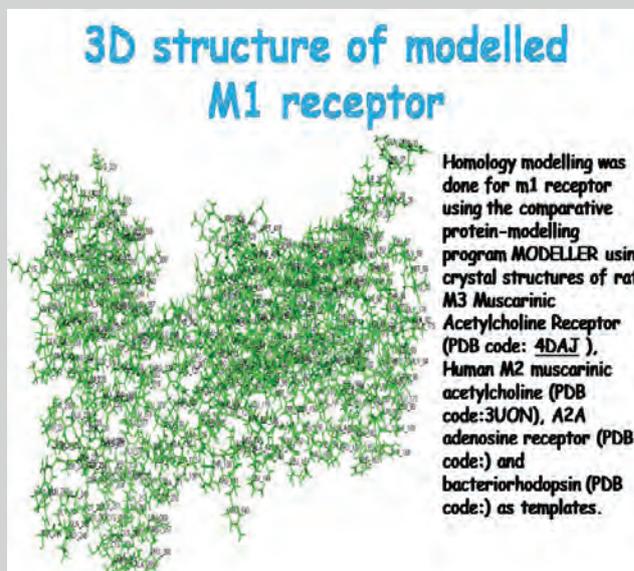
Jan. 2011 - Dec. 2013

Background

The discovery of cholinergic deficit in Alzheimer's disease patient's brain has triggered research efforts, using cholinomimetic approaches for their symptomatic and putatively neuro-protective efficacy in AD therapy. Cholinergic agents include muscarinic agonists, cholinesterase inhibitors and acetylcholine releasing agents. One of the muscarinic agonists tested in AD is arecoline, and its bioisosters, widely explored as muscarinic receptor 1 agonist. This project focuses on design and synthesis of novel arecoline and heterocyclic derivatives, as selective M1 agonist for the treatment of AD. Newly synthesized molecules will be pharmacologically characterized. Potent and selective derivatives will be tested in an in vivo nontransgenic model of AD, the central injection of A β 25-35 peptide in mice. Their neuro-protective activity will be determined using a combined molecular, morphological and behavioural approach, by the French partner.

Objectives

- Design and synthesis of new M1 receptor selective, potent, bioavailable and receptor wash resistant non-ester analogs of Arecoline and similar heterocyclic derivatives as agonists.
- Synthesized derivatives will be checked for M1 receptor binding constant in vitro and determination of IC50 values.
- Based on the above binding studies the lead will be optimized by substituting different groups by QSAR studies.
- The screened molecules will be tested for prevention or reversion of A β 25-35 induced learning and memory deficits (large dose response studies).
- Neuroprotective activity of the most effective doses and compounds will be assessed at the biochemical level (measures of oxidative stress, induction of pro-apoptotic caspases...).
- The neuroprotective activity will be confirmed at the morphological level by an immunohistochemical analysis of the brain of treated mice with a panel of specific markers (cell death, neurons, glia and microglia, synapse...).



Knowledge Products Developed

The constraints on the project are essentially the labour, and financial constraints; more repetitive experiments are conducted in behavioural studies to get statically reliable results, which consumed more animals and time. Consequence to this, there was less time and money available for molecular marker based study. In spite of some constraints, some of arecoline derivatives tested showed promising results at 0.03mg/kg body weight, the project needs an extended study mainly emphasizing molecular mechanistic aspects.

Principal Collaborators



K. S. Rangappa
Mysore University
Mysore



Tangui Maurice
Université Montpellier II
Montpellier

Publications

SCI Journal Publication : 1
Papers Presented in Conferences : Nil

Mobility Support

India to France : Collaborators-1
France to India : Collaborators-1

Biological Peroxide Sensing: The Bacterial Regulator PerR, Synthetic Analogues and Biomimetic Reactivity

Project No. : 4109-1

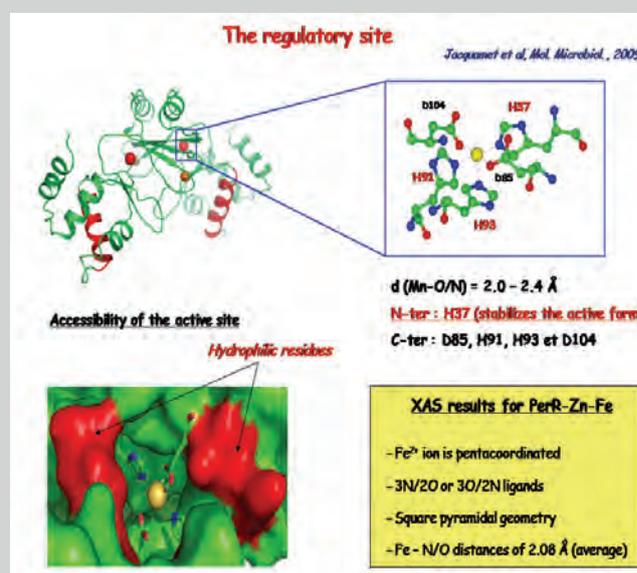
Nov. 2009 - Oct. 2013

Background

The project seeks to isolate and study low molecular weight mononuclear iron(II/III) coordination complexes as structural and functional models for the peroxide regulator (PerR) zinc-iron proteins that sense hydrogen peroxide in prokaryotes and release the expression of defence enzymes. Mononuclear iron(II)/(III) complexes and manganese analogues of suitable tetra- and pentadentate ligands containing biomimetic donors will be isolated for the first time as models for the PerR protein. X-ray structure determination of suitable single-crystals of these complexes will also be undertaken to ascertain the coordination environments of the models. The ability of the mononuclear iron(II)/(III) complexes to activate a variety of substrates will be studied using GC, HPLC and GC-MS techniques. The catalytic activity of the iron and manganese complexes towards oxidation of histidine imidazole moieties and other oxotransfer reactions will be studied.

Objectives

The newly found metalloregulator PerR is a H₂O₂ sensor that controls the defences against oxidative stress in a number of bacterial pathogens including *Staphylococcus aureus*. PerR is activated by the binding of a ferrous ion in the so-called regulatory site comprising three histidines and two aspartates. It has been shown that PerR senses H₂O₂ through oxygenation of a histidine residue bound to the iron. It was proposed that this oxygenation follows a mechanism akin to a Fenton reaction involving a hydroxyl radical. This hypothetical mechanism is puzzling in several respects, both from chemical and biological standpoints. A variety of non-heme iron enzymes with a similar active site perform related amino acids oxygenations and operate along an iron-based mechanism that would provide a reliable alternative. This project aims at probing PerR mechanism at the molecular level by combining chemical (model studies), biochemical (protein chemistry) and biophysical (molecular spectroscopy) approaches. In addition it will address the question of the reversibility of the histidine oxygenation to find whether PerR is a sacrificial sensor or can be regenerated in the cell. An important benefit of these studies will be to open the way to new biomimetic catalytic processes based on H₂O₂ since PerR functions does not rely on reductive dioxygen activation.



Knowledge Products Developed

- Several 5N, 4N, 2N2O ligands isolated and characterised.
- Fe(II) and Mn(II) complexes isolated and characterised. Catalytic activity of the isolated complexes towards oxidation of imidazoles done.
- Crystal structure of the active PerR protein solved

Principal Collaborators



Mallayan Palaniandavar
Bharathidasan University
Tiruchirappalli



Jean-Marc Latour
Institut de Recherches en Technologies
et Sciences du Vivant, Grenoble

Publications

SCI Journal Publication : 5
Papers Presented in Conferences : 3

Mobility Support

India to France : Collaborators-2; Student -1
France to India : Collaborators-1

Mineral-Fluid Interaction Model for CO₂ Sequestration

Project No. : 4409-1

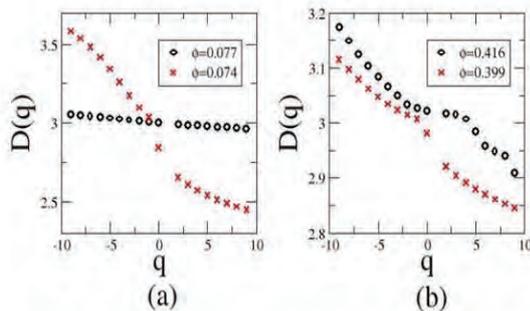
Jan. 2011 - Dec. 2013

Background

Fluid-rock mass transfer processes play an important role in a number of geosciences applications. We propose to study a more recent application that concerns the underground storage of CO₂ (now considered necessary to mitigate global warming). Quantifying the long-lasting presence of huge volumes of CO₂ in reservoirs requires addressing the essential issue of the pore structure and the hydrodynamic properties of the reservoir induced by the chemical reactions. In this case, the thermal, chemical and hydro dynamical forcing of the reservoirs may induce important and sustainable mass transfers that can change irreversibly the hydromechanical properties of the reservoir and of the surrounding rocks. Modelling these processes is therefore essential to evaluate the feasibility and the integrity of long-term confinement of the storage.

$D(q=0)$ is Capacity Dimension
 $D(q=1)$ is Information Dimension
 $D(q=2)$ is Correlation Dimension

$$D(q) = \frac{\tau(q)}{q-1}$$



Simulation model good for high porosity rocks!

Objectives

- Characterization of the mass transfers heterogeneity triggered by the flow field and rock-forming mineral heterogeneity in the case where diffusion is not dominant at pore scale.
- Test different modeling approaches, based on advanced random walk techniques, at pore scale using both high-resolution three-dimensional images taken before and after dissolution/precipitation experiments, and generated statistically equivalent porous media.
- Explore genetic models based on compaction and diagenesis.
- Role of the interface contact area versus reactive surface area, reactants spreading and mixing and advection versus diffusion will be investigated.
- Extension towards the modeling of variable viscosity fluids will be investigated.
- Up-scale these processes in order to produce operational models at Darcy's scale using the continuous medium approach.
- Darcy's scale properties, such as the bulk reaction rate, porosity and permeability, will be directly computed from mass and momentum balance equations.

Knowledge Products Developed

- Code developed to convert X-ray microtomography images of actual sedimentary rock samples into binary data format.
- Code developed to do multifractal analysis of real rock samples and simulated rock samples.
- Code developed to simulate reactive flow in sedimentary rock at pore scale.

Publications

SCI Journal Publication : 4
 Papers Presented in Conferences : 4

Mobility Support

India to France : Collaborators -2 ; Student -1
 France to India : Nil

Principal Collaborators



(Ms) Tapati Dutta
 St. Xavier's College
 Kolkata



Philippe Guoze
 Université de Montpellier
 Montpellier

Interstellar and Intergalactic Medium at High Redshift: Reservoir of Gas for Galaxy Formation

Project No. : 4304-2

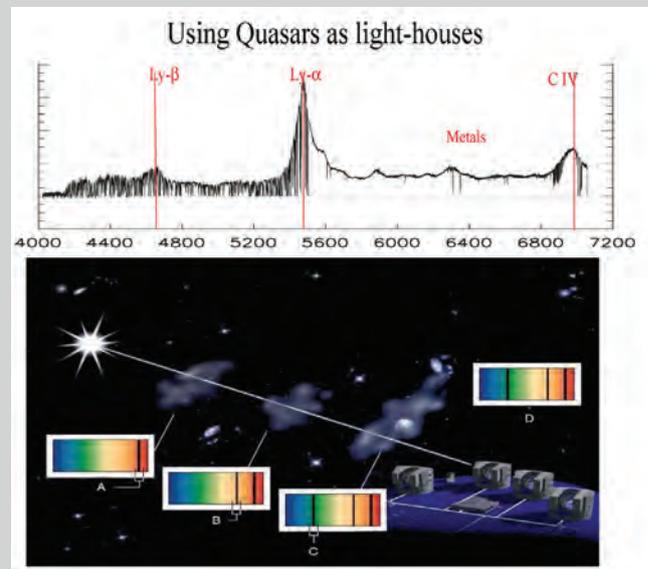
Sept. 2013 - Feb. 2014

Background

Absorption lines seen in the spectra of high-redshift quasars are very sensitive and luminosity unbiased tracers of the gas located in dense regions like disks of galaxies as well as in the diffuse intergalactic medium. Observation of quasars allows one to probe the evolution of our universe over a large look back time. We have (i) derived the redshift dependence of the cosmic microwave background temperature (ii) placed stringent constraints on variations of fundamental constants using very large optical telescopes (iii) studied the physical conditions in high-redshift protogalaxies and their time evolution using extensive surveys of cold neutral hydrogen with GMRT and molecular hydrogen and carbon monoxide with the ESO Very Large Telescope (VLT). Our team also studied various issues related to physical state and ionization history of the distant inter-galactic medium.

Objectives

One of the main goals of observational cosmology is to find answers to questions such as how star-formation proceeds, what is the resultant metal production, how it is related to the physical and chemical state of the interstellar medium (ISM) and what is the mode of transport of metals from galaxies to the intergalactic medium (IGM). Absorption lines seen in the spectra of high-redshift quasars are very sensitive tracers of the gas located in dense regions like disks of galaxies as well as in the diffuse intergalactic medium. Using this powerful tool in the radio and the optical wavebands, we wish to study (i) the molecular and dusty interstellar medium of distant galaxies, (ii) the multiphase structure of the neutral gas probed by 21-cm absorption, (iii) the metal enrichment of the IGM and its connection to outflows from galaxies and quasars and (iv) the time variations of different dimensionless fundamental constants of Physics.



Knowledge Products Developed

- Completing the systematic survey of 21-cm absorption in a sample of Mg II absorbers in the redshift range $0.5 < z < 1.5$ using GMRT, GBT and VLA.
- Strongest constraints on the combination of fundamental constants using four 21-cm absorbers detected in GMRT survey together with VLT observations specifically obtained for the project with attached calibrations.
- We report the discovery of a double hump Lyman-alpha emission line from a high redshift damped Lyman-alpha system using X-shooter observations.
- We reported the first case of variable Fe fine-structure absorption in a low ionization BAL QSO.
- We also reported the first detection of Diffuse Interstellar Bands (DIBs) from a low-z QSO galaxy pair.

Principal Collaborators



Raghunathan Srianand
Inter-University Centre for Astronomy
& Astrophysics, Pune



Patrick Petitjean
Institut d'Astrophysique de Paris
Paris

Publications

SCI Journal Publication : 6
Papers Presented in Conferences : Nil

Mobility Support

India to France : Collaborators - 2
France to India : Collaborators - 2

Non-Adiabatic Quantum Reactive Scattering Dynamics on Multi-Sheeted Potential Energy Surfaces

Project No. : 4404-1

April 2011 - Sept. 2014

Background

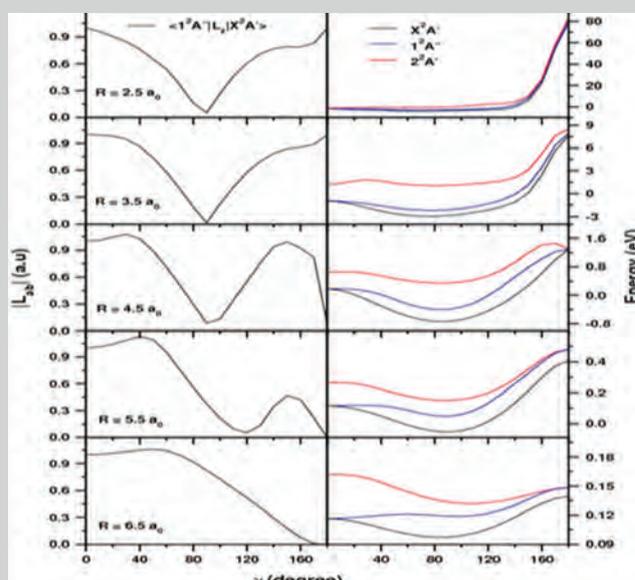
Relative scattering dynamics of prototypical exoergic insertion reactions on multi-sheeted coupled electronic potential energy surfaces (PEs) will be investigated with the aid of time-independent and time-dependent quantum mechanical methods. The findings will be compared with the crossed molecular beam results. As a prerequisite of quantum dynamical studies, extensive ab initio quantum chemistry calculations will be carried out and the relevant PEs will be constructed by fitting the ab initio data. The adiabatic PEs will be diabaticized and the diabatic coupling surfaces will be established. The French team will develop the time independent method in body-frame hyperspherical coordinate system. The Indian team will develop the time-dependent method in body-fixed Jacobi coordinate system to treat the nonadiabatic reactive dynamics. The Besancon team will be involved in PES calculations.

Objectives

Theoretical studies of reactive chemical dynamics beyond Born-Oppenheimer approximation, development of electronic potential energy surfaces, investigation of nuclear dynamics by quasi-classical trajectory, time-independent and time dependent quantum mechanical methods

Knowledge Products Developed

- Salient features of the potential energy surfaces of the electronic ground state of S + OH and electronic excited state of the C + OH reactive systems are examined in detail.
- Optimal grid in the reagent Jacobi coordinates is established.
- Time-dependent wave packet propagation is being carried out to calculate reaction probability, integral cross section and thermal rate constant.



Principal Collaborators



Susanta Mahapatra
Univ. of Hyderabad
Hyderabad



Pascal Honvault
Labo ICB, Univ.
de Bourgogne, Dijon

Publications

SCI Journal Publication : Nil
Papers Presented in Conferences : 1

Mobility Support

India to France : Collaborators - 1; Student - 1
France to India : Collaborators - 3

Extreme QCD in the LHC Era

Project No. : 4404-2

Jan. 2011 - June 2014

Background

This project is in the area of Theoretical High-Energy Nuclear Physics being pursued experimentally at the Large Hadron Collider (LHC) at CERN. Project aim is to map out quantitatively the phase diagram of quantum chromodynamics (QCD). QCD is one of the four basic interactions in physics and has been well-tested in perturbative domain only. The experiments aim to test non-perturbative aspects of QCD. We aim to characterize the initial state formed in nucleus-nucleus collisions, the knowledge of which is crucial to extract the properties of QGP. To that end, we have presented several new correlation observables. We have proposed a simple model to understand the anisotropy generated by initial-state fluctuations. We have also studied event-plane correlators which have the potential to throw additional light on the initial-state phenomena.



Objectives

The LHC collider at CERN will accelerate beams of lead nuclei in 2010, at energies 30 times larger than the present collider RHIC at Brookhaven. These collisions are expected to produce a phase of matter named the quark-gluon plasma. This project is devoted to theoretical studies in close relation with this experimental programme. The first aspect of the project is to compute the production of particles in these collisions from first principles, using recent developments in perturbative Quantum Chromodynamics (QCD). The second aspect is to study specific signatures of the quark-gluon plasma using QCD at finite temperature, namely the production of charmonium, and of particles with high transverse momenta. The third aspect of the project investigates the expansion of the quark-gluon plasma and its decay into particles using relativistic hydrodynamics.

Knowledge Products Developed

Correlators between event planes of different harmonics in relativistic heavy-ion collisions have the potential to provide crucial information on the initial state of the matter formed in these collisions. We present a new procedure for analyzing such correlators, which is less demanding in terms of detector acceptance than the one used recently by the ATLAS collaboration to measure various two-plane and three-plane correlators in Pb-Pb collisions at LHC. It can also be used unambiguously for quantitative comparison between theory and data. We use this procedure to carry out realistic simulations within the transport model AMPT. Our theoretical results are in excellent agreement with the ATLAS data, in contrast with previous hydrodynamic calculations which only achieved qualitative agreement. We present predictions for new correlators, in particular four-plane correlators, which can easily be analyzed with our new method.

Publications

SCI Journal Publication : 2
Papers Presented in Conferences : Nil

Mobility Support

India to France : Collaborators - 6
France to India : Collaborators - 4

Principal Collaborators



Rajeev S. Bhalerao
Tata Institute of Fundamental Research
Mumbai



Jean-Yves Ollitrault
Institut de physique théorique
Gif-sur-Yvette

Distant Obscured Galaxies from GMRT and Herschel

Project No. : 4404-3

April 2011 - Mar. 2015

Background

This project falls in the broad area of galaxy evolution, where statistical changes in galaxy populations over cosmic time are studied and compared to the predictions of theoretical and numerical models and then placed in the larger cosmological context. There are a number of challenges here. The epoch of peak star formation is extremely distant and most star formation occurs in extremely dusty star forming regions. This makes optical observations nearly useless and sensitive radio and far-infrared observations which are more transparent to dust are required. This early epoch also witnesses peak activity in active galactic nuclei. With our new radio data, and extensive archival observations in optical, near/mid/far infrared and high frequency radio bands, we will explore a number of problems related to star formation and AGN activity in these distant, obscured galaxies.

Objectives

- To understand star formation in high redshift Ultra-Luminous Infrared Galaxies (ULIRGs) from combined radio/submm/mid-IR data.
- To study far-infrared and radio properties of Active Galactic Nuclei (AGN) and their host galaxy.
- To study the properties and structure of exceptionally strong high-redshift submillimetre sources.

A number of sub-projects have been identified to pursue these broad objectives in greater detail. e.g. one project aims to identify a sample of high redshift radio galaxies using the steepness of the radio spectral index. Another project involves separating star forming galaxies from AGN using the entire panchromatic photometry in the optical, infrared and radio bands.



Principal Collaborators



Yogesh Wadadekar
National Centre for Radio Astrophysics
Pune



Alexandre Beelen
Institut d'Astrophysique Spatiale
Orsay

Mobility Support

India to France : Collaborators - 2
France to India : Collaborators - 1

Computational Studies of Frustrated Quantum Magnets

Project No. : 4504-1

June 2011 - May 2014

Background

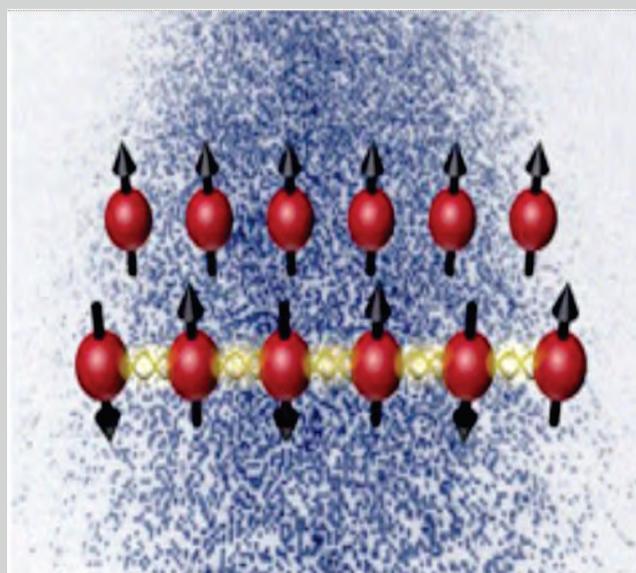
The field of quantum magnetism is at the heart of several important developments in fundamental and applied science, such as MRI, magnetic storage devices and spintronics. It has also provided a major impetus for the development of new theoretical tools and algorithms, as well as major conceptual advances and experimental techniques (NMR, polarized synchrotron, pulsed high magnetic fields). In spite of being a mature discipline, it remains a fertile area of research, as it provides many examples of unusual collective behaviour due to the strong correlations between particles and frustration effects. The projects mentioned above are positioned at the frontiers of current research developments in quantum magnetism and are mainly of fundamental nature (pure basic science). The main applications will involve better understanding and interpretation of experimental results in the area.

Objectives

We aim to investigate several open issues in quantum magnetism and other strongly correlated systems. The work proposed is of a theoretical nature and is well-motivated by connections to experimental systems.

Due to the intrinsic quantum nature of the problem, the complexity of strongly correlated problems grows exponentially with the physical system size. We aim to develop and use a mixture of analytical and computational techniques (including quantum Monte Carlo simulations) to tackle the following issues :

- Real-time dynamics of quantum magnets
- Improved mean-field theory for quantum anti ferromagnets
- Exotic deconfined quantum critical points in quantum spin systems
- Computational studies of quantum dimer and related valence-bond systems



Knowledge Products Developed

Evidence for an unusual quantum phase transition occurring in quantum magnets on the honeycomb lattice. We demonstrated with large scale quantum Monte Carlo simulations that a continuous transition occurs between an anti ferromagnet and a crystal of singlets (Valence Bond crystal). This is at odds with the usual Landau description of phase transitions which predicts a generic first order phase transition between phases of matter with different broken symmetries.

Publications

SCI Journal Publication : 4
Papers Presented in Conferences : 3

Mobility Support

India to France : Collaborators- 1 ; Student - 1
France to India : Collaborators- 1

Principal Collaborators



Kedar Damle

Tata Institute of Fundamental Research
Mumbai



Fabien Alet

Université Paul Sabatier
Toulouse

Probing Dense Matter and Strong Gravity

Project No. : 4604-1

Jan. 2012 - Dec. 2014

Background

A fundamental problem of particle physics is to understand the nature of supra-nuclear degenerate matter of neutron star cores. One cannot solve this problem by doing experiments in terrestrial laboratories. Possibly the only way to solve this problem is to measure the structural parameters of neutron stars. Another fundamental problem of physics is to probe the strong gravity regime. Strongest gravitational field exist around neutron stars and stellar mass black holes. kHz QPOs are believed to originate from within a few Schwarzschild radii of neutron stars, and hence can be useful to measure the neutron star parameters and to probe the strong gravity region. However, the actual origin of this timing feature is not yet known making it unreliable as a tool yet. In this project, we plan to study kHz QPOs in order to establish this feature as a tool.



Artistic view of an X-ray binary

Objectives

Analysis and modelling of kilohertz quasi-periodic oscillation (kHz QPO) data of RXTE archive to understand the origin of this timing feature, which could be very useful to constrain neutron star parameters and to probe the strong gravity. More specifically on the data analysis part, Manoneeta Chakraborty, under the French collaborator's supervision, will investigate the time lag properties of both the lower and upper kHz QPOs, in order to place constraints on the location site of the modulated emission. The soft lags of the lower kHz QPOs observed may be linked to reverberation of the QPO signal onto the accretion disk, consistent with the location of the modulated signal to be on the neutron star surface (or in the boundary layer). What happens then to the upper kHz QPOs? Is it also produced at the neutron star surface or in the disk? This is the question we wish to answer next, but the task is extremely challenging, as the upper QPO signal is much broader and harder to detect and follow. Appropriate selection of the data may be needed.

Mobility Support

India to France : Collaborators - 2; Students : 1
France to India : Collaborators - 2

Principal Collaborators



Sudip Bhattacharya
Tata Institute of Fundamental Research
Mumbai



Didier Barret
Centre d'Etude Spatiale des
Rayonnements, Toulouse

Slow Highly Charged Ion Molecule Collisions

Project No. : 4604-2

Dec. 2011 - Nov. 2014

Background

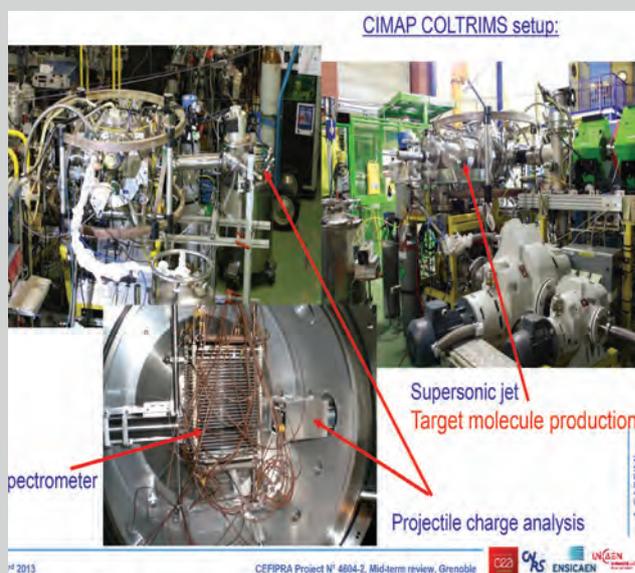
The project aim is to generate the ability to study extremely slow ion-molecule collisions. This information is of fundamental interest to atomic and molecular physicists, to study processes where the kinetic energies involved in the collision are much smaller than the potential energy carried by the projectile. Such interactions would test the commonly used "Oppenheimer approximation" to calculate potential energy curves.

Such approximations are commonly made in all ion molecule scattering calculations which are ubiquitously done to explain ion atom and ion molecule collisions in plasmas, both man made and naturally occurring.

Objectives

The basic objective of the project is to study and understand the interaction of very slow highly charged ions with atoms and molecules. The interaction of highly charged ions with matter, in the form of atoms, molecules, clusters and bulk matter is a region of much contemporary interest. The present proposal is limited to the study of the interaction of "slow highly charged ions" with "atoms and molecules" with focus on electron transfer and fragmentation dynamics.

The collaborators propose to study the interaction of the highly charged ions at very low velocities (a few eV/q), such that the interaction times are large, and the target electrons can react to the incoming and outgoing projectile's electric field. The collisions would not be adiabatic, and a sort of "chemical reaction" would occur with a breakdown of the Born-Oppenheimer approximation. This is expected to result in the population of different final channels as compared to the impulse excitation case. The availability of modern time of flight based spectrometers allows to decode the dynamics of the interaction based on the detection of the final fragment ions by looking at their velocities and positions. It is expected that the experiments to throw valuable insight into the reaction mechanisms of the system studied. The availability of slow highly charged ions at both the partner institutes is the main inspiration for the project. It is proposed to do complimentary experiments at the two institutes to address the various aspects of slow highly charged ion molecule collisions.



Knowledge Products Developed

We have been able to determine the requirements for pulsing of ion beams and pulsed extractions. The feasibility of producing slow multiple charged ions has been definitively demonstrated in Caen, with ion beams with energy 80qeV achieved. Knowhow on the use of delay line detectors has been exchanged.

Theoretical simulations on the possibility of decoding the kinetic energy releases in ion molecule collisions show that extraction delays of about 50ns are acceptable for the experiments that are being planned.

Principal Collaborators



C P Safvan

Inter University Accelerator Centre
New Delhi



Amine Cassimi

Centre de Recherche sur les Ions
Caen

Mobility Support

India to France : Collaborators-2
France to India : Collaborators-3

Effect of the Correlations in the Statics and Dynamics of Extended Systems

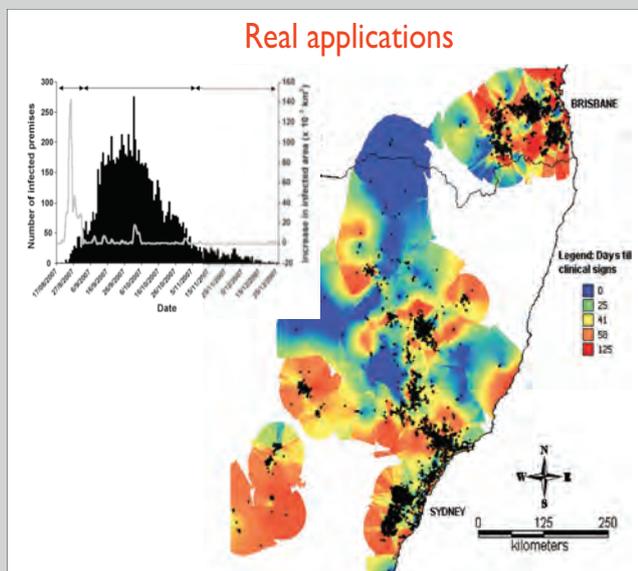
Project No. : 4604-3

Jan. 2012 - Dec. 2014

Background

In this project we wish to investigate the role of strong correlations in the statics and dynamics of extended systems. An example of such a system is a polymer chain (or an assembly of chains) moving in a complex medium which may be pure or disordered. Our research will focus on four aspects of such a correlated system: (i) to investigate the statistics of rare and extreme events (ii) to investigate the first-passage properties associated with the dynamics (iii) to study the avalanche dynamics when the chain moves in a quenched disordered medium and find possible mappings to sandpile models.

Real applications



Objectives

To understand the static and the dynamical properties of an extended object, with strong correlations between its different parts, is an important challenge in theoretical physics. In addition, recent experiments on a single DNA molecule have raised important new questions regarding the role of correlations in such systems. The main aim of this project is to study the role of correlations in an extended system such as a polymer chain, via theoretical analysis of solvable models as well as extensive numerical simulations. The collaborators plan to study four different aspects of such extended systems: phases and phase transitions, extreme value statistics, first-passage properties and avalanche dynamics. Each of these aspects requires developing new theoretical and numerical tools which is the main objective. Subsequently, it is expected to use the results in various applications.

Knowledge Products Developed

- Resulted in 13 publications with CEFIPRA acknowledged.
- Recruited a postdoctoral fellow (S. Gupta) on the French side.
- Analytical results for universal order and record statistics of random walks have been obtained.
- The spatial extent of animal epidemics has been characterized both analytically and numerically using connections to the extreme statistics of branching Brownian motion.
- Analytical results for work fluctuations for a Brownian particle harmonic trap has been obtained.

Publications

SCI Journal Publication : 11

Papers Presented in Conferences : Nil

Mobility Support

India to France : Collaborators -2

France to India : Collaborators -3

Principal Collaborators



Sanjib Sabhapandit
Raman Research Institute
Bangalore



Alberto Rosso
Université Paris Sud
Orsay

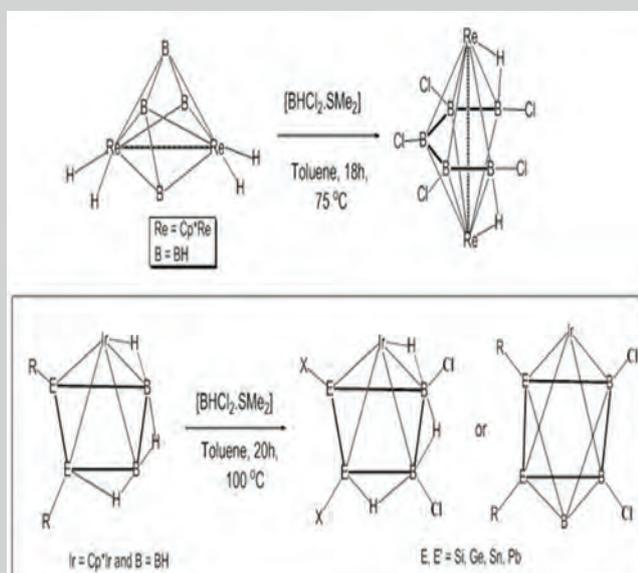
Chemistry and Application of Metallasila and Metallagermaboranes Derived from Group 14 Unsaturated Organic Substrates

Project No. : 4405-1

Feb. 2011 - Jan. 2014

Background

Our research encompasses the synthesis and characterization of new inorganic species as well as a study of their electronic structures and reactivity in the domain of inorganic chemistry. An experimental plus modern electronic structural computational approach is proposed. Young coworkers participating in this research receive a broad training in modern inorganic chemistry and gain a range of skills that permits valuable versatility in their future careers. Our work takes Ph.D. students and research associates to one frontier of inorganic chemistry where they encounter unusual structures with new types of bonding and reactivities. The international dimension provided by this joint proposal will enhance these educational activities providing Indian co-workers with significant exposure to modern inorganic chemistry in a prominent French laboratory and the reciprocal for the French colleagues.



Objectives

The project aims at developing new synthetic routes for the preparation of novel metallaheteroboranes, under mild conditions. The synthesis of novel unsaturated organic substrates, e.g., E=E' double bonds (E = C, Si, Ge, Sn and Pb; and E' = Si, Ge, Sn, Pb) or E≡E' triple bond (E, E' = Si or C) and the study of their reactivity with group 5-9 metallaboranes revealed to be very difficult. New and unexpected metallaboranes were achieved instead. A detailed structural study of these complexes was done to understand the structure-property relationship. Theoretical studies on metallaheteroboranes using quantum chemical calculations gave critical information on their formation, structures and stabilities. Computations served as both rationalising and guiding the experimental work, with the ultimate overall objective of establishing a firm understanding of the systems synthesised and characterized.

Knowledge Products Developed

Experimental chemical synthesis work, made in India has led to the characterization of a series of dimetallaboranes.

Theoretical calculations were carried out at Rennes at the density-functional theory level to complement the experimental studies, allowing to understand the electronic and structural properties of these new species.

Publications

SCI Journal Publication : 16

Papers Presented in Conferences : 2

Mobility Support

India to France : Collaborators - 2; Student - 1

France to India : Collaborators - 2

Principal Collaborators



Sundargopal Ghosh
Indian Institute of Technology - Madras
Chennai



Jean-François Halet
Université de Rennes
Rennes

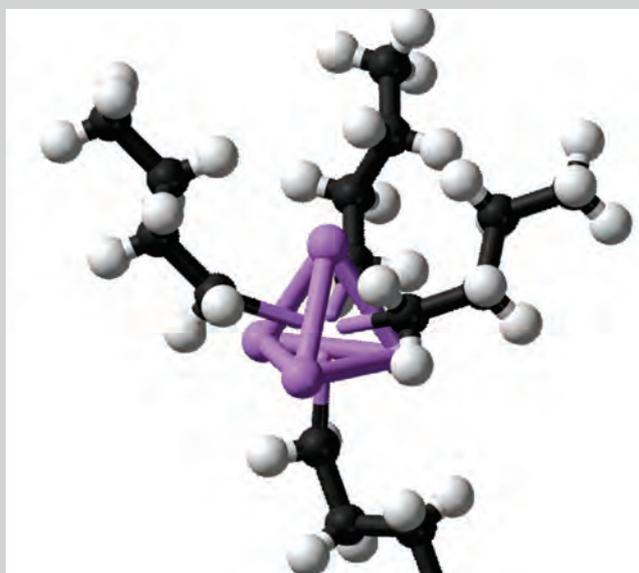
Development of fulvene-based Zr(II) and Ti(II) chemistry : organometallics, reactivity and applications in organic synthesis

Project No. : 4505-1

July 2011 - June 2014

Background

Pentafulvenes are readily accessible building blocks in organic synthesis. Their unique unsaturated system gives access to cycloaddition reactions in which the three double bonds of the fulvene system can react as a 2, 4 or 6π electron component. The Indian partner of the project has a wide expertise in the fulvene-based organic synthesis. Fulvenes offer the possibility of unexplored reactivities towards the organometallic reagents, particularly column IV transition metal complexes (Ti, Zr) are promising candidates. In fact, organometallic complexes of zirconium and titanium in the oxidation state +II are well-known to interact with alkenes and dienes, resulting in a large number of applications in organic synthesis. The interaction of these complexes with fulvenes may therefore reveal original transformations convenient for organic synthesis.



Objectives

The main objective of this project has been the introduction of fulvenes as substrates to the divalent chemistry of zirconium and titanium, opening up the way for new atom-economic transformations and efficient pathways for the synthesis of useful organic molecules. At first, an in-depth organometallic study has been planned to establish the reactivity between fulvenes and divalent zirconium and titanium species. Secondly, based on this organometallic study, some five-membered as well as polycyclic frameworks, typically found in molecules of biological interest would be efficiently accessed.

Knowledge Products Developed

The initial organometallic study using low-valent zirconium or titanium complexes and pentafulvenes gave rise to a better understanding of the coordination of fulvenes to the metal center. Indeed, the first zirconocene-pentafulvene could be synthesized and characterized by X-ray crystallography and its reactivity towards carbonyl compounds was assessed. In a parallel project, trivalent titanium complexes were shown to undergo hydrotitanation at the endocyclic position of pentafulvenes. The resulting allyltitanocenes yielded homoallylic alcohols in a highly regio- and stereoselective manner. In a third project, a domino process involving palladium and Lewis-acids allowed the transformation of pentafulvene derived diazabicyclic olefins towards indoline and pyrazolidine fused cyclopentenes.

Publications

SCI Journal Publication : 2

Papers Presented in Conferences : Nil

Mobility Support

India to France : Collaborators- 1; Students : 2

France to India : Collaborators- 2

Principal Collaborators



K. V. Radhakrishnan
National Institute for Interdisciplinary Science
and Technology, Thiruvananthapuram



Jan Szymoniak
Université de Reims
Reims

Studies of Iron Complexes of N/O-Functionalized N-Heterocyclic Carbenes in Homogeneous Catalysis

Project No. : 4605-1

Nov. 2011 - Oct. 2014

Background

The central theme of this proposal are in the preparation of new and innovative N,O-functionalized N-heterocyclic carbenes (NHC) ligands and the corresponding iron complexes. The potential utilities of these complexes as catalysts are being examined in selected organic transformation reactions including hydrosilylation, hydrogen transfer, amination and C-H bond activation and functionalization. Detailed mechanism studies will be undertaken to understand the pathway of these transformations, in order to design more active iron catalysts. In the emerging field of iron catalysis and in the competitive area of C-H activation, the proposed project is expected to provide guidelines to obtain competitive eco-compatible iron-NHC catalysts.

Objectives

The original objectives of the proposal were :

- the design and the synthesis of original *N,O*-functionalized NHC ligands.
- the preparation of the corresponding iron complexes. It must be underlined that only few examples of NHC-iron complexes are reported to be active catalysts.
- the use of the prepared complexes as catalyst in organic transformations such as hydrosilylation, hydrogen transfer, amination and C-H activation/functionalization.

The overall emphasis would thus lay on the generation of new knowledge in the areas of synthesis and catalytic activities of these complexes.



Mr. A. P. Prakasham at work inside a glove box performing experiments related to the Indo-French IFCPAR-4605-1 project.

Principal Collaborators



Prasenjit Ghosh
Indian Institute of Technology Bombay
Mumbai



Christophe Darcel
Université de Rennes I
Rennes

Thermo-Hydrodynamics of Phase-Change Induced Oscillating Taylor Bubble Flows

Project No. : 4408-1

Jan. 2011 - Sept. 2014

Background

The project is focused on bubble dynamics and associated heat transfer during two-phase flows in mini/micro/capillary pipe geometries. This configuration and these phenomena are of high importance in a variety of situations of practical engineering problems of various fields, from thermal control (heat pipes) to microfluidic devices, MEMS, etc.

The objectives of the project are to study thermo-hydrodynamics of phasechange induced oscillating Taylor bubble flows in mini-micro channels under various boundary conditions namely: Mini-Micro Channels (typical hydraulic diameter 500 μm to 3 mm); Adiabatic as well as diabatic conditions; Controlled/uncontrolled oscillations of Taylor bubbles and Various fluid/solid combinations (most important being transparent material for a proper observation of the thermo-hydrodynamic phenomenon).

Objectives

Fundamental understanding of Taylor bubble flows is highly lacking in mini/micro channel geometries, under phase-change processes and oscillating flow conditions. Many emerging applications of mini/ micro phase-change thermal-fluid systems have such flow conditions. Such systems routinely have oscillations, either intentionally generated or occurring due to flow instabilities. The project aims to understand thermo-hydrodynamic response of oscillating Taylor flows under aforementioned boundary conditions and its effect on thermo-fluidic transport coefficients. We plan to employ Particle Image Velocimetry (PIV), Infra Red Thermography (IRT) and High Speed Videography (HSV) to achieve this aim. The results will have direct implications on design and understanding pulsating heat pipes, compact phase change electronics cooling modules, micro-fluidic devices and micro-biochemical reactors and mass transfer systems.



Students working on Micro-PIV setup at IIT Kanpur, India

Knowledge Products Developed

Because of the specific character (i.e. non-routine) of the temperatures measurement in oscillating flows with periods of the same order of the magnitude as the response time constant of the sensor, initially, unexpected developments of a new calibration method of small thermocouples in dynamic regime was required. This was done internally at CETHIL by members of the laboratory who are not involved in the project and who belong to another research group of the Center. This might lead to a publication and maybe in a longer term to a technological transfer to the partner spin-off company of CETHIL.

Principal Collaborators



Sameer Khandekar
Indian Institute of Technology Kanpur
Kanpur



Jocelyn Bonjour
Institut National des Sciences
Appliquées de Lyon, Villeurbanne

Publications

SCI Journal Publication : 7
Papers Presented in Conferences : 11

Mobility Support

India to France : Collaborators - 1; Students - 1
France to India : Collaborators - 2

Development of a Non hydrostatic Finite volume Icosahedral Model for Regional /Global Climate Simulation and Weather Forecast

Project No. : 4107-1

Nov. 2009 - Oct. 2013

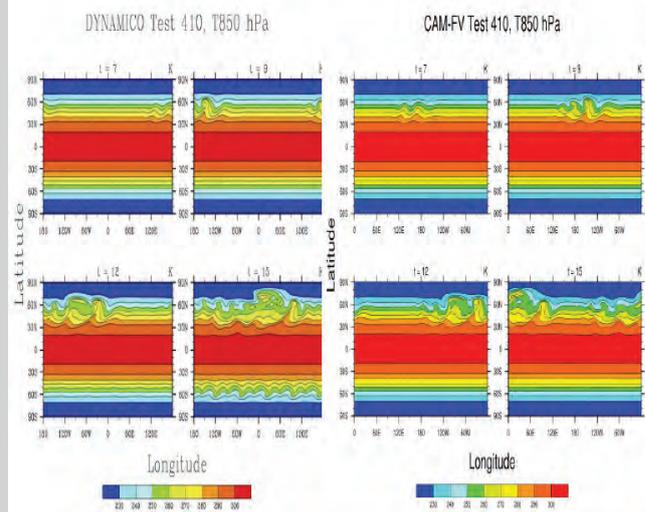
Background

Icosahedral-hexagonal grids are quasi-uniform as well as free of the polar singularity of latitude-longitude grids. These grids have opened the way to massively parallel execution of general circulation models (GCM). Our goal is to develop an icosahedral hexagonal version of the LMD-Z (GCM). However numerical schemes of LMD-Z relying on the Cartesian grid must be replaced. Exact mass conservation, an essential requirement for climate models is achieved by finite-volume scheme.

Objectives

The objective of this project is to develop a non hydrostatic general circulation model for climate simulations as well as weather forecast using finite volume methods on icosahedral hexagonal grid.

Results of Dry Baroclinic Instability test case



Knowledge Products Developed

Included the physics package to the dynamical core of the model and different test cases are being evaluated.

Principal Collaborators



H. C. Upadhyaya
Indian Institute of Technology
New Delhi



Frédéric Hourdin
Laboratoire de Meteorologie
Dynamique, Paris

Mobility Support

India to France : Collaborators-1
France to India : Collaborators-3

Nurturing Knowledge



Ongoing Projects
Applied Sciences

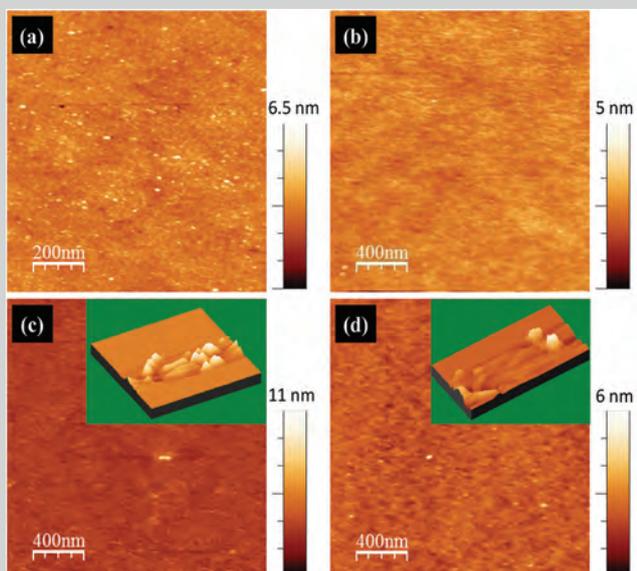
Puzzling Properties of Ultrathin Polymer Films

Project No. : 3808-3

Feb. 2010 - Sept. 2014

Background

In our quest for making functional devices smaller, the thickness of polymer films has reached values even smaller than the diameter of the unperturbed molecule. However, despite enormous efforts, our understanding of the origin of some puzzling properties of such thin films is still not satisfactory. In our project we bring together two complementary groups for studying confined polymer films in order to find out how and why properties of polymers in thin films differ from their behaviour while in bulk. Aiming at unveiling the origin for such "mysterious" behaviour, we will relate structural properties as determined by reflectometry techniques with the dynamics of polymer chains in thin films determined via dewetting experiments. The ultimate goal is to propose a general concept relating molecular aspects and the properties of thin polymer films.



Objectives

- Prepare a uniform, smooth and continuous ultra-thinnest polymeric film, which has anti-corrosion and hydrophobic properties, on semiconductor surface. This study is not only important from the technological point of view but also it has fundamental importance in understanding the origin of strong interaction between solid surfaces with the extremely confined polymer chains.
- Understanding the role of concentration in determining the ultimate structure of the triblock copolymer films on Si surface. Role of their initial structures in swelling behaviour under humid environment.

Knowledge Products Developed

- Preparation of ultra-thinnest films ($\leq 2\text{nm}$) of PS by spin-coating followed by toluene rinsing.
- Characterization of the films by x-ray reflectivity and Atomic force microscope.
- Ultra-thinnest film of PS shows anti-corrosion and strong hydrophobic characteristics.
- Structure of PEO-PPO-PEO triblock copolymer ultra-thin films is greatly influenced by the concentration of polymeric solution used for the film preparation.
- A compact, continuous and uniform film begins to form at 4.5 g/l concentration. Below this concentration the films are incomplete and discrete.

Mobility Support

India to France : Collaborators -4
France to India : Collaborators -3

Principal Collaborators



Milan K. Sanyal
Saha Institute of Nuclear Physics
Kolkata



Alain Gibaurd
Université du Maine
Le Mans

Organic Materials for Energy Devices

Project No. : 4208-1

March 2010 - June 2013

Background

The practical implementation of alternative energy storage systems is becoming increasingly important. Fuel cells will most likely be the energy source of the future. However, there are issues to be addressed before such devices can become economically viable and technically sure. Amongst the problems to be solved is the question of the separating membrane. The most common polymer based membranes currently used are sulfonated perfluoropolymers commonly known as Nafion. They need to be fully humidified because the proton conductivity of such membranes depends heavily on the water content in the membrane. Recently, tremendous efforts have been devoted to realize the dry operation of membrane and reduce the cost. The focus of this project is to develop fullerene based membranes as basic components for proton conducting materials.

Objectives

This project is directed towards the development of low-to-medium temperature (60-200°C) fuel cell proton conducting membrane electrolytes, and polar liquid crystalline materials. Here, we propose a different type of functionalization on fullerene by which one can control the properties of functionalized organic materials. For example: by increasing fullerene acidity, we expect to lower the barrier for proton hopping and thus achieve proton transport properties superior to that of Nafion. These studies will provide useful inputs for the generation of new, novel materials for energy devices. The focus of this project is to develop new materials for the next generation of energy devices. In particular towards the development of materials for organic devices such as solid electrolyte for lithium-ion (Li+) rechargeable batteries, and polar liquid crystalline materials.



Knowledge Products Developed

- Synthesis and Characterization of penta-adducts of fullerenes.
- Preparation of Langmuir-Blodgett (LB) films from fullerene derivatives and study of the film morphology by AFM probe.
- Preparation of Nafion Composite Membrane with Fullerene derivatives.
- Measurement of conductivity and performance of the membrane.

Principal Collaborators



Satish Patil

Indian Institute of Science
Bangalore



Daniel Guillon

IPCMS, Groupe des Matériaux Organiques
Strasbourg

Mobility Support

India to France : Collaborators -1
France to India : Nil

Mechanisms of New Long-Lasting Luminescence Biomarkers

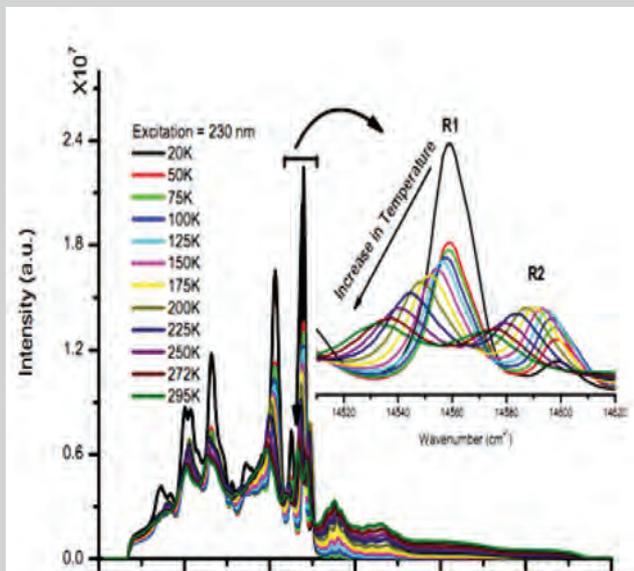
Project No. : 4508-1

July 2011 - June 2014

Background

A biomarker, or biological marker, generally refers to a measured characteristic which may be used as an indicator of some biological state or condition. In medicine, a biomarker can be a traceable substance that is introduced into an organism as a means to examine organ function or other aspects of health.

The project aims at developing novel biomarkers emitting red Long-Lasting Phosphorescence (LLP) for in vivo small animal optical imaging. The biomarkers are first excited by ultraviolet light for a couple of minutes outside the animal body, then injected to the animal, where they emit red/infrared light detectable for several hours after the injection.



Objectives

- Development of Long Lasting Luminescence Materials
- Study of Structural and Optical Properties
- Identification of Defects participating in LLP mechanism

Knowledge Products Developed

New long-lasting phosphorescence (LLP) material, MgGa₂O₄:Cr was prepared. This along with other LLP materials like ZnGa₂O₄:Cr were characterized by several techniques like electron paramagnetic resonance (EPR) spectroscopy, thermally stimulated luminescence (TSL) and X-ray absorption fine structure (XAFS) spectroscopy to identify defects responsible for LLP property. The materials developed show excellent LLP properties for UV or X-ray excitation. Furthermore, LLP is also observed using relatively less harmful visible light as excitation source. This has a great implication in bio-imaging as the biomarker can now be re-excited from within the animal body thereby enhancing the detection time.

Publications

SCI Journal Publication : 2
Papers Presented in Conferences : Nil

Mobility Support

India to France : Collaborators -2; Students -2
France to India : Collaborators -2

Principal Collaborators



Kaustubh R. S. Priolkar
Goa University
Goa



Aurélie Bessiere
Laboratoire de Chimie de la Matière
Condensée de Paris, Paris

Developing Design Guidance for Rammed Earth Construction

Project No. : 4608-1

Nov. 2011 - Oct. 2014

Background

Buildings sector contributes >40% of GHG emissions globally. Primary energy consumption in the building sector is attributable to embodied energy of materials and building systems. There is a need for evolving low embodied carbon construction materials in order to reduce GHG emissions. Rammed earth is a low embodied carbon and eco-friendly construction material, which utilises local soil resources. There is a lack of standardised testing procedures for assessing the strength of rammed earth walls. Currently available codes of practice on rammed earth lack proper design guidance. The novelty of the project is to standardise the testing procedure for evaluating the strength of rammed earth and to develop design guidance. The outcome of the project will help the professionals involved in promotion of rammed earth constructions.



Moving the samples

Objectives

Rammed earth can be categorised into stabilised rammed earth (SRE) and unstabilised rammed earth (USRE). These two types have distinctly different characteristics in terms of strength, stiffness and elastic properties. The project focuses on the following aspects of USRE and Cement stabilised rammed earth (CSRE.):

- Standardising specimen size for assessing the characteristic compressive strength. Variables: Soil grading, density and cement content
- Establishing stress strain relationships and elastic constants (modulus, Poisson's ratio, etc) considering soil grading, density and cement content as variables
- Examining compressive strength of CSRE and USRE with different slenderness ratios and load eccentricities, for deriving stress reduction factors.
- Examining behaviour of rammed earth elements under lateral loads in order to assess the behaviour under seismic or wind loads.

The project aims to establish design methodology for rammed earth structures and the development of code of practice on design of rammed earth.

Mobility Support

India to France : Collaborators : 1
France to India : Nil

Principal Collaborators



B.V. V. Reddy
Indian Institute of Science
Bangalore



J. C. Morel
Ecole National des Travaux Publics de l'Etat
Vaulx en Velin

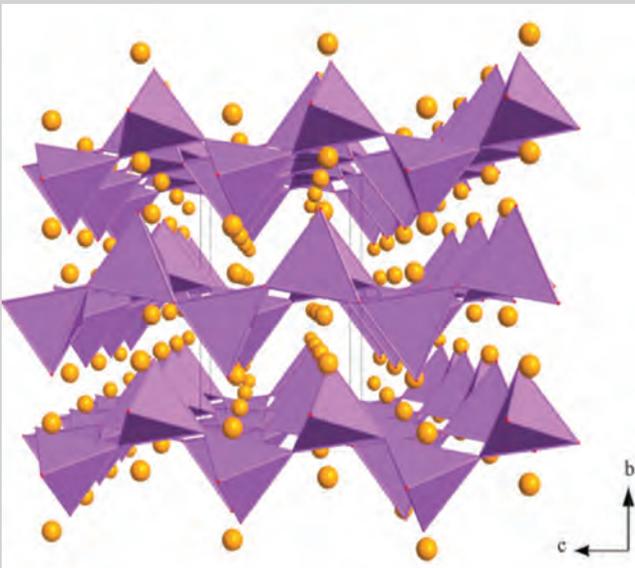
Environmentally Benign Materials for Lithium Ion Batteries

Project No. : 4608-2

Nov, 2011 - Oct, 2014

Background

Electronic devices are highly dependent on the properties of their power sources which involve layered transition metal oxides. Environmental concerns have encouraged the development of research of new materials. The key of the majority of the physical properties, the most important parameters remain to be the duality between electronic and ionic conductivity which could be generated by the electrochemical-driven redox reaction. Tuning the electronic-ionic allows researchers to control the transition metal valences and then the electronic properties which are the basement for a majority of today's applications. The most relevant example could be the lamellar cobaltite compound Li_xCoCO_2 commercially used in Li-ion batteries while the isotypic phase Na_xCoO_2 is actually intensively as a new thermoelectric material without forgetting the hydrated phase $\text{Na}^+\text{CoO}_2 \cdot y\text{H}_2\text{O}$ which presents superconductivity.

Structure view of LiVO_3 along the a axis

Objectives

The collaborators propose to explore the synthesis and characterization of new layered phases potentially attractive as electrode materials for secondary lithium batteries and/or thermoelectrics.

The research will be focused on transition metal oxides. The mixed valences of these materials obtained by low temperature synthesis or electro chemistry will allow to adjust physical properties. Structural-chemical bond properties relationships will be studied and the possibility to use these materials as materials for electrodes for power generation systems.

Knowledge Products Developed

- $\text{Li}_2\text{-xVO}_3$ as electrode material for Li ion batteries
- New family as electrode material for Li ion batteries FeOHSO_4 and $\text{Fe}_2\text{O}(\text{SO}_4)_2$
- Exploration of the iron hydroxy phosphate : $\text{Fe}_3(\text{PO}_4)_2(\text{OH})_2$
- $\text{Na}_2\text{VO}(\text{HPO}_4)_2$ through a topotactic reaction electrochemical reactivity with lithium (62mAh/g) at ~ 3.9 V for 0.7 Li at C/10 $\text{Na}_2\text{VOP}_2\text{O}_7$ from dehydrated $\text{Na}_2\text{H}_2\text{VO}(\text{PO}_4)_2$

Mobility Support

India to France : Collaborators : 1
France to India : Nil

Principal Collaborators



U.V. Varadaraju
Indian Institute of Technology-Madras
Chennai



Valerie Pralong
Laboratoire CRISMAT, ENSICAEN
CAEN

Hydrology and Water Resources from Space over the Indian Continent

Project No. : 4000-W1

April 2010 - Mar. 2014

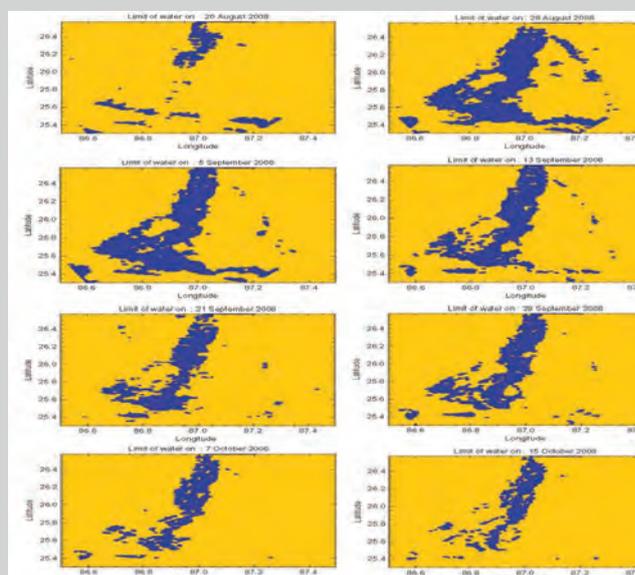
Background

The knowledge of water storage in different forms-surface water, snow, moisture, groundwater- and their variability on different spatial and temporal scale is important at scientific as well as at policy levels. This especially is true for a vast country like India with a rapidly growing economy and resultant rise in living standards.

Space borne measurements have exceptionally improved our understanding of the Earth's global water storage variability and also able to provide information on the regional scale. New space-based observation tools particularly GRACE gravity and satellite altimetry are providing critical information for monitoring of total and surface water storage variations.

Objectives

The objective of this project is to monitor land water storage of the Indian continent using space gravimetry and satellite altimetry data. Observations of the GRACE space gravimetry mission will be used to provide soil and groundwater volume time series over the main river basins of India since mid-2002 at ~ 10-day interval. Altimetry data from Topex/Poseidon, Jason-1, ERS-2 and Envisat satellites will provide surface water time series since early 1993, in particular over the main Indian rivers as well as over man-made reservoirs. Altimetry data combined with visible and radar satellite imagery will allow determination of surface water volumes over flooded areas during flood season. Combination of surface water volumes with GRACE-based total water storage will permit determination of the groundwater component. The space-based hydrological products will be compared to land surface model outputs as well as with in situ data when available.



Knowledge Products Developed

- Extent and volume of Kosi flood 2008, India and 2010 Pakistan flood.
- Estimates of replenishable total water storage and groundwater storage over India as well as their spatial and temporal variability.
- Water level time series over Ganga, Krishna and Godavari rivers for all the possible virtual stations using satellite altimetry data.
- Estimates of vertical deformation due to seasonal hydrological loading.

Principal Collaborators



V.M. Tiwari
National Geophysical
Research Institute, Hyderabad



Jean François Cretaux
Laboratoire d'Etudes en Géophysique
et Océanographie Spatiales, Toulouse

Publications

SCI Journal Publication : 2
Papers Presented in Conferences : 3

Mobility Support

India to France : Collaborators -3
France to India : Collaborators-1

The Kosi River Alluvial Dynamics

Project No. : 4500-W1

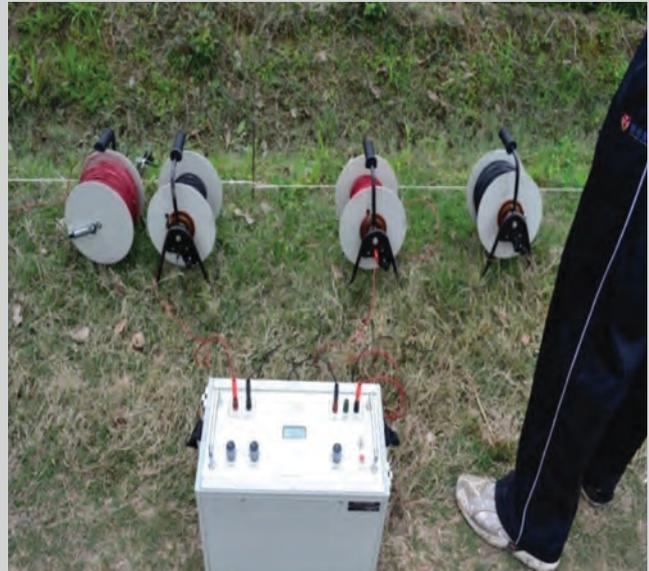
Jan. 2012 - Dec. 2014

Background

The objective of the project is to study the dynamics of an alluvial fan building and evolution with a special emphasis on avulsion dynamics. The project site is located in north Bihar India and is looking at the Kosi river which has built the largest alluvial fan in the world and is also known for rapid and frequent avulsion. The project is making use of physical models and cellular automata of alluvial fans and braided streams and their application on the field to the study of the dynamics of the Kosi fan system in north Bihar, India. Two physical models are being developed and analyzed, one on the braided channel dynamics, and one alluvial fan building. A cellular model of fan dynamics will also be developed. Together with field surveys the models will help understand the stability of a stream on its fan and will also make recommendations on best engineering practices on such dynamic rivers such as Kosi for designing a sustainable management strategy.

Objectives

- To understand the historical-scale dynamics of the Kosi alluvial fan through numerical modeling and flume experiments
- To estimate the modern sediment flux in the Kosi river and relate this to morphological changes e.g. Channel aggradation and flooding,
- To understand the alluvial architecture and long-term (pre-historic) avulsion history of the Kosi river through geophysical surveys and shallow coring.
- To estimate pre-historic sediment flux in the Kosi fan using geochemical (isotopic) methods and to understand the forcing functions (climate-tectonics coupling), and
- To develop long-term strategy for river management in this region based on process-response system.



Resistivity soundings on the fan surface

Knowledge Products Developed

- Alluvial stratigraphy of the Kosi megafan
- Sediment Transport and Channel Morphology of the Kosi River, India
- 1D theoretical and experimental fan

Principal Collaborators



Rajiv Sinha
Indian Institute of Technology
Kanpur



François Métivier
Institut de Physique du Globe de Paris
Paris

Publications

SCI Journal Publication : 1
Papers Presented in Conferences : Nil

Mobility Support

India to France : Collaborators - 3
France to India : Collaborators - 2; Students - 3

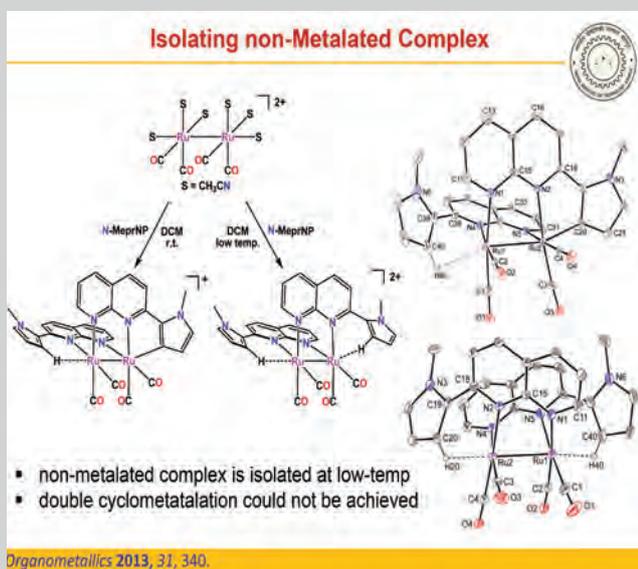
Bimetallic Catalysis Involving Ruthenium and Palladium: C-H Bond Activation/Functionalization and Beyond

Project No. : 4205-1

Feb. 2010 - Sep. 2013

Background

The central theme of this proposal is cooperative bimetallic catalysis and it aims to utilize bimetallic compounds in organic transformations. Dipalladium and diruthenium systems, in which two metal ions are in close proximity, will be synthesized and their potential utilities as catalysts will be examined. The carbene (NHC) and 1,8-naphthyridine (NP) based ligands and their chiral versions will be synthesized. The [Ru]-[Ru], [Ru]-[Pd], [Pd]-[Pd] and [Pd]-[Ru] dimetal precursors will be subjected to complexation reactions with newly synthesized ligands. Synthesis, molecular structure determination and elementary organometallic reactions (oxidative addition, elimination, insertion) will be carried out in the laboratory of Dr. Bera in India. Dr. Doucet's group in France will probe these complexes as catalysts in a myriad of organic transformation reactions including C-H bond activation. Detailed theoretical calculations will be undertaken to understand the superiority of dimetal catalysts compared to their mono-metal congeners. In the emerging field of cooperative bimetallic catalysis, a project proposal of this type is expected to provide guidelines that will enable to design tomorrow's catalysts having higher reactivity and better selectivity.



Objectives

- Design and synthesis of multidentate ligands to stabilize a dimetal core.
- The synthesis of diruthenium and dipalladium precursors.
- Systematic collaborative studies on the interaction of C-H bond with dimetal core, stoichiometric organometallic reactions at the dimetal platform, organometallic catalysis employing diruthenium and dipalladium complexes for a variety of reactions including cross-coupling reaction: Suzuki, Sonogashira, Negishi, Heck reaction.
- Special attention will be given to C-H bond activation/functionalization reactions of hetero-aromatics, which are important building blocks in organic synthesis.

Knowledge Products Developed

- A diruthenium(I) compound has been shown to catalyse aldehyde olefination reactions effectively.
- A set of diruthenium(I) compound with NHC ligands are shown to catalyse carbene-transfer reactions.
- Palladium-catalyzed direct arylation of thiophenes or arenes bearing SO₂R substituents have been demonstrated.
- Dipalladium(II) compounds bridged by proline-based chiral ligand have been synthesized.
- Non-classical carbene compound of Ru(II) have been synthesized.

Publications

SCI Journal Publication : 11
 Papers Presented in Conferences : Nil

Mobility Support

India to France : Collaborators- 2
 France to India : Collaborators-1

Principal Collaborators



Jitendra K. Bera
 Indian Institute of Technology-Kanpur
 Kanpur



Henri Doucet
 Université de Rennes
 Rennes

Self-Assembly in Novel Macromolecular Systems Based on Bioresource Materials: Synthesis, Characterization and Applications

Project No. : 4305-1

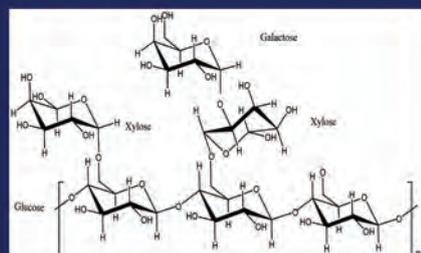
Oct. 2010 - Mar. 2014

Background

Associating Polymers [APs] have attracted increasing attention lately due to their unique property of self-assembly in aqueous media. These systems provide a rich background for designing novel formulations for a wide range of applications in cosmetics, pharmaceuticals, biomedical, food, paints, oil recovery, paper, textile, etc. In the framework of our research proposal, we propose to work on design and synthesis of novel associating polymers and gels based on natural polymers. Polysaccharides containing reactive functional groups can be easily modified chemically. The commercial production of polysaccharides has expanded steadily over the last 20-30 years. There is a great scope for these 'environmentally friendly', renewable resource materials and to prepare value added APs with applications in health care.

Tamarind Kernel Powder (TKP)

- Source – *Tamarindus indica*
- Sugar content – 67% of kernel
- Common names
 - » Jellose
 - » Tamarind seed polysaccharide
 - » Xyloglucan



* Sarkar P B & Mazumdar A K / *Tex. Inst. Trans.* 43, 6, T453-T454, 1957, 25

Objectives

- Utilization of bioresource materials as base polymers to synthesize novel APs.
- Making use of new developments in organic as well as in polymer chemistry for the design and synthesis of APs, hydrogels and nanocomposite gels.
- The study will focus on novel associating polymers and hydrogels based on polysaccharides with the following objectives:
- To design and develop biocompatible precursors of hydrogels based on Guar Gum [GG], Tamarind kernel Powder [TKP], hyaluronic acid [HA], and alginate [ALG].
- To prepare responsive and/or reactive graft copolymers by chemical modification of polysaccharides using controlled radical polymerisation techniques (such as ATRP and RAFT) and "click chemistry" approach.
- To elucidate the structure and properties by FT-IR, NMR, DSC, SANS, Rheometry, Dynamic Mechanical Analysis and Fluorescence spectroscopy.
- Application development in the area of industrial thickeners, tissue engineering and injectables in controlled release of drugs.

Knowledge Products Developed

- A new thermo-thickening polymer CMT-g-PEPO was synthesized and characterized using Rheometry.
- Hydrogels based on polysaccharides namely, Tamarind Kernel Powder (TKP) and Ethyl Hydroxy Ethyl Cellulose (EHEC) were synthesized using Divinyl sulphone as crosslinking agent.

Publications

SCI Journal Publication : Nil

Papers Presented in Conferences : 1

Mobility Support

India to France : Collaborators - 3

France to India : Collaborators - 3

Principal Collaborators



M. V. Badiger
National Chemical Laboratory
Pune



Dominique Hourdet
Laboratoire de Physico-Chimie
des Polymères, Paris

Compact Modeling of Asymmetric Double Gate Nano Scale Transistors

Project No. : 4300-IT-1

Aug. 2010 - July 2013

Background

Relentless focus on Moore's Law transistor scaling has provided ever-increasing transistor performance and density. To continue the technology scaling beyond 22nm node bulk-MOSFET needs to be replaced by new device architectures, most promising being the Multiple-Gate MOSFETs (MuGFET). As like bulk- MOSFET, an accurate and physical compact model is important for MuGFET based circuit design. In nanoscale regime there will always be some asymmetry between the gate oxide thicknesses due to process variations and uncertainties. This can affect device performance significantly. At the same time, independently controlled DG (IDG) MOSFETs have gained tremendous attention owing to its ability to modulate threshold voltage and trans-conductance dynamically. Due to the asymmetric nature of the electrostatic, developing efficient compact models for asymmetric/independent DG MOSFET is a daunting task.



Objectives

Development of Compact Models for the Electrostatics of Asymmetric DG Transistors

- Explicit modeling of body potential as a function of Gate Voltage
- Modeling of threshold voltage, short channel effect, drain induced barrier lowering and sub-threshold slope
- Modeling of inversion charge
- Modeling of energy quantization effects
- Development of Compact Models for the Electrostatics of Asymmetric DG Transistors
- Closed form drain current model
- Modeling of large signal parameters
- Modeling of small signal parameters

Knowledge Products Developed

- A simple surface-potential based compact terminal charge models, for common gate Asymmetric DG (ADG) MOSFETs.
- Demonstration of limitation of conventional charge linearization technique for the terminal charge modeling of IDG MOSFET.
- A novel piece-wise linearization technique for the accurate modeling of IDG MOSFET terminal charges.
- Concept of secondary input voltage equation (S-IVE).
- Applicability of planner DG models for non-planner MuG MOSFET.
- Closed form expressions for surface potential for ADG MOSFETs.
- 'Root Bracketing Method' based algorithm for efficient calculation of surface-potential of IDG MOSFET.

Publications

SCI Journal Publication : 3
Papers Presented in Conferences : Nil

Mobility Support

India to France : Collaborators-2
France to India : Collaborators-2

Principal Collaborators



Santanu Mahapatra
Indian Institute of Science
Bangalore



Costin Anghel
Institut Supérieure d'Electronique
de Paris (ISEP), Paris

Research and Development of Micromegas Detector and Related Devices

Project No. : 4304-1

April 2011 - Sept. 2014

Background

Accelerator based High Energy Physics (HEP) research requires very precise tracking detectors that are capable of handling high luminosity, are stable and less expensive. TPCs based on the Micromegas detectors can be a very strong candidate in this context. There can be good utilization of the Micromegas detectors in various other fields, as well. These include low or medium energy nuclear physics, astro-particle physics, medical or industrial imaging, homeland security. To achieve this we need to develop a thorough understanding of various characteristics of the Micromegas detectors under different environments. These characteristics are determined through complex physical processes occurring inside the detector. It is towards this development of understanding that this project is oriented.

Objectives

- Development of in-depth understanding of intrinsic properties of a Time Projection Chamber (TPC) based on Micromegas detectors.
- Optimize design/ operational parameters of the TPC device.
- To study the effect of such power pulsing in a given magnet field.
- Detailed detector simulation of the Micromegas-based TPC.
- Train young students to design and work with the Micromegas detector.
- Exploration and initiation of work in socially relevant areas like medical imaging or industrial imaging, homeland security using Micromegas.
- Possibility of low cost production of Micromegas in local industries.



Knowledge Products Developed

- Prototypes:** Small test boxes for carrying out off-line detector characterization using radioactive sources.
- Bulk Micromegas:** Several bulk Micromegas of different design parameters have been obtained from Saclay for carrying out characterization in the SINP laboratory.
- Time Projection Chambers:** Design of a simple and small prototype TPC completed.
- Test Bench:** A well-equipped test bench set up to carry out off-line experiments with test boxes and TPCs.
- Ion back-flow experiments:** Two drift planes were used in the present set-up at CEA, Saclay.

Principal Collaborators



Supratik Mukhopadhyay
Saha Institute of Nuclear Physics
Kolkata



Paul Colas
CEA/Saclay IRFU
Gif Sur Yvette

Publications

SCI Journal Publication : 1
Papers Presented in Conferences : 3

Mobility Support

India to France : Collaborators - 3 , Student - 1
France to India : Nil

Constraint-based Design of Controllers and Prefilters

Project No. : 4502-1

Mar. 2012 - Feb. 2015

Background

The task of designing and implementing a controller or a control strategy on any industrial or laboratory plants is a tough and complex exercise. Uncertainty in a system comes from modeling errors of the plant, or diversity of exogenous disturbance. We often hope classical controller would satisfy the performance objectives for a large range of parameter variations in control system design. However, in reality, classical controllers usually achieve the desired performance in a limited range of disturbances and parameter variation. Thus, it is necessary to design robust controller which a priori takes into account the uncertainties in the plant model parameters and disturbance. Quantitative Feedback Theory (QFT) is a well-known approach for designing robust control system. However, the manual approach is often tedious and time taking, and usually leads to considerable over designs.



Objectives

Many applications in science and engineering require automatic control of several variables that strongly interact with each other. To effectively handle variations in the system parameters and cope with external disturbances, a robust control system is desired. Robust controller and prefilter synthesis of system is of great practical interest, and their automation is a key concern in control system design.

Project objectives are as follow:

- To develop an ICST-based procedure for automated design of QFT controllers for multivariable systems;
- To develop an ICST-based procedure for automated design of QFT prefilters for multivariable systems;
- To develop computer code for the proposed procedures, and to integrate it into industrial strength MATLAB toolboxes;
- To test and validate the computer codes through extensive computer simulations;
- To test the efficacy of the developed procedures and codes, via real-time experiments performed on a magnetic levitation system in the laboratory.

Publications

SCI Journal Publication : 5
Papers Presented in Conferences : Nil

Mobility Support

India to France : Nil
France to India : Collaborators - 2

Principal Collaborators



P. S. V. Nataraj
Indian Institute of Technology Bombay
Mumbai



Frédéric Goulard
Université de Nantes
Nantes

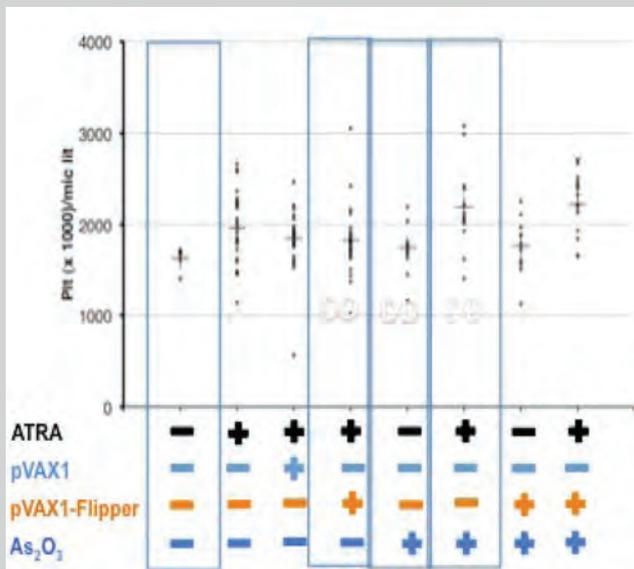
Evaluation of Cellular and Immune Response in Mice and Patients with Acute Promyelocytic Leukemia Treated with Arsenic Trioxide

Project No. : 4503-2

July 2011 - June 2014

Background

Acute promyelocytic leukemia (APML, APL) is a subtype of acute myelogenous leukemia (AML), a cancer of the white blood cells. In APL, there is an abnormal accumulation of immature granulocytes called promyelocytes. The disease is characterized by a chromosomal translocation involving the retinoic acid receptor alpha (RAR α) gene and is distinguished from other forms of AML by its responsiveness to all-trans retinoic acid therapy. APL was first characterized in 1957 by French and Norwegian physicians as a hyperacute fatal illness. Currently it is one of the most treatable forms of leukemia with a 12-year progression-free survival rate estimated to be approximately 70%. But several patients still suffer a relapse. Efforts to improve clinical outcomes in this group are ongoing.



Objectives

The overall goal of this collaboration is to study the effects of novel agents used in the treatment of acute promyelocytic leukemia on the immune response through preclinical studies in mice models and ongoing clinical trials in patients. In specific:

- Study antibody responses to acute promyelocytic leukemia (APL) in mouse model of acute promyelocytic leukemia and in APL patients with newly diagnosed and relapsed acute promyelocytic leukemia treated with an arsenic trioxide based regimen.
- Study immune re-constitution and cellular response to APL in patients with newly diagnosed and relapsed acute promyelocytic leukemia treated with an arsenic trioxide based regimen.
- Study safety and efficacy of PML-RAR α targeted DNA vaccine as an adjunct to arsenic trioxide in the treatment of a mouse model of acute promyelocytic leukemia mice with and without all-trans retinoic acid.

Knowledge Products Developed

- Transfer of animal model of acute promyelocytic leukemia and APL transplantable model to India and establishment of the preclinical animal model of APL treated by arsenic trioxide
- Induction of the APL in FVBN mice
- Transfer of DNA plasmid vaccine and its evaluation in a mouse model
- Technology for in-house evaluation of antibody response to APL

Publications

SCI Journal Publication : 1
Papers Presented in Conferences : Nil

Mobility Support

India to France : Collaborators- 1; Student – 1
France to India : Collaborators- 1

Principal Collaborators



Vikram Mathews
Christian Medical College
Vellore



Christine Chomienne
Institute of Universitaire Hématologie
Paris

Genome-wide Recruitment Profiling of BLM after DNA Damage

Project No. : 4603-1

Nov. 2011 - Oct. 2014

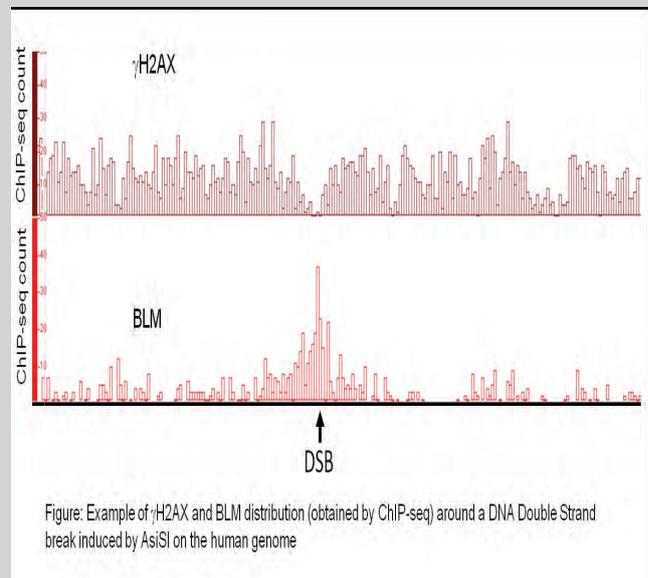
Background

Mutation in the BLM helicase results in Bloom syndrome (BS), an autosomal recessive disorder. Patients with BS exhibit hyper-recombination and are prone to almost all forms of cancer. Although previous research has clearly implicated the BLM protein in the DNA Double Strand Breaks (DSB) response and repair, its exact role in these pathways still remains to be fully deciphered. We have recently developed a new system capable of generating sequence-specific and annotated DSBs across the genome. This technology can be used to profile DSB repair proteins around multiple breaks at high resolution, when coupled to high throughput technologies like ChIP-chip and ChIP-seq. Using this system, we propose to generate the first comprehensive recruitment map of BLM on the human genome, before and after DSB induction. This will be a major step towards characterizing how BLM accumulates at DSB sites, and reveal the factors that contribute to its recruitment.

Objectives

The specific aims of the original project were:

- ChIP-chip profiling of BLM at DSBs generated by AsiSi-ER, in asynchronous cells
- Profiling of BLM at DSBs generated by AsiSi-ER, in synchronized cells
- Investigate the determinants that control BLM accumulation at DSBs



Knowledge Products Developed

- Characterised BLM and H2AX expression upon DNA damage induction in U2OS-AsiSi-ER cells .
- Demonstrated BLM and H2AX recruitment to the sites of double stand breaks.
- Performed and analysed the genome wide profile of gammaH2AX.
- Performed the genome wide profile of BLM after DSB induction.
- Started the process of generation of U2OS-AsiSi-ER cells in which the expression of BLM is decreased.

Principal Collaborators



Sagar Sengupta

National Institute of Immunology Cellulaire du Controle de la Proliferation
New Delhi



Gaëlle Legube

Toulouse

Publications

Papers Presented in Conferences : 6

Cometary Grains: Observations and Simulations

Project No. : 4507-1

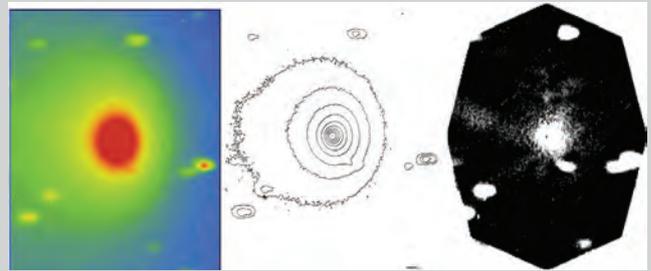
July 2011 - June 2014

Background

The dust tail is the most visually spectacular part of the comets we occasionally see in the night sky. Reaching typical lengths of tens of millions of kilometres, they are composed primarily of smoke-sized dust particles with an average diameter of around a micrometre, and are yellow in colour as they shine by reflected sunlight. Understanding the properties of cometary dust helps in a greater way to understand the formation and evolution of our solar system. Building phenomenological tools validated with both numerical and experimental simulations is extremely important in this context. Use of computers for numerical modelling of grains aggregates (composed of nanometer sized individual grains) is becoming an essential tool to interpret and understand observational data obtained from electromagnetic wave scattering.

Objectives

- To propose a complete numerical protocol to analyze observational data from the light scattered by cometary comae dust, in order to obtain definite information about physical properties of the dust particles ejected from a comet nucleus.
- Numerical protocol for light-scattering data analysis will be applied to the comet 103P/Hartley to supplement the direct observations obtained by the Deep Impact Extended Mission (DIXI/EPOXI) involved in spacecraft flyby over the comet in October 2010.
- The ultimate goal is to give to all scientists involved in comet rendezvous missions, a practical tool to get easy and reliable access to some parameters (particle size and morphology) crucial to foresee the interaction between a probe and the cometary dust particles.



Photograph of the comet C/2009 P1 Garradd (26 October 2011 at OHP), and treated intensity images showing the large tailward feature

Knowledge Products Developed

- Evolution of organics with the solar distance and related polarization.
- Titan's aerosols analogues after refractive index measurements.
- Organics in cometary coma, production of analogues.
- Investigation of the large-phase angle light scattering to give a practical tool to measure the fractal dimension of particles (numerical project).

Principal Collaborators



Asoke Kumar Sen
Assam University
Silchar



Dr Robert Botet
Université Paris-Sud
Paris

Mobility Support

India to France : Collaborators- 1; Student-2
France to India : Collaborators -3

Nurturing Knowledge



New Projects
Basic Sciences

Correlations and Transport Far from Equilibrium in Nanosystems

Project No. : 4704-2

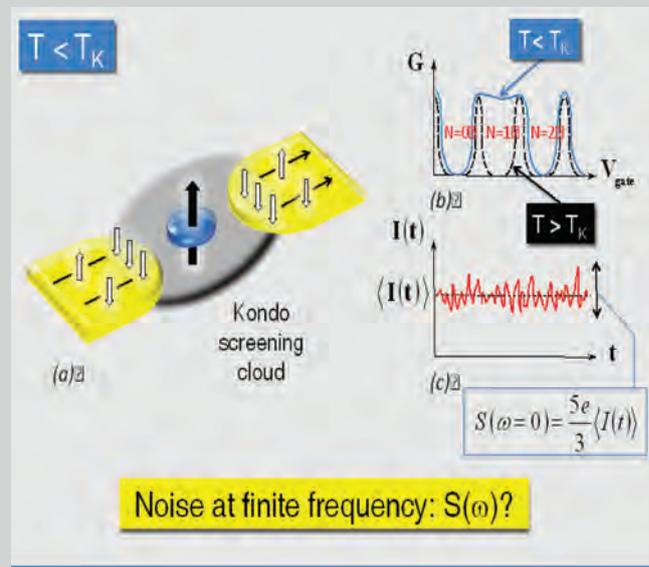
Oct. 2012 - Sept. 2015

Background

The focus of the project is on the development of new theoretical techniques to tackle non-equilibrium quantum phenomena in strongly correlated nanoscale systems like for instance interacting quantum dots in the Kondo regime. By means of these techniques, we will study charge- and spin- currents driven by a time-independent bias voltage across the dot and will derive current noises at finite frequency and third cumulant making use of full counting statistics. We will then examine other ways of achieving non-equilibrium by applying a time-dependent bias or gate voltage.

Objectives

The objectives of the project is to study non-equilibrium quantum phenomena in strongly-correlated nanoscale systems like for instance interacting quantum dots in the Kondo regime. We will study various sources of non-equilibrium. In a first step we will consider the application of a time-independent bias voltage to the dot and will study the induced charge- and spin-currents and more specifically the noise at finite frequency and third cumulant. The discussion will be extended to the case of a modified environment like ferromagnetic leads. In a second step, we will examine other ways of achieving non-equilibrium by applying a time-dependent bias or gate voltage. The photo-assisted charge- and spin- noise will be computed for an ac modulation of the external field. We will finally address the questions related to charge and spin dynamics after a fast switching (step pulse) of the gate voltage. The whole results will be discussed in light of recent experiments.



Principal Collaborators



Pareek Tribhuvan P.
Harish Chandra Research Institute
Allahabad



Mireille Lavagna
Institut Nanosciences et Cryogénie
Grenoble

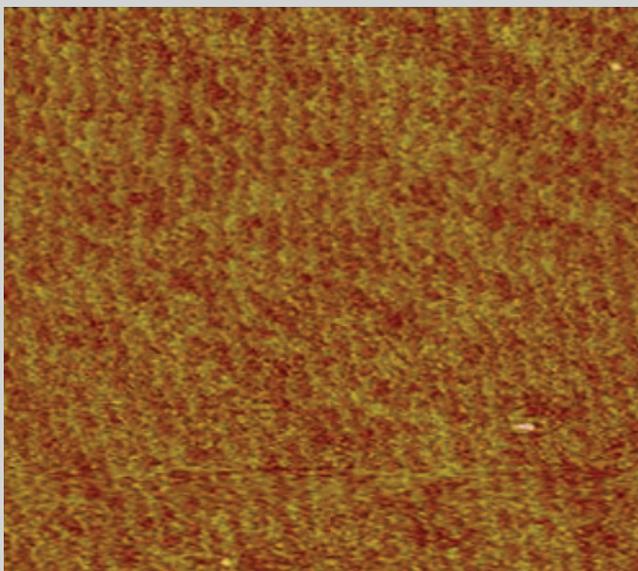
Two-Dimensional Electron Gas Physics in Oxide Heterostructures

Project No. : 4704-1

May 2012 - April 2015

Background

Conducting quasi two-dimensional electron gas (q2-DEG) is formed at the interface between the two insulating, dielectric perovskites, LaAlO₃ and SrTiO₃. Despite numerous investigations, there are still a lot of open questions. The pioneer work of Okamoto et al introducing the concept of "electronic surface reconstruction" to explain the origin of the free charges at the interface is still under debate, and their prediction of a rich phase diagram for ultra-thin LaTiO₃ layers on SrTiO₃. Related to more general context is of making new devices and functions with oxides heterostructures, the goal of this project is to make and study epitaxial oxides heterostructures of pure and magnetic impurity doped LaTiO₃/SrTiO₃ and LaAlO₃/SrTiO₃ systems, where various kind of phenomena like superconductivity, ferromagnetism etc has been discovered.



Objectives

The original aim is to study the physics of the two dimensional electron gas which takes place at the LaTiO₃/SrTiO₃ interface with three main objectives:

- Phase diagram of the superconducting 2DEG in LaTiO₃/SrTiO₃ interfaces
- Electronic correlations in LaTiO₃/SrTiO₃ based heterostructures.
- Doping LaTiO₃/SrTiO₃ structures with Mn or Co.

Principal Collaborators



Anjana Dogra
National Physical Laboratory
New Delhi



Jérôme Lesueur
Laboratoire de Physique et d'Etude
des Matériaux (LPEM), Paris

Rotating and Curved Boundary Layer Instabilities

Project No. : 4704-3

Mar. 2013 - Feb. 2016

Background

Shear flows display a wide range of instabilities and undergo transition to turbulence by vastly different routes. The dynamics of wall-bounded shear flows determines global flow quantities of such friction coefficients and heat transfer rates. In many practical configurations of interest, fluid flows around objects that are curved and rotating. Curvature and rotation both have a major role in stability and transition to turbulence, but the combination has not been studied very much. The combination is likely to display different behaviour from merely the sum of its parts. The current project is therefore aimed at completely understanding the fundamental dynamics of a geometrically simple prototype of such flows. By bringing together the expertise of the two principal collaborators, linear and nonlinear analyses will be carried out so as to completely characterise the complex three-dimensional dynamics leading to turbulence in this context.

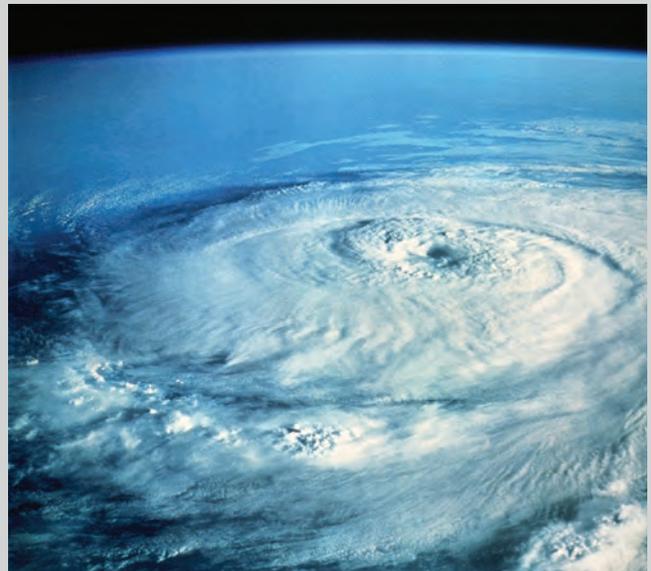
Objectives

Instabilities in wall-bounded shear flows depend qualitatively and sensitively on the details of the geometry and external forcing. An understanding of this for each flow of physical relevance is thus very important, and forms a significant area of present-day research in this area. The present project is aimed at studying one such shear flow, where two features which may be expected to co-exist, namely a curvature of the wall and a rotation of the system or parts of the system, are studied together. The global performance (viscous dissipation, transition to turbulence, thermal transfer rates, noise levels...) in the boundary layer closely depends on the near-wall flow structures. Innovative designs and operating conditions thus require a better understanding of the near-wall dynamics.

The flow selected for study is the geometrically simple but technologically relevant configuration of flow along a rotating cylinder. Extensions of this 'canonical' flow to configurations encountered in technological applications will be planned at a later stage.

The proposed research is a blend of theoretical analyses and numerical simulations, in close interaction. Objectives of the project include:

- computation of the unperturbed flow fields;
- linear stability analysis of these flows;
- derivation of fully nonlinear wavetrains;



- secondary stability analysis of these finite-amplitude solutions;
- characterization of the fully developed global flow dynamics.

Principal Collaborators



Rama Govindaraj

TIFR Centre for Interdisciplinary Sciences
Hyderabad



Benoit Pier

Laboratoire de mécanique des
fluides et d'acoustique, Ecully

Reversals of a Large Scale Field on a Turbulent Background

Project No. : 4904-1

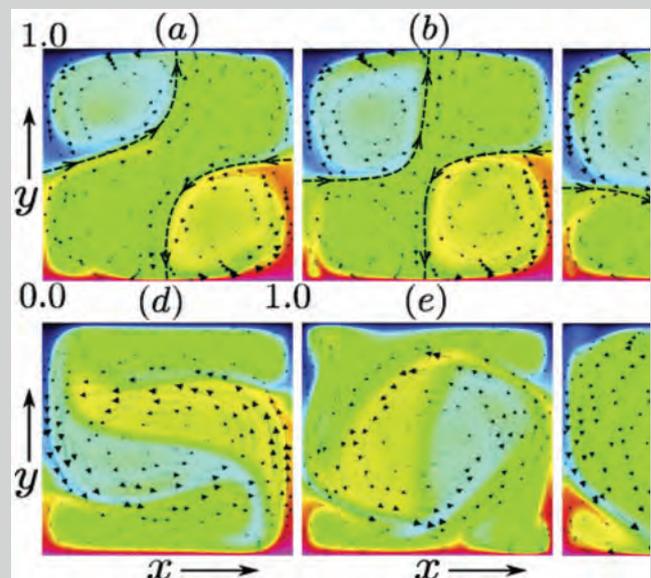
Mar. 2013 - Feb. 2016

Background

According to geophysical observations, the magnetic field of the Earth is known to have reversed with random time interval. The solar magnetic field however reverses approximately every eleven years. A recent laboratory experiment using a von Karman flow of liquid sodium (VKS experiment) exhibits similar features for different parameter regimes. The above field reversals bear certain similarity with the reversals of the large scale velocity field in turbulent convection, as well as in Kolmogorov flows. In this project we study the physics of flow reversals using numerical simulations and experiments. We explore quasi two-dimensional turbulence with Kolmogorov-like forcing and study the behaviour of large-scale modes of the flow. The above analysis and related low-dimensional models would provide us important clues underlying flow reversals.

Objectives

The recent experimental observations of magnetic fields generated by turbulent flow have prompted new interest in the studies of magneto hydrodynamic (MHD) flows in liquid metals and plasmas. Such flows raise both fundamental problems, as well as find applications in geophysics, astrophysics, and various industrial processes. In this project, we will use numerical simulations and theoretical models to understand experimental results as well as observations related to a striking phenomenon: the dynamics of large scale fields on a turbulent background. This includes random reversals of the field polarity, as observed for the magnetic fields of the Earth or the Sun and for large-scale zonal wind in the Earth's atmosphere. We will determine why a small number of large-scale modes accurately capture the dynamics of the reversals although these systems are strongly turbulent. We will study how reversals are triggered and determine their correlation with the fluctuations of the energy flux that drives the large scale modes.



Flow profile during a reversal in turbulent convection. Chandra and Verma (Phys. Rev. Lett. 2013) show a vortex reconnection [see (a,b)] during the reversal. The Fourier mode $(1, 1)$ dominates the flow before and after the reversal, while $(2, 2)$ mode plays a dominant role during the reversal.

Principal Collaborators



Mahendra K. Verma
Indian Institute of Technology-Kanpur
Kanpur



Stephan Fauve
Ecole Normale Supérieure
Paris

Study of Neural Development in hiPS Models of Microcephaly

Project No. : 4903-2

Mar. 2013 - Feb. 2016

Background

Human Primary Microcephaly is an autosomal recessive genetic disorder manifested in a reduction of cortical outgrowth causing congenital microcephaly and mental retardation. Study of neural development in vertebrates and notably to use mouse and human embryonic stem (ES) cells to understand key steps of neuronal differentiation and model human diseases is important, as the project aims to do. We have been able to describe the contribution of extrinsic and intrinsic factors on the differentiation of ES cells into mature granule neurons, a means to better control the fate of neural progenitors in vitro. The project now aims to differentiate human ES cells into cortical neurons and use dermal fibroblasts from patients carrying mutations in genes involved in brain growth to model human microcephaly, using the hiPS reprogramming strategy.



Sagittal section from an adult mouse cerebellum labelled in green with the neuron-specific beta-tubulin antibody and showing successfully engrafted cerebellar progenitors labelled with red tracer (DsRED). This picture has been selected to appear as the cover page of the April issue of the STEM CELLS journal (AlphaMed press)

Objectives

- To generate human induced pluripotent stem (hiPS) cell lines from normal human fibroblasts and patients fibroblasts mutated in MCPH1.
- To differentiate normal and patient hiPS cell lines into neural progenitors and differentiated cortical neurons.
- To study cell cycle and proliferation of neural progenitors from normal and patient hiPS lines.
- To study cortical neurons specification (layer markers and connexions).
- To study mode of cell division and centrosome composition in neuronal progenitors derived from hiPS cell lines.

Principal Collaborators



Shyamala Mani
Indian Institute of Science
Bangalore



Pierre Gressens
INSERM U 676
Paris

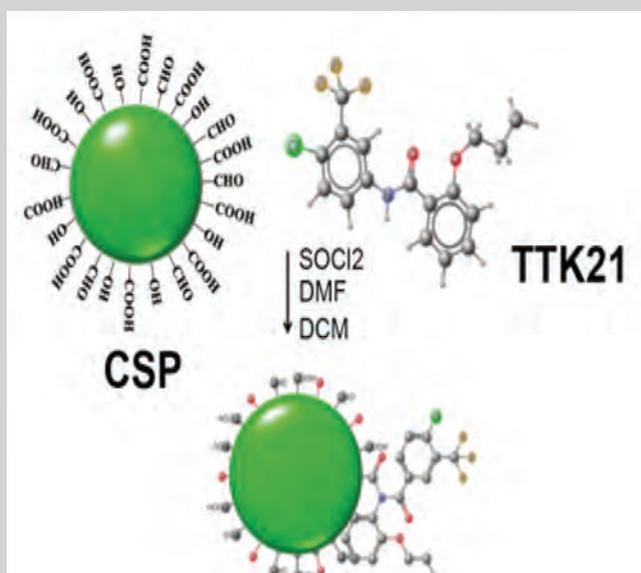
Mechanisms of Lysine Acetyltransferase (Kat/Hat) Activation by Small Molecule Activators and Use Thereof in Memory

Project No. : 4803-3

Jan. 2013 - Dec. 2015

Background

There is credible evidence that chromatin modifying machinery has a role in CNS disorders. The CREB-Binding Protein (CBP) plays a crucial role in neuronal survival, as well as in memory formation. Previous work has shown that CBP function is altered in neurodegenerative diseases. As it becomes clear that chromatin is dynamic and is subjected to extensive experience- and age-associated remodeling, it was quickly realized that a pharmacological tool, able to modulate histone acetylation, could represent a good therapeutic option. So far inhibitors of histone deacetylase as enzymes have been used, thanks to cancer research. However, HAT activation based therapeutic strategy, and specifically that of CBP, could prove efficient to treat memory disorders found in neurodegenerative diseases.



Synthesis of Carbon nanosphere conjugated TTK21 (CSP-TTK21). The HAT activator TTK21 is derived from salicylic acid. As is, it is poorly permeable to living cells, but when covalently coupled to a glucose-derived carbon nanosphere (CSP) it becomes permeable to mammalian cell membranes (including nuclear membranes), crosses the blood brain barrier and induces histone hyperacetylation in the brain.

Objectives

Reversible acetylation of histone and presumably nonhistone proteins play pivotal role in the normal function of brain. Alteration of histone acetylation thus have causal relationship to neurodegenerative diseases. In the present project we wish to use small molecule activator(s) of histone acetyltransferase conjugated with a glucose derived cell permeable self fluorescent carbon nanosphere as a tool to induce histone hyperacetylation in mice brain. We wish to elucidate the mechanisms of induction of the acetylation and its downstream effect gene expression in the neural tissue. The role of histone acetylation in development of newly-generated neurons and in spatial memory formation will be studied in details. Special emphasis will also be given to understand the therapeutic potential of HAT activator(s) in the treatment of neurodegenerative disorders especially, Alzheimer's disease (AD), using a transgenic mouse model of the disease.

Principal Collaborators



Tapas Kumar Kundu
Jawaharlal Nehru Centre for Advanced
Scientific Research, Bangalore



Anne-Laurence Boutillier
Laboratoire d'Imagerie et de
Neurosciences Cognitives, France

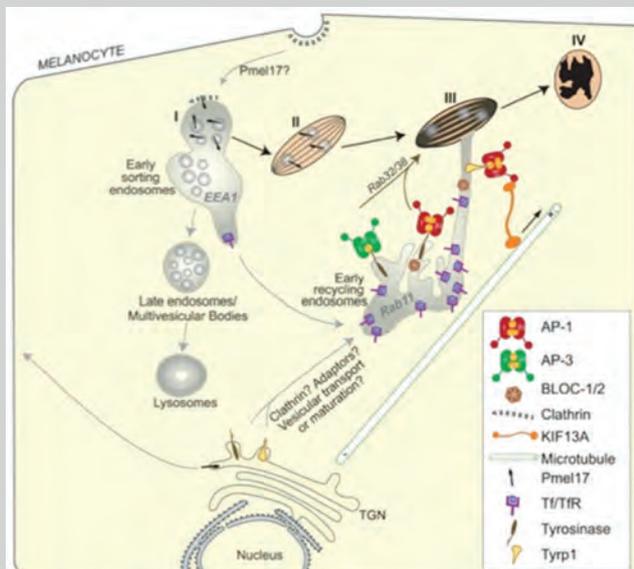
Control of Melanosome Biogenesis by Small GTPases

Project No. : 4903-1

Mar. 2013 - Feb. 2016

Background

Melanosomes are cell type-specific organelles within retinal pigment epithelial cells and epidermal melanocytes in which melanin pigments are synthesized and stored. They are "lysosome-related organelles" but, as first shown in our group, they coexist with late endosomes and lysosomes. Over the past years we and others have performed studies to decorticate several aspects of early and late melanogenesis. Stage I premelanosomes correspond to early endosomal vacuoles that serve as intermediates for cargo bound both for lysosomes and melanosomes at different stages. Using High Pressure Freezing (HPF) and electron tomography we have shown that premelanosome fibrils form in association with intraluminal endosomal membranes and that fibrils assemble into fibrillar sheets upon which melanin deposits. Melanin synthesis during late melanogenesis requires delivery of melanogenic enzymes from yet still distinct endosomal domains.



Proposed model for melanosome biogenesis.

Objectives

- Investigate the role of small GTPases Rab in endosomal trafficking in melanocytes and in the production of functional melanosomes. Endosomes are required intermediates in trafficking to the melanosome. We aim to unravel the mechanisms involved in maintenance and specialization of the endosomal domains and in the establishment of the dialogue between endosomes and melanosomes. RabGTPases are essential regulators to create and maintain membrane domains. We will test the function of Rab22A and Rab22B (Rab31) that interact with KIF13A (our studies) and Rab4, another endosomal Rab (that does not interact directly with KIF13A) but proposed, in previous studies, to regulate pigmentation (Ganesan, H.K. et al. PLoS Gen., 2008).
- Investigate the function of GTPases of the Arl family in the formation of melanosomes. Arl4A has been proposed to regulate the pigmentation (Ganesan, H.K. et al., PLoS Gen., 2008). We will test how it is involved on melanogenesis.
- Investigate how trafficking in melanocytes controlled by these proteins and melanocyte biogenesis/ transfer is influenced by interactions with keratinocytes. Within the epidermal melanin unit, melanocytes are in direct contact with keratinocytes who directly influence melanogenesis through the secretion of several factors. We aim to address using co-culture systems, the behaviour of endosomes in melanocytes and consequences on melanogenesis.

Principal Collaborators



Subba Rao Gangi Setty
Indian Institute of Science
Bangalore



Graca Raposo
Institut Curie
Paris

Anti-factor H Autoantibody Associated Hemolytic Uremic Syndrome

Project No. : 4703-1

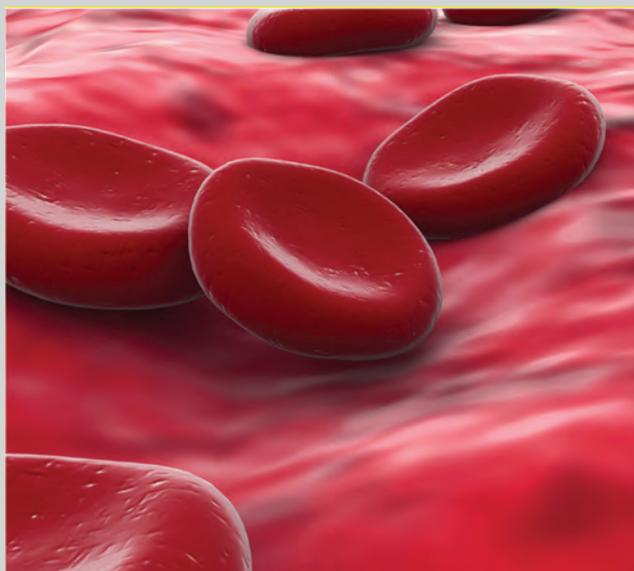
Sept. 2012 - Aug. 2015

Background

Hemolytic Uremic Syndrome (HUS) is a condition characterized by the triad of acute renal failure, hemolytic anemia and thrombocytopenia. In 2005, a new form of atypical HUS associated with development of auto-antibodies directed against factor H, the main plasmatic regulatory protein of the complement alternative pathway was identified. Its incidence might be related to specific genetic background and/or environmental factors as a large proportion of patients show deletion of CFHR1 and CFHR3 genes. Data suggests that complete absence of CFHR1 is frequently associated with anti-FH autoantibody associated HUS, something that is still unexplained. This project focuses on this problem and the proposed hypothesis regarding pathogenesis of HUS.

Objectives

- Validate anti-factor H antibody assay in India and establish a normal threshold
- Obtain genetic insights into the mechanisms of immunization against factor H by: (i) performing MHC haplotype determination of all patients; (ii) examine deficiency of CFHR1 in patients, relatives and controls
- Screen for mutations in genes implicated in susceptibility to HUS
- Determine microbial triggers associated with the disease, by (i) collection of clinical and biological data, (ii) parasitological and bacterial examination of stools, and screening for fecal shigatoxin, (iii) serological identity of infections
- Study anti-factor H cellular immune response, through constitution of a peripheral blood mononuclear cell and plasma samples bank of patients with HUS and anti-FH IgG antibodies



Principal Collaborators



Arvind Bagga
All India Institute of Medical Sciences
New Delhi



Marie-Agnès Dragon-Durey
INSERM UMRS 82, Cordeliers
Research Center, Paris

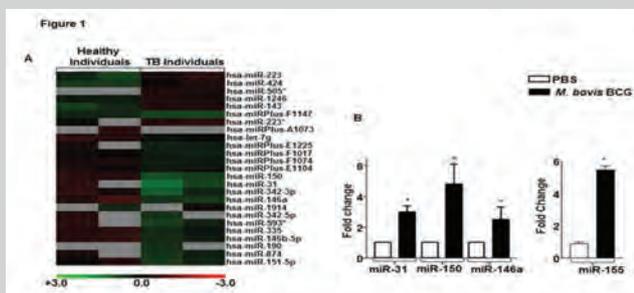
Molecular Mechanisms of Immune Evasion by *M. Tuberculosis*

Project No. : 4803-1

Oct. 2012 - Sept. 2015

Background

Mycobacterium tuberculosis, an etiologic agent of tuberculosis, is a major cause of morbidity and mortality worldwide. The interaction of *M. tuberculosis* and immune system is of dynamic process and implicates several cellular and molecular partners. The central theme of our proposal concerns molecular dissection of immune evasion mechanisms of *M. tuberculosis* and designing tools for the conception of novel vaccines. Overall, our proposal addresses both basic and medical sciences and are expected to deliver preventive and therapeutic tools to combat tuberculosis.



TB patients have distinct microRNA signature. (A) Genome-wide miRNA microarray profiling was done in PBMCs from TB patients and healthy individuals. A heat map of the profile in TB patients (n=4) compared with that in healthy individuals (n=4) is shown.

Objectives

- To study differential microRNA (miRNA) profile of tuberculosis patients and to correlate its relevance to disease progression.
- To explore the role of innate pattern recognition receptors (PRRs) and intracellular signaling dynamics in the modulation of miRNA expression by virulent antigens of *M. tuberculosis*.
- To decipher the role of candidate miRNA in the pathogenesis/protection against tuberculosis *in vivo*.
- To dissect molecular immunoregulatory function of Haemoxygenase-1 (HO-1) and CD4+CD25+Foxp3+ regulatory T cells (Tregs), the two major regulators of immune response to an antigen/pathogen, in the pathogenesis of tuberculosis.
- To study the impact of Tregs on miRNA expression pattern and HO-1-mediated immune regulation towards *M. tuberculosis* and to conceive novel vaccine and adjuvant candidate.

Principal Collaborators



K N Balaji
Indian Institute of Science
Bangalore



Jagadeesh Bayry
INSERM UMR S 872, Institut National
de la Santé, Paris

Analytic Aspects of Modular Forms

Project No. : 4601-2

Aug. 2012 - Jul. 2015

Background

The area of study of the proposed project is number theory, one of the central branches of Pure Mathematics. Modular forms have been the subject of intense investigations in analysis, arithmetic, geometry, topology etc. The goal of the project is to focus on the analytic aspects of these developments. The topics to be investigated are related to central questions and themes in number theory such as the Langlands programme, the generalised Riemann hypothesis and the Birch Swinnerton Dyer conjecture.

Objectives

As stated below the central theme of the project is number theory. Here a major challenge is the understanding of automorphic L functions. In this project we have contributed to this theme in the case of a specific automorphic L function. This is the spinor zeta function of a SiegelHecke eigencusp form of degree 2. We obtained quantitative results on sign changes of the coefficients of the spinor zeta function in short intervals.



Principal Collaborators



J. Sengupta

Tata Institute of Fundamental Research
Mumbai



Jie Wu

University Henri Poincare
Vandœuvre Nancy

Nutrient Sensing in Plants

Project No. : 4609-1

Mar. 2013 - Feb. 2016

Background

Understanding the interaction between Na^+ and nitrate have been chosen for several reasons. First they are of extreme importance at both a cognitive level and at the agricultural level, because as stated above, Na^+ is the #1 cause of salinity in watered soil and NO_3^- is the main Nitrogen (N) source for the vast majority of plants and for crops. Second, this couple ($\text{NO}_3^-/\text{Na}^+$) is known to interact at the physiological level (Zolla et al., 2010).

We will develop a project integrating 2 approaches: i) candidate gene studies as well as ii) a machine learning approach using the power of systems biology to discover new regulatory signalling network. Since roots are the unique interface between the plant and both studied ions (NO_3^- and Na^+), we will pay special attention to root responses.



Objectives

Food production should increase by 40% by 2050 to cope with the growing population. Two restrictions of increasing production yield have been studied: (i) the presence of salt in at least 20% of irrigated land worldwide, which impairs crop production and (ii) the effect of nitrate on both plant growth and development. The basis of this project is supported by the interaction between nutrition and stress tolerance and specifically the role of nitrate in such mechanisms. The signal transduction pathways involving the CIPK, a family of kinase interacting with a calcium sensor (CBLs) will be studied in *Arabidopsis*.

The aim of the presented project is to understand the mechanisms by which plants sense the concentration of sodium and nitrate in the media and integrate downstream signalling pathway to adapt their developmental processes. We will have special attention to root developmental responses.

Principal Collaborators



Narendra Tuteja

International Centre for Genetic Engineering & Biotechnology, New Delhi



Benoit Lacombe

Biochimie et Physiologie Moléculaire des Plantes Montpellier

Gene Resources from Polluted Soils

Project No. : 4709-1

Sept. 2012 - Aug. 2015

Background

Soil is a reservoir of biodiversity and contains large number of yet to be discovered microorganisms expressing new unidentified genes. This gene reservoir can yield new eukaryotic genes implicated in heavy metal resistance or in organic matter degradation by using "functional meta-transcriptomics" approach, as we do in this project.

Similar but distinct to metagenomics, this approach is a recent culture-independent method in microbial ecology which gives a direct and simultaneous access to the genes expressed by all the eukaryotic microbial species, cultivable or not, living in a common environment. It also has a strong potential in environmental biotechnology to discover novel genes of interest.



Sampling in PierreLaye site, France

Objectives

The objectives of the project are to explore, at the gene level, the functional biodiversity of soil eukaryotic microbial communities living in stressful polluted soil environments. This will allow us to characterize genes implicated in adaptation to these stressful conditions such as: heavy metal resistance mechanisms but also genes implicated in basic processes such as organic matter degradation under stressful conditions.

Principal Collaborators



M. Sudhakara Reddy
Thapar University
Patiala



Laurence Fraissinet-Tachet
Université Lyon 1
FRANCE

Arithmetic Circuits Computing Polynomials

Project No. : 4702-1

May 2012 - April 2015

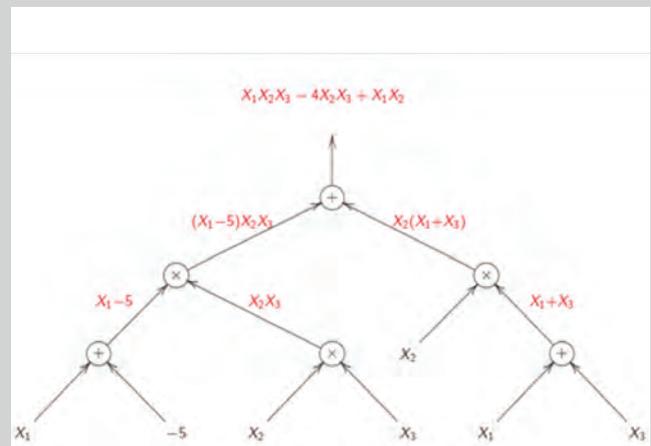
Background

In the field of "computational complexity" the most important issue is to show that some given problem is difficult. This information, apart from its theoretical value, is useful for someone interested in practical applications, because once a problem is shown to be "hard" in some sense then research can turn towards alternative strategies. Two of the three objectives of this project are clearly linked to this issue, as proving lower bounds or establishing completeness are two ways to show that a problem is "hard" in some specific sense. The third objective is the establishment of a framework for showing hardness result (notions of reduction and completeness) in a class of questions which have not been very well studied yet (enumeration) but which have practical importance.

Objectives

The aim of this project is to better understand arithmetic circuit computations of polynomials and related counting and enumeration complexity questions, organised along three main axes :

- Proving lower bounds for restricted models of computations (multilinear branching programs), with a particular focus on the computation of the determinant.
- Finding new natural complete polynomials for the classes in the general theory defined by Valiant, in particular for the class of feasible computations VP, and understanding the role of the characteristic in results of VNP completeness.
- Defining or refining notions of reduction, completeness, parallel complexity, space bounded complexity for enumeration and studying enumeration questions related to polynomials computed by circuits.



Algebraic computation models: Formulas

Principal Collaborators

**Meena Mahajan**The Institute of Mathematical Sciences
Chennai**Guillaume Malod**Université Paris Diderot - Paris
Paris

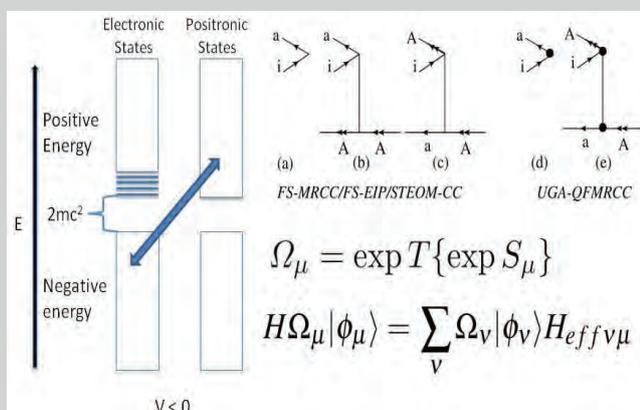
Correlated Studies of Response Properties of Open-Shell Molecules in the Relativistic Framework

Project No. : 4705-3

May 2012 - April 2015

Background

The overall objective is to develop computational tools for the study of reactivity and properties of molecules containing heavy elements. Such complexes often display complicated electronic structure. Actinides in particular have several features such as numerous energetically close orbitals and significant relativistic effects making them a challenge for theoretical chemists. We propose to address these challenges by consolidated and successive developments of high level of correlation theory combined with relativistic corrections.



Relativistic corrections for spin-free computation of Core Ionization and Excitation Energy

Objectives

The overall objective of project 4705-3 is to develop computational tools for the study of reactivity and properties of molecules containing heavy elements. More precisely, we aim at developing state of the art electron correlation methods (coupled-cluster) providing highly accurate results for molecules displaying relativistic effects, on par with what has been achieved for light elements. It is essential to bring together the complementary expertise of the Indian side in formulating the necessary high-level multi-reference electron correlation theories and that of the French side in implementing them in a highly efficient manner amenable to application in medium-large molecules of spectroscopic and chemical interest.

Principal Collaborators



Ankan Paul
Indian Association for the Cultivation
of Sciences, Kolkata



Trond Saue
Université de Toulouse 3
Toulouse

Supra-Molecular Approach to Composite Materials for Advanced Technologies

Project No. : 4805-1

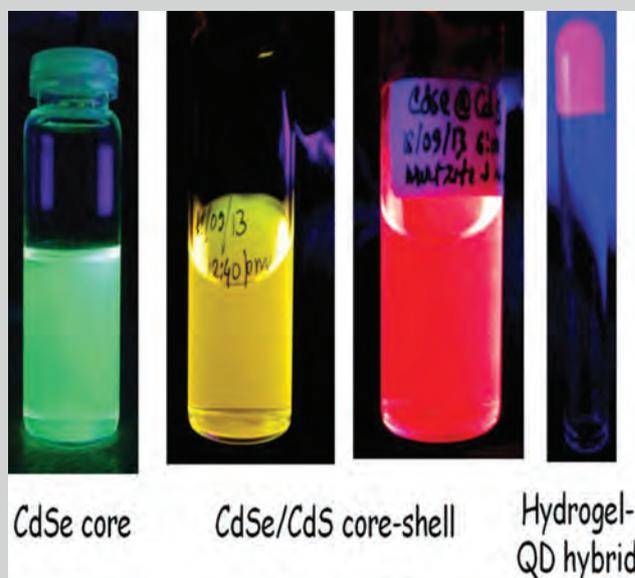
Jan. 2013 - Dec. 2015

Background

Materials with functionality controlled by molecular composition and order can revolutionise soft solvated materials or optical nanostructured materials. Bottom-up approaches using self-assembly are the most appropriate routes for the synthesis of gel-phase soft materials, copying the advantages of biological systems but exploiting synthetic accessibility and robustness. Nano- and micro-structures controlled in size, shape, order, stiffness, optical stability and tunability are challenges that can individually be overcome but seldom achieved simultaneously. We will combine the 'best of both worlds' to design and develop original molecular systems that induce a synergy between organic and inorganic building blocks. We expect developing functional materials with novel emergent properties for high-tech applications, for example in photonics and opto-electronics.

Objectives

Composite and hybrid materials result from two worlds with complementary properties. The combination of organic and inorganic components, or two different families of molecules, is a challenge that is addressed using supramolecular interactions. Novel gelators, chelating and bridging ligands are specifically designed for intimate intermixing and structuring into gels of organic self-assembled nanofibers, inorganic nanoparticles and/or lanthanide salts. Besides the synthetic effort performed both at the IISc-Bangalore and at the ISM-Bordeaux, original solvent processing techniques using supercritical fluids are developed at the ICMCB-Bordeaux to form desolvated aerogels and nanoparticles. The interaction of the material with light, revealed at the nanoscale by confocal fluorescence microscopy (ISM), serves as a handle for the understanding of supramolecular interactions and could result in potential applications in photonics.



Luminescent nanoparticle solutions and a composite gel in an inverted test tube

Principal Collaborators



Uday Maitra

Indian Institute of Science
Bangalore



André Del Guerso

Institut des Sciences Moléculaires Talence
University Bordeaux, Bordeaux

Deep Structure of the Indian Continent

Project No. : 4707-1

May 2012 - April 2015

Background

Thickness of the lithosphere has a prominent role in shielding the mantle attrition processes vital for the stability factor of the Precambrian crust making its precise determination important. Additionally, imprints of major tectonic events are manifested as alterations in deep lithospheric architecture. Present day configuration of the Indian tectonic plate is a consequence of its breakup from the Gondwana super continent. Paleomagnetic data demonstrates that the Indian continent moved northwards at exceptionally high speeds (explained by an unusually thin Indian lithosphere). Thermo-barometric estimates in Central India suggest an approximately 175 km thick lithosphere. An analysis of heat flow data and P-T estimates on mantle xenoliths indicate a thick lithosphere beneath south India. To solve this apparent contradiction, we investigate the lithospheric and as the nospheric structure underneath the Indian cratons and the Indian plate and trace its evolution through time.

Objectives

This proposal is primarily aimed at investigating the causative factors that determine the unique nature of the Indian continent, with emphasis on its origin, deformational history, interactions with Asia and its tectonic evolution. The specific objectives are:

- To assemble teleseismic data registered at all the Indian broadband seismological stations.
- To constrain the thermal structure of the Indian shield lithosphere.
- To characterize the seismic structure and deformation through application of recent methodologies (P- and S- receiver functions, SKS splitting).
- To obtain the crustal structure at high resolution using ambient noise
- To obtain a 3-D anisotropic, heterogeneous mantle model of the Indian continent and surrounding oceans.
- To map lateral variations in the lithosphere-asthenosphere boundary.
- To calculate synthetic seismograms at the regional scale by spectral element method
- To derive a consistent evolutionary model of the Indian continent by synthesizing the seismic results and constraints from heat flux, petrological and paleomagnetic data.

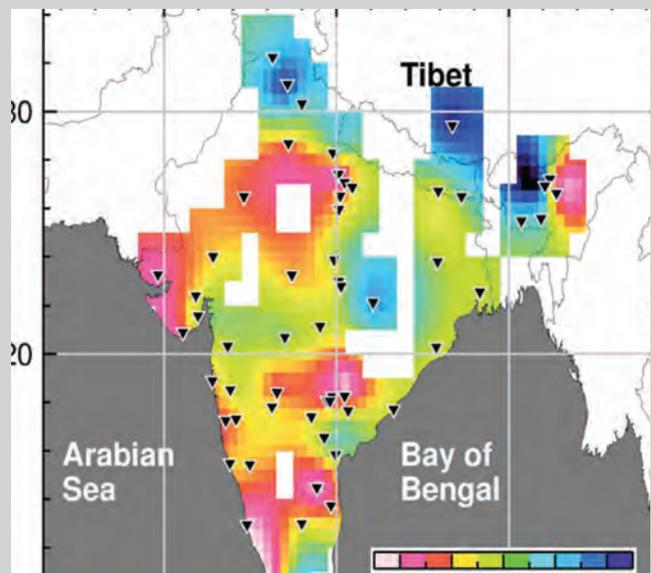


Image of the Lithosphere Asthenosphere Boundary (LAB) beneath India inferred by S receiver function data. Inverted triangles are the locations of seismic stations whose data have been used in the present study. The image has been constructed where we have sufficient number of data. The image clearly reveals the undulating LAB topography.

Principal Collaborators



M. Ravi Kumar
National Geophysical Research Institute
Hyderabad



Jean-Paul Montagner
Institut de Physique du Globe
France

High Anisotropy Molecular Magnets Synthesis & Modelling

Project No. : 4808-1

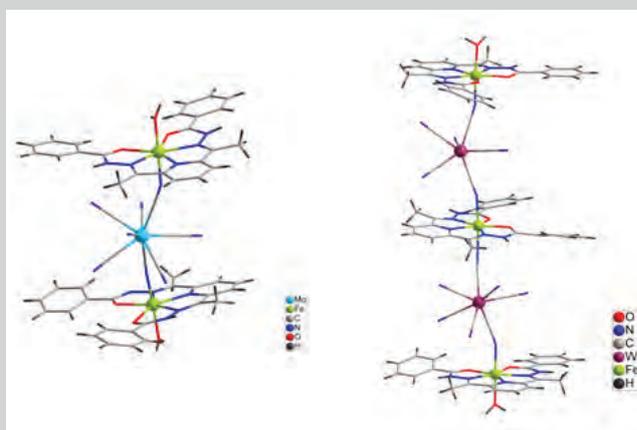
Jan. 2013 - Dec. 2015

Background

This proposal is an off-shoot of the previous IFCPAR proposal 3108-3 that we had earlier. The motivation for the earlier proposal was our collaboration with late Professor Olivier Kahn who first initiated the project on molecular magnetism between India with Dr. J.V. Yakhmi and myself as his Indian collaborators. During this period, the Indian collaborator of 4808-1 had interacted with Professor Sutter scientifically. After the untimely demise of Professor Kahn, Sutter moved to Toulouse and our collaboration continued since it was complimentary. Dr. Sutter was synthesizing molecular magnets and the theoretical inputs for understanding their behaviour and for tweaking the magnetic properties was provided by my group. Since, this was quite successful, we have been having continued collaborations and under the framework of IFCPAR, we have formalized it again, facilitating close personal interactions between the two groups which is highly required for this to be fruitful.

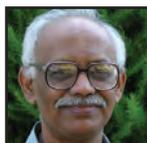
Objectives

The first year of the project has been devoted to the synthesis of Fe(II) compounds in heptacoordinated surrounding. These derivatives are based on a pentadentate ligand (Fig. 1) that ensures pentagonal bipyramid geometry around the transition metal ion. Such species are anticipated to exhibit significant magnetic anisotropy. In figure 1, we show the structure and magnetic properties for $[\text{FeLN3O2PhCl}_2]$. This molecular compound was found to exhibit slow relaxation of its magnetization as shown by the frequency dependent $\chi M''$ susceptibility behavior. Analysis of this behavior yielded an energy barrier Δ/k_B of 14 K and a $t_0 = 2.65 \cdot 10^{-6}$ s. Work is in progress to quantify the anisotropy, i.e. the zero field splitting parameter, for such an Fe(II) center. Theoretical modeling of SCMs using anisotropic magnetic centers is being undertaken by the Indian collaborator.



Molecular structures for $[\{\text{FeL}^{\text{N3O2Ph}}\}_2\{\text{Mo}(\text{CN})_8\}]$ and $[\{\text{FeL}^{\text{N3O2Ph}}\}_3\{\text{W}(\text{CN})_8\}_2]$

Principal Collaborators



S. Ramasesha
Indian Institute of Science
Bangalore



Jean-Pascal Sutter
Laboratoire de Chimie de
Toulouse, Toulouse

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New Projects
Applied Sciences

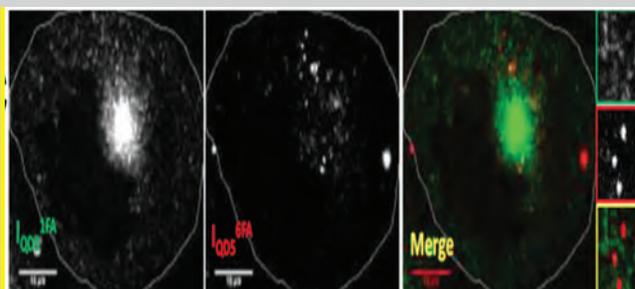
DNA Encapsulated Quantum Dots for Bioimaging

Project No. : 4803-2

Feb. 2013 - Jan. 2016

Background

In order to understand biological systems they need to be visualized alive, and in real-time. To this end, fluorescence microscopy has been crucial in the visualization of sub-cellular and cellular architectures that frequently are smaller than the dimensions perceivable by simple light microscopy. Many cellular processes need to be observed on long time scales, and the use of organic fluorophores proves limiting as they are subject to bleaching and blinking. Long duration imaging is best achievable by quantum dots, however, their ability to be used in living systems requires bio-compatible surface chemistry and molecular exactness for efficient targeting. We propose to interface quantum dots with DNA surface chemistry to achieve long duration bio-imaging in both cells and living organisms.



Images of IA2.2 cells marked by molecularly identical quantum dots functionalised with DNA that are carrying biological tags in different stoichiometries ($n=1$ in green and $n=6$ in red). Scale bar 10 microns.

Objectives

The objective of the proposal is to create a new class of DNA-quantum dot complexes where non-blinking quantum dots are interfaced to DNA surface chemistry. These easily bio-functionalizable QDs will be used for cutting edge bio-imaging applications. Thus first non-blinking quantum dots will be realized. Then they will be interfaced with DNA through optimal bioconjugation routes using appropriate chemistry. These molecularly precise DNA-quantum dots will then be functionalized with biological tags and used for targeting in-vivo long duration bioimaging.

Principal Collaborators



Yamuna Krishnan

National Centre for Biological Sciences
Bangalore



Benoit Dubertret

Labortoire de physique d'Etude
des Matériaux, Paris

Novel Nanotechnological Approaches for Treatment of Leishmaniasis Using 2-Propylquinoline

Project No. : 4803-4

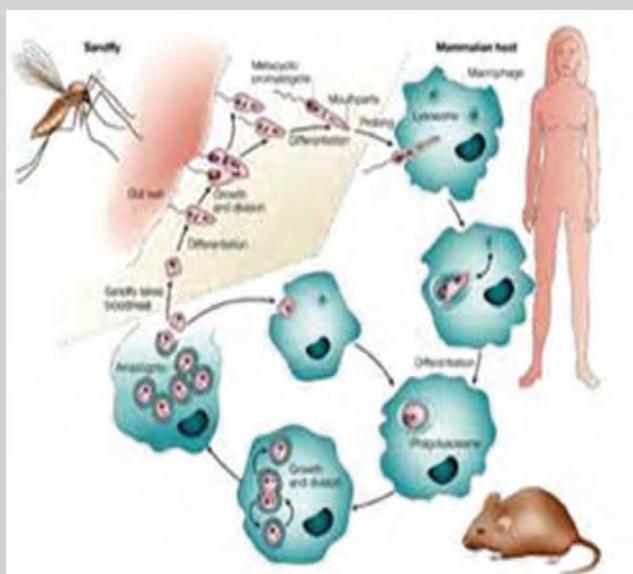
Jan. 2013 - Dec. 2015

Background

Visceral leishmaniasis is a parasitic disease that affects humans in India and South Europe. Classical drugs are toxic and generate resistance. The chemical series of 2-substituted quinolines is in pre-clinical development for the treatment of visceral leishmaniasis. One molecule, propyl-2-quinoline (2-PQ), shows qualities which justify its further development. Although 2-PQ is active by the oral route, an intravenous formulation that could be used in cases of advanced disease is necessary. Therefore, we plan to develop several formulations that could be used to treat either visceral or disseminated leishmaniasis. Furthermore, in order to prevent drug resistance, we propose to combine 2-PQ with Amphotericin B (AmB), an important drug in the treatment of leishmaniasis. All these formulations will be low-cost and they will be studied for their stability, their ability to release the drugs, their bioavailability, their antileishmanial activity in vivo and their toxicity.

Objectives

This project aims to design novel nanoformulations of 2-propylquinoline (2-PQ), an emerging drug with potential for the treatment of leishmaniasis in humans. These formulations will allow this lipophilic drug to be administered intravenously in a safe and reliable manner, in order to treat both visceral and disseminated leishmaniasis. Furthermore, since in-vitro combination of 2-PQ and Amphotericin B (AmB) did not exhibit any antagonism in either promastigotes or intramacrophage amastigotes, we propose combining them in a formulation in an attempt to prevent the emergence of drug resistance.



Life cycle of *Leishmania* sp., the parasite responsible for leishmaniasis

Principal Collaborators



V. Kesavan

Indian Institute of Technology Madras
Chennai



Philippe Loiseau

Université Paris-Sud 11
Chatnay Malabry

Real-time Imaging Through Fog Over Long Distances (RITFOLD)

Project No. : 4604-4

Oct. 2012 - Sept. 2015

Background

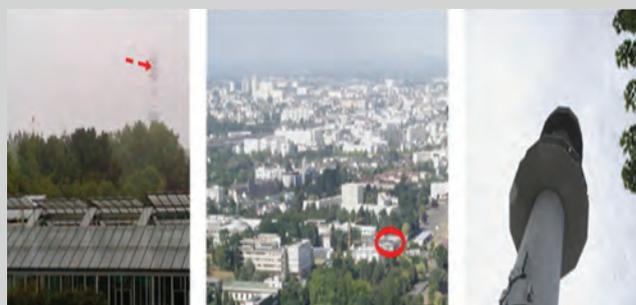
The problem of imaging through turbid media has elicited great interest in the optics community. This may be attributed to fundamental aspects of light propagation through diffusive media on the one hand, and the large potential for application for augmented-vision through diffusive atmosphere for navigation and transportation safety. Several techniques have been developed either using time-consuming image reconstruction strategies (inversion algorithms) or cost-prohibitive time-gating techniques which employ a pulsed light source and a time-gated ultra-fast camera to detect ballistic photons. Development of affordable and user friendly systems that could be implemented on small aircrafts, and introduced on small airports that are not equipped with radio-frequency Instrument Landing Systems.

Objectives

The objective of this research project is to develop a real-time, long-range imaging system providing visual assistance under low visibility conditions. Two imaging techniques will be explored, implemented, tested and optimized. Both are based on the detection of ballistic photons, i.e. the potentially few photons that have not (or marginally) been scattered by the diffusive medium.

The first approach is based on the use of polarised light, while the other technique involves a modulation technique, varying either the light polarisation state or its intensity. Novel modulation, synchronisation and sampling techniques will be used in an effort to provide real-time visual images over long distances of scattering media.

Among a variety of potential applications, we wish to examine the applicability of our techniques to the problem of aircraft landing under poor visibility. To this aim, extensive field experiments will be conducted to test these techniques under real atmospheric conditions.



(a) View of the TV tower from the laboratory in Rennes with light fog. The arrow indicates the expected location of the light emitter. (b) Tele-lens view of the laboratory (circled on the photograph) from the TV tower. Rennes city centre appears in the background. (c) View of the TV tower from the ground

Principal Collaborators



Hema Ramachandran
Raman Research Institute
Bangalore



Mehdi Alouini
Université de Rennes
Rennes

Multilingual Word spotting for Degraded Documents

Project No. : 4700-IT-1

May 2012 - April 2015

Background

In all countries there is significant number of scanned documents some of which are of historical importance. Most of them are with noisy background and broken foreground, handwritten, with graphics. For retrieval of relevant documents from this huge database and for their categorization, OCR are not usable. That is the reason why word spotting has received an increasing interest as it allows querying using image comparison without relying on any transcription/annotation. Even though some work on word spotting has been done, it remains a challenge owing to lingual diversity, degraded and multi-oriented text. The project is dedicated to printed modern and historical documents in main Indian languages like Bangla, Devnagari and Telugu, along with English and French.



Automatic writing mode detection

Significant knowledge products developed out of the project

- A generalized sequence matching approach based on Dynamic Time Warping algorithm and its variants has been designed to be highly configurable. In case of word spotting, it is configured to allow to skip elements in target lines at beginning/end and to skip local degradations.

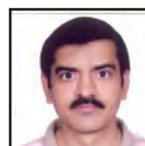
- A two-stage approach for word spotting in graphical documents has been designed. In the first stage, using rotation invariant features, isolated components corresponding to the query are recognized, producing initial spotting. Candidate regions for missing characters are then defined. Next, SIFT is applied to find those missing characters. Finally, spotting is validated using writing constraints.

Objectives

The objective of the project is to develop a word spotting method which is an interesting alternative to OCR for document indexation and retrieval of specific documents (degraded, historical, graphics, handwritten etc.). The main goals that need further research are to be able to:

- retrieve candidates not exactly similar to the query;
- search inside graphical parts with multi-oriented text;
- search with multilingual abilities;
- integrate user feedback to improve the ranking of the retrieval.

Principal Collaborators



Umapada Pal
Indian Statistical Institute
Kolkata



Nicolas Ragot
Université François Rabelais Tours
Tours

Development of Carbon Nanotube-Metal Hybrid Catalysts

Project No. : 4705-1

May 2012 - April 2015

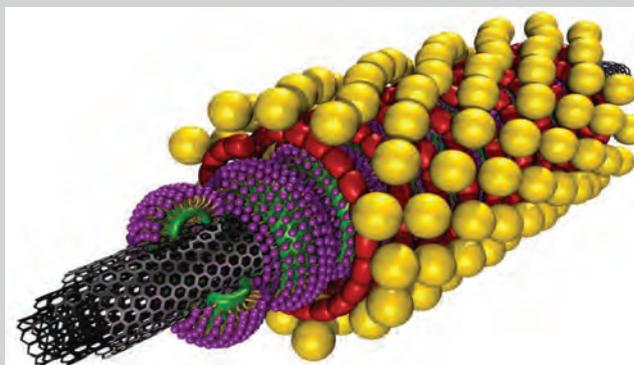
Background

Construction of highly efficient and recyclable heterogeneous catalysts applicable in a variety of organic transformations with high degree of selectivity is an important objective from academic and industrial perspectives. For these novel catalytic systems, carbon nanotubes (CNT) were chosen as support due to their low cost, stability, high surface area, inertness, tunable topography, and their ability to stabilize transient higher oxidation states of supported metals. Although CNT-supported noble metal catalysts have been employed in selected organic transformations, due to poor distribution of metal nanoparticles along the nanotube, their performance was unpredictable. It is possible to overcome this problem by uniformly embedding metal nanoparticles on functionalized nanorings around CNT. A catalyst on these lines can be robust and exhibit superior catalytic efficiencies in various organic reactions.

Objectives

Design and construction of metal catalysts supported on carbon nanotubes (CNT): Proposed to be carried out via self-assembly of surfactants that form supramolecular nanorings around the CNTs and anchoring of metal nanoparticles on the CNT-nanorings resulting in supramolecular structures that would function as highly efficient and recyclable heterogeneous catalysts in various organic reactions.

Nanohybrids as catalysts in organic transformations: The study of gold (Au), palladium (Pd) and platinum (Pt) embedded on the CNT-nanorings was proposed as these metals are known to be excellent catalysts for diverse organic reactions: For instance, (a) Au-CNT hybrids should be efficient for chemoselective hydrogenation, stereo- and regioselective cyclization and regioselective ring opening; (b) Pd-CNT hybrids for hydrogenation and various coupling reactions such as Heck, Suzuki, Sonogashira, and Tsuji-Trost; (c) Pt-CNT hybrids for sequential hydrogenation-oxidation, intramolecular Diels-Alder reaction-ring opening etc; (d) Mixed metal (e.g. Pd-Au) hybrids for alcohol oxidation and sequential reactions, e.g. coupling hydroamination.



Reductive amination of aldehydes

Principal Collaborators



Irishi N. N. Namboothiri
Indian Institute of Technology
Mumbai



Eric Doris
Gif-sur-Yvette, CEA
SACLAY

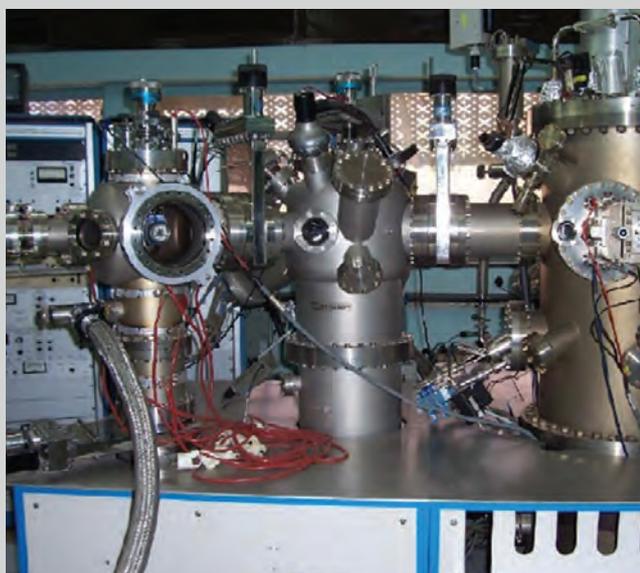
All Polymer Flexible Gas Sensors (Flexi-Sensors)

Project No. : 4705-2

May 2012 - April 2015

Background

Chemi-resistive sensors based on metal oxide semiconductors have been extensively studied for detection of various toxic gases because of their reasonably good sensitivity, stability, and convenience of operation. Nanostructured oxide-semiconductors though exhibit better sensitivity to different gases, their potential for the commercial sensors is hampered by high operating temperatures and lack of selectivity. Conducting polymers have also been used as gas sensors because their electrical conductivity changes when they come in the contact of analyte gases and have distinct advantages. However, similar to their inorganic counterparts they, too, suffer from lack of specificity, in addition to sluggish response and recovery. To overcome these problems, we worked on a new concept of organic/inorganic hybrid films so that the best of the two worlds namely, metal-oxides and polymers, could be utilized to obtain highly selective gas sensor.



Objectives

This project aims at providing simple and versatile strategies for the fabrication of new generation “all polymer flexible sensors”, which would not only be highly selective, room temperature operating, and low cost but also provide portability. Such all-polymer flexi-sensors would allow new applications, such as their integration to textiles, food-wraps and RFID tags. The flexible substrates will be biaxially oriented polyethylene terephthalate (BOPET) or polyimide sheets and the sensing layers will consist of inherently conductive polymers (ICPs) viz. polypyrrole (PPy). In this project, the key issues that will be investigated are: (i) covalent grafting of PPy layer on BOPET sheets for perfect adhesion; (ii) selectivity enhancement of target gases (i.e. H₂S, NH₃, Cl₂, CO, NO₂ etc.) by tuning the conductivity of sensing layer through embedding of nanostructures (e.g. ZnO, CNTs, metal nanoparticles, graphene etc.); and (iii) the long term stability enhancement of the flexi-sensors by modifying the nature of sensing layer to hydrophobic.

Knowledge Products Developed

- Reproducible modification of the flexible BOPET sheets by silane coupling agent through self assembly process for covalent grafting of polypyrrole-silver (PPy-Ag) nanocomposite films.
- Synthesis of PPy-Ag films on silanised BOPET sheets by UV induced polymerization.
- Room temperature operated flexi-sensors based on PPy-Ag films for parts per million (ppm) level detection of NH₃ and H₂S.
- Highly sensitive –selective NH₃chemi-resistive gas sensor based on flexible cobalt phthalocyanine films.

Principal Collaborators



D.K. Aswal
Bhabha Atomic Research
Center, Mumbai



M. M. Chehimi
Université Paris Diderot
Paris

Kinetics and Spectroscopy in Extreme Environments: Applications to Astrophysics and Astrochemistry

Project No. : 4905-1

March 2013 - Feb. 2016

Background

Radioastronomy has been extensively used for identifying the chemical species in stellar and interstellar environments. Infrared spectroscopic measurements are currently used to study the atmospheric composition of several transiting exoplanets characterized by surface temperatures comprised between 500 and 2000 K (hot Neptunes and hot Jupiters). The discovery of such exoplanets has revived questions about other habitable planets in our universe and also the question of life beyond earth. Fundamental understanding of interstellar dust on the one hand and diesel engine soot on the other hand, require extensive spectroscopic and kinetic data of relevant chemical species, that include radicals, molecules and weakly bound complexes. All the experimental and theoretical work planned in this project will be addressing these issues.



The Pulsed Nozzle Fourier Transform Microwave Spectrometer at the Inorganic and Physical Chemistry Department being used for observing the microwave spectrum of propargyl alcohol complexes.

Objectives

The objectives of the present project are centred on the acquisition of some fundamental data relevant to Astrophysics and Astrochemistry. During our previous project, following the numerous visits and discussions, a novel high temperature source was designed and developed. This could be used for spectroscopic and kinetics studies at high temperatures, typically in the range of 800 – 2000 K. It opened up new avenues that were not envisaged at the beginning of our project. In the current project, we would like to use this source for production of materials (simulating hot astrophysical atmospheres) and kinetics and spectroscopic studies at high temperatures. In parallel, the existing facilities at Rennes and Bangalore will be used to complement these experiments. In particular, shock tube studies on propargyl alcohol pyrolysis and combustion, C atom reactions with small hydrocarbons, FTMW investigations propargyl alcohol and its complexes will be carried out in Bangalore. Theoretical and modelling work will also be carried out in Bangalore to provide additional insights.

Principal Collaborators



Elangannan Arunan
Indian Institute of Science
Bangalore



Robert Georges
University of Rennes 1
Rennes

Controlling for Upscaling Uncertainty in Assessment of Forest Aboveground Biomass

Project No. : 4509- 1

Jan.2013 - Dec. 2015

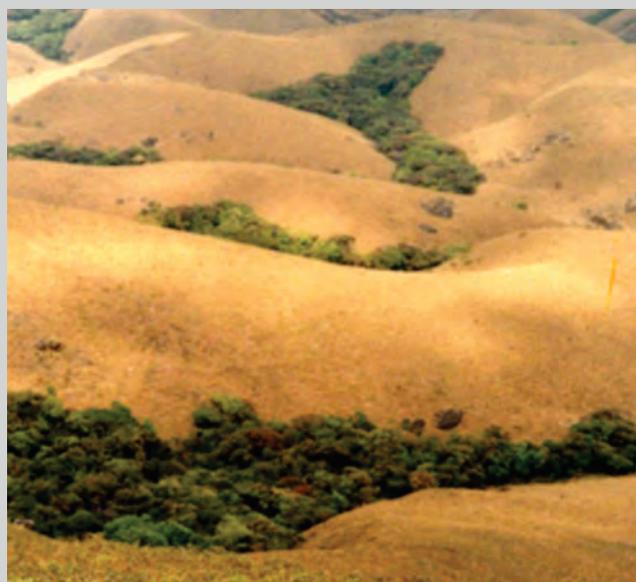
Background

The goal of the project is to assess uncertainty in evaluation of forest aboveground biomass at critical steps of the upscaling process from local forest data to regional extrapolations, in order to improve large scale biomass and carbon stock assessments. It focuses on the humid forests of the Western Ghats of India, for which field data, satellite images and detailed vegetation maps are available. This project is an accompanying research of the National Carbon Project (NCP) led by the Indian Principal Collaborator. It is also part of a research program of the French Principal Collaborator, which searches for a pertinent integration of the allometric theory of plants with 3D simulations of forest stand dynamics and canopy texture analysis in order to predict properties of forest stands at multiple spatial scales. The project has great potential applications within the framework of NCP and more generally within the REDD+ mechanism on Reducing Emissions from Deforestation and Forest Degradation in Developing Countries. Following its approval in the beginning of 2013, a kickoff meeting was held in April 2013 in Pondicherry.

Objectives

The main objective of our project is to assess uncertainty in evaluation of forest aboveground biomass (AGB) at critical steps of the upscaling process from local forest data to regional extrapolations, in order to improve large-scale biomass and carbon stock assessments. The project will focus on the humid forests of the Western Ghats (WG) of India, for which field data from forest sample plots, satellite images at various spatial and spectral resolutions, as well as detailed vegetation maps are available. This project can be seen as an accompanying research program of the Indian National Carbon Project of ISRO-Geosphere Biosphere Programme.

- Conversion of tree measurements into plot-level AGB estimates: as a first task we propose to conduct
- Prediction of nominal forest-type AGB densities
- Landscape-scale extrapolation of AGB estimates



Principal Collaborators



V. K. Dadhwal

Indian Institute of Remote Sensing
Dehradun



Pierre Couteron

Botanique et bioinformatique de
l'Architecture des Plantes, Montpellier

Academia-Industry Partnership



Industrial
Research

Shaping of Durable, Thermal Shock Resistant High Volume Ceramic Containers

Background

For establishing a process for the realization of high volume, thermal shock resistant ceramic crucibles, International Advanced Research Centre for Powder Metallurgy and New Materials (ARCI), India having their expertise in formulating ceramic compositions for engineered properties, M/s Pierre Arquié Céramique Technique, France with their capability for shaping high volume ceramic containers and M/s Ceradecor India Ltd. with their interest in carrying out the application development collaborated through this industrial project.

Objectives and Outcome

Development of a process for casting high volume, thermal shock resistant ceramic containers with improved life time.

Out of various formulations explored cordierite: mullite ($2 \text{MgO} \cdot 2\text{Al}_2\text{O}_3 \cdot 5\text{SiO}_2 : 3\text{Al}_2\text{O}_3 \cdot 2\text{SiO}_2$) formulation is found to be more adaptable in terms of the chemical and thermal stability through laboratory scale tests. Several parameters such as specific gravity of the slurry, rheology, modification of surface through dispersants and additives were experimented to achieve a castable slurry suitable for the conventional slip casting process. Typical cast crucibles are depicted in Fig 1a. Green crucibles thus obtained were binder removed and sintered based on the optimum temperature schedule developed through several trials undertaken during the course of this development. Typical sintered crucibles close to the targeted dimensions are also shown in Fig 1b.



Crucibles of (a) Cast and dried and (b) Sintered

Project Partners

Indian Research Partner



Y.S. Rao
International Advanced Research Centre
for Powder Metallurgy and New Materials
Hyderabad

Industrial Partner (France)



Monsieur G. Rosenblat
Pierre Arquié Céramique
Technique (PACT)
Limoges

Industrial Partner (India)



Rajiv Verma
Ceradecor India Limited
Greater Noida (UP)

Screening for K-Ras and B-Raf Mutations in Tumor Tissues and Circulating Nucleic Acids present in Plasma and Urine in Patients with Colo-rectal Cancers in India.

Background

Circulating nucleic acids are excellent tools for cancer detection. In human body, circulating nucleic acids originate due to several physiological / pathological processes such as exosome mediated secretion, NETosis, cell death (necrosis or apoptosis), infections etc. The genomic DNA undergoes breakages that result in the formation of cell-free circulating nucleic acids that range from 60-1000 bases length. This project is aimed at developing non-invasive diagnostic method for early detection of colo-rectal cancers and specific mutations in Indian population.

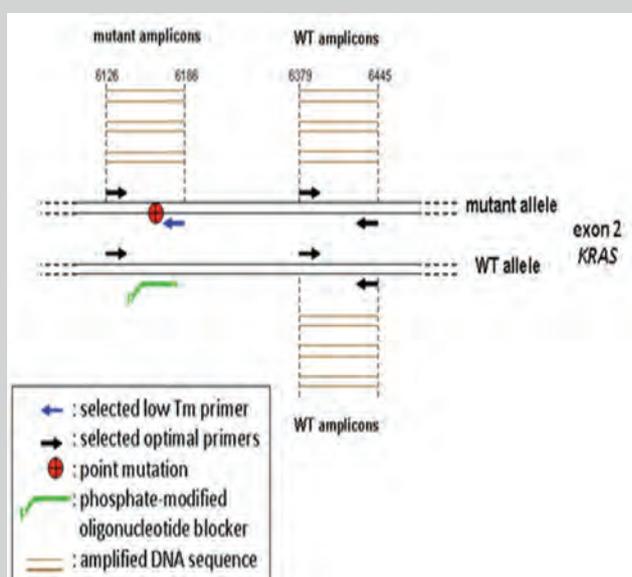
Objectives and Outcome

Prof. Thierry has demonstrated that smaller circulating nucleic acids (60-150 bases length) correlate with tumor size and the stage of cancer progression. He has developed a method to analyze the circulating nucleic acids in plasma. Using this methodology we can analyze several parameters such as i) Concentration of circulating nucleic acids ii) Nucleic acid integrity index iii) Mutations in K-Ras and B-Raf genes.

General scheme for design of primers for Polymerase chain reaction

A general scheme of primer design for real-time PCR based identification of wild type / mutations in K-Ras and B-Raf genes using Intplex technology developed by Prof. Thierry is outlined above. Using this Intplex method the collaborators proposed to determine the existence and the copy numbers of mutated genes in a given sample.

The present bridge project has two distinct objectives: i) identify the existence of K-Ras / B-Raf mutations similar to those reported earlier or report novel mutations, if any, in the DNA of Indian patients affected with colorectal cancer ii) develop methodologies for isolation and concentration of circulating nucleic acids from urine. The Collaborators presently focusing on isolation of circulating nucleic acids from plasma and urine and detection mutations in K-Ras gene (G12V, G12D, G12C, G12S, G12A, G13D) and B-Raf gene (V600E).



These mutations reflect the status of cancer progression and associated resistance to EGFR targeted therapies in colorectal cancers.

Presently 11 clinical samples (tumor DNAs) obtained from Asian Health Care Foundation, Hyderabad have been analysed. Out of these 4 samples were found to be positive for G12V mutations and 7 negative. One specimen has a novel A11A (silent) mutation, the importance of which needs to be confirmed further.

Project Partners

Indian Research Partner



Ch. Mohan Rao
Centre for Cellular and Molecular Biology
Hyderabad

French Industrial Partner



Alain R. Thierry
Sysdiag UMR3145-CNRS
CR1 INSERM,

FIRST Project

(FIRST:Financial - Inclusion based upon Rural mobiquitous Services Technological platform)

Background

The "FIRST" was conceived and proposed in which TCS, University Of Nice-France, Gemalto -France and IISc Bangalore formed a consortium to evaluate the technologies like NFC and mobile phones to address the existing problems faced by Rural Initiatives in India including FI,RSBY, NAREGA etc.



Project Team during demonstration of application during Indo-French Tech Summit -2013 held at Delhi

Indo-French Consortium Members

Co-Leaders

- Dream IT foundation /Univ of Nice (France)
- Tata Consultancy Services Ltd (India)

Partners

- Gemalto (France)
- IISc, Bangalore (India)

Extended Partners

- Banks and Mobile Operators
- TSM providers
- NFC H/W manufacturer

Objectives and Outcome

The main objective of FIRST project is to enable India and other emerging countries (Morocco, Tunisia, Haïti, Vietnam, Nigeria, Russia, Brazil ...) to achieve their vision regarding FI and RI scenario (like PDS, NREGA, RSBY in India etc) by offering/creating a sustainable ECOSYSTEM involving a viable business model with low cost, secured generic and symmetric NFC platform, open equally both to banks, Mobile Network Operators and others who are focusing on rural initiatives.

Strategically, the project involves the following :

- Financial Inclusion represents the first ICT (Information and Communication Technology) step for Rural Inclusion (RI) issues in India and many emerging countries.
- Cell phones (and smart phones) should naturally be the base to deliver financial and rural services to unbanked people.
- The solutions built around cell phones (Mobility) should be studied in depth around technology and standards (like NFC- Near Field Communication) and generic open source platforms. The consortium is planning to participate in pilots this year.

First Year

- Trusted NFC Platform V1

Second Year

- Trusted NFC Platform V2
- Pilot Reports (India & 3rd Year)

Third year

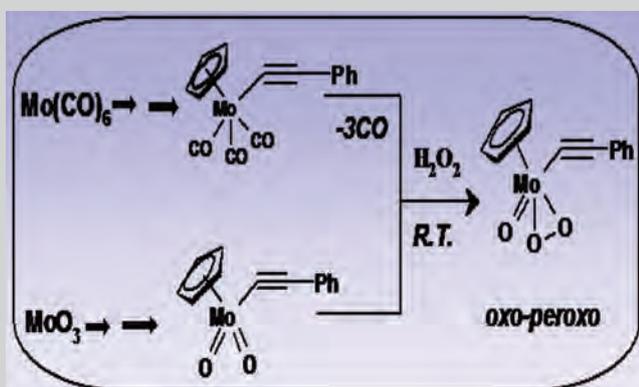
Platform consolidation towards delivering a kernel in open Source (to be decided by the consortium)

- Trusted NFC Platform
- Economics study Report
- Sociological study Report
- Haiti

Selective Oxidation with Hydrogen Peroxide: Development of New Catalyst & Process Conditions

Background

Hydrogen peroxide is a well known green oxidant that produces only water as byproducts. It is therefore a very interesting oxidant for environmentally friendly industrial processes. Even though the oxidation potential of hydrogen peroxide is high (1.77 eV) it is not very reactive without activation. The activation of hydrogen peroxide has to be selective without direct decomposition. Over oxidation is a well-known problem with hydrogen peroxide. Hence developing suitable catalyst for activation of hydrogen peroxide for oxidation is a great challenge. The project focuses on the activation of hydrogen peroxide and its use as reagent in reaction with biomass. The goal of the project is to find a catalytic system for selective activation of hydrogen peroxide for industrial applications.



Objectives

- Development of new catalysts and process conditions for selective oxidation with hydrogen peroxide
- Promotion of oxidation processes using the green oxidant hydrogen peroxide, accessible to a large number of end-users

Accomplishments

Synthesis of molybdenum dioxo based organometallic complexes from simple precursor like MoO₃

Utilisation on lab-scale of the synthesised complexes for oxidation of an alcohol using hydrogen peroxide as green oxidant

High efficiency of hydrogen peroxide for this oxidation without direct decomposition

Set-up of characterisation methods for structural analysis of the catalysts

Validation tests done with new catalysts on selected industrial application

Project Partners

Research Partner (India)



Shubhangi B. Umbarkar
CSIR-NCL, Pune, India

Industry Partner



Markus Brandhors
Arkema Lyon, France

Research Partner (France)



Edmond Payen
UCCS, Lille, France

2,4 Dichloro 5 Fluoro Acetophenone (DCFA) Intermediate for Ciprofloxacin Hydrochloride

Background

It has been estimated that the total annual worldwide consumption of antibiotics is somewhere between 100,000 and 200,000 tons. Among all known antibiotics, the ciprofloxacin has taken an important place because of its broad spectrum of activity including most strains of bacterial pathogens responsible for respiratory, urinary tract, gastrointestinal, and abdominal infections, including Gram(-) and Gram-(+) bacterial pathogens. Ciprofloxacin also plays an important role in excellent tissue penetration, and for its availability in both oral and intravenous formulations. CIP is one of the most prescribed antibiotics in the world and is one type of Fluoroquinolones (FQ), a wide-ranging class of antibiotics used on both human and animals.

Objectives

The main goal of this projects is to:

- develop an environmental friendly industrial method for the synthesis of DCFA
- to provide a process for high yield synthesis of 2, 4-dichloro-5-fluoro acetophenone.
- to find substitute of $AlCl_3$ or find a method to recover catalyst.
- to make acylation step catalytic in order to reduce cast and environmental wastage.
- to develop an alternative industrial synthesis for DCFA or a substitute for the synthesis of Ciprofloxacin.



Project Partners

Research Partner (India)



M. Lakshmi Kantam
Indian Institute of Chemical
Technology, Hyderabad

Research Partner (France)



Dr. Michel Vaultier
Université Bordeaux 1
Talence

Industry (India)



Dr. P Ravi
Neuland Laboratories Limited
Hyderabad

Real-time Mapping of Particulate Pollution Using a Scanning Lidar



The Consortium



Chandra Venkataraman (IITB)



Mani Bhushan (IITB)



Hervé DELBARRE (LPCA)



Benjamin GUINOT (LA)



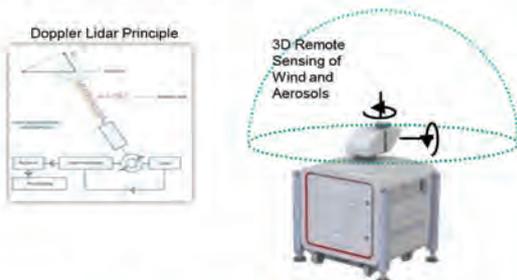
Jean-François LEON (LA)

RATIONALE

Atmospheric pollution studies in urban industrialized areas are of increasing interest as it has been established that fine aerosol particles ($< 2.5 \mu\text{m}$, mainly originating from anthropogenic combustion sources) are directly related to adverse human health impact. Scanning LIDARS have been used over the last few years for wind energy, meteorology and airports applications and also deployed in polluted urban and industrial environments. **Real-time and dynamic mapping** by LIDAR remote sensing is very sensitive to aerosol (Mie scattering), with the capability of large range (m to km) and high repetition rate ($\sim 20 \text{ Hz}$). **The present study thus attempts to develop and validate a methodology to convert lidar signal into aerosol mass concentration.**

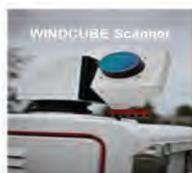
THE TECHNOLOGY

The heterodyne WINDCUBE lidar principle relies on the measurement of the Doppler shift of laser radiation backscattered by particles in the air (dust, water droplets, pollution aerosols, salt crystals, biomass burning aerosols, ...).



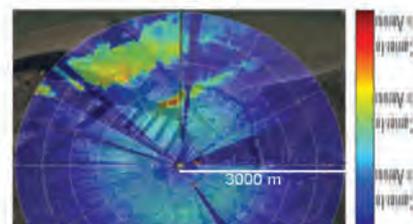
The WINDCUBE is an industrial grade Wind Doppler Scanning Lidar which has been designed to match airport met sensors operability, reliability and robustness requirements. No regular calibration is necessary.

CHARACTERISTICS	
Scanning time	Flexibility: Full hemisphere or scanning
Scanning mode	Continuous or real time
Range of scanning length	0 to 3000 m
Resolution angle	0.5° to 200°
Angular resolution	0.5°
Pointing accuracy	0.5°
Maximum detection range	0 to 3000 m (depending on atmospheric conditions)
Additional optional performances (extra-costs)	0 to 3000 m (depending on atmospheric conditions)
Scanning mode available	0 to 3000 m (depending on atmospheric conditions)



PROGRESS

Four test campaigns have been organized which led to new algorithms to retrieve extinction from the Lidar signal and work out the parameters that affect its conversion into mass concentrations. Below are the latest results from the test campaign in July-August 2013 in Dunkerque.



2D Map of aerosol plumes in Dunkerque taken on August 2nd, 2013 during the last CEFIPRA test campaign.



Temporal comparison between TEOM PM10 data from two nearby locations and the optical signal from Lidar averaged at those two locations on July 24th, 2013 in Dunkerque.

OUTCOMES

- Development of algorithm that converts the LiDAR backscatter optical signal into particle extinction, then into particle mass concentration. Field campaign data used to gradually validate the conversion algorithm.
- Approaches to improve accuracy of PM prediction using measured lidar extinction. Identification of an optimal instrument package to be used along with LIDAR to predict PM with high accuracy. Ability to predict PM accurately even if some instruments malfunction.

Fostering Dialogue



Seminars &
Workshops

Since inception, the Centre has supported 108 Seminars/Workshops/Training schools. The seminars/workshops are held in areas of high priority of mutual interest to both countries with a mandate for knowledge sharing in incipient scientific and technological areas of current relevance, enabling academia-industry linkages and developing collaborative research projects. CEFIPRA gives opportunity to the participants to initiate knowledge exchange in mutually identified areas of interest to initiate knowledge forward chaining, information broadcasting in public domain through different media, advertisement in each country, linkages with international wing of academic/research institutes of both countries and to initiate bilateral training school. This year CEFIPRA has supported 6 seminars/workshops.

Collaborative opportunities on Advanced Glasses and Glass-ceramics

Lille, France
6-9 June 2012



The IFWGGC Workshop brought together 10 scientists

from India and 18 from France for deliberating on areas of collaborative research under the chairmanship of Dr. G.P. Kothiyal (BARC, Mumbai) and Prof. L. Montagne (University of Lille). The workshop gave the opportunity for exchange of information in the glass/glass-ceramics area, presentation of the CEFIPRA and its funding schemes and identification of areas for collaboration. The workshop was held at the University of Lille (USTL) and at the National School of Chemistry of Lille (ENSCL) with CEFIPRA/CNRS support. The workshop was highly successful since 11 bilateral collaboration projects have been identified among the participants.

Automorphic forms, Galois representations and L-functions

IISER, Pune
3-7 Sept. 2012



To commemorate 25 years of existence of CEFIPRA an Indo-French Symposium was held at IISER Pune from September 3rd through 7th, 2012. It was organized by A. Raghuram (IISER, Pune) and J. Tilouine (Univ. - Paris 13 with Baskar Balasubramanyam acting as the

local organizer. The symposium was devoted to current developments of modern Number Theory in connection with Automorphic Forms, in its various aspects: analytic, harmonic analytic, representation-theoretic, algebro-geometric, Galois-theoretic, cohomological, Hodge-theoretic, p-adic Hodge the oretic, etc.

Interesting and potentially fruitful discussions occurred on the work on the interior motive of Shimura varieties of PEL type. The study of automorphic Galois representations is also a strong link between the Indian and the French research groups. On the Indian side Baskar, Ghate and Shekhar, and on the French side Brinon, Clozel, Stroh, Taibi and Tilouine (and his former student Pilloni, now in CNRS in the ENS Lyon) are interested in the p-adic aspect of such Galois representations.

Recent advances and innovations for sustainable water management

New Delhi, India
3-6 Dec. 2012



This seminar represents a direct outcome of the “Interactive Applied Research Seminar”, jointly organized by the Indian Institute of Technology (IITD) and the GEM, September 24th - 26th, 2008 at the IITD, India addressing the concerns of industry in the areas of Environment, Energy and Material Sciences. As a result, “Water & wastes; process engineering; valorization” had been identified as one of the thrust areas of environmental research to be investigated further. The

Seminar consisted of an inaugural and a closing session, 8 technical sessions, 1 poster session, an Indo-French Water Network session and an industrial site visit. Over the technical sessions, 30 scientific communications and 21 master and Ph.D. student posters were presented.

There were strong incentives towards the setting up of a training platform at one of the GEM Indian partners place. Training programs would cover technical and management aspects of water sustainability. It would target different audiences, from top managers to field operators through master students aiming at preparing a PhD. This program could be supervised jointly by French and Indian professors. People from the corporate world have to be involved & a technical research/demonstration platform could be worked out and built for both training and research and development. French SMEs would be ready to provide the necessary equipment for free or for next to nothing. IIT Delhi has already shown interest in developing such a technical platform on its Delhi campus.

Energies for the Future

Paris, France
29 Nov. to 1 Dec. 2012



The seminar focused on emerging paradigms that will be prominent components of energy solutions of the future. The specific topics covered during the seminar included :

- Amorphous and crystalline silicon based photovoltaics
- Organic photovoltaics.
- Materials for energy storage
- Hydrogen as a source of energy
- Bio hydrogen and molecularly engineered materials for its production.

Apart from scientific discussions the seminar also explored the possibilities of future collaboration between Indian and French scientists in field energy. It was noted that there is a great scope for increased cooperation between France and India in the following sectors :

- Photovoltaics- (silicon + organic) and Energy storage devices & engineering materials for the same
- Biohydrogen

The participants included Dr Marc Rapin (French National Aerospace Research Center), Prof. Patrice Simon (Centre Interuniversitaire de Recherche et Ingénierie des MATériaux), Prof. François Béguin (Centre de Recherchesur la Matière Divisée), Prof. C N R Rao (Jawaharlal Nehru Centre for Advanced Scientific Research), Prof. D D Sarma (Indian Institute of Science), Prof. A K Barua (Bengal Engineering and Science University), Dr. Pushpito Ghosh (Central Salt and Marine Chemicals Research), Prof. Pradip Dutta (Indian Institute of Science), etc.

Smart System Integration Based on MNT (Micro and Nano Technology) for Harsh Environments

Mumbai India
5 - 7 Feb. 2013



Initiated by Astrium Space Transportation (Dr. Coumar Oudea) and organized by CEFIPRA with the help of team from IIT Bombay the seminar also had a significant involvement of Prof. Ramgopal Rao and Dr. Nitin Kale, CTO of Nano Sinoff Technologies. Deliberations spread over three days helped identify common ground between the various stake-holders. These included Sensors, Integration of components/sub-systems in a complex system and Packaging issues During the seminar, Indian and French industrial actors articulated their needs in the domain of micro and nano technologies. These included:

- MEMS for high temperature and pressure (Aerospace – Dr. Coumar Oudea, Astrium Space Transportation, France; Energy Industry – Dr. R. Sonde, Thermax Ltd, India)

- High reliable technology (Aerospace – Dr. Coumar Oudea, Astrium Space Transportation, France, Dr. Francis Presseccq, French Space Agency (CNES), France)
- Developing strategies with other sectors to cross the gap of the Valley of Death (Aerospace – Dr. Coumar Oudea, Astrium Space Transportation, and France)
- Nano coating for protection against corrosion (Oil and Gas Production Industry – Dr Anil Bhardwaj, Oil& Natural Gas Commission Ltd, India; Petrochemical Industry – Dr. P. Uppara, Reliance Ltd, India)
- Biochemical sensors/water quality sensors (Energy and Water Industry – Dr. R. Sonde, Thermax Ltd, India)
- Gas detection sensors (Petrochemical Industry – Dr. P. Uppara, Reliance Ltd, India, Astrium ST, France).

During the concluding session, the participants from both countries identified several project ideas based on common interests and needs.

Embedded Systems for Aeronautical and allied sectors

Bangalore
5 Feb. 2013



A seminar was organized jointly with SAE INDIA and IFCCI on “New Vistas in Indian Aerospace & Defence” ahead of AERO-India at Bangalore. Five French experts from the Systematic Cluster in Paris had been invited for the meeting. This strategic level discussion program explored the way forward for the A&D Industry and aimed to seek solutions to the various issues and

challenges faced by the industry. The discussion sessions provided a platform to foster honest debates on the current scenario in the Industry. The panelists responded to the issues faced by the visiting delegates creating an interactive environment. Each panel consisted of members representing various elements of the industry. The representatives ranged from the big players in the industry to the MSMEs, the Industry think tanks (KPMG, PWC) etc. Each panel was headed by a panel chair whose responsibility was to direct the discussions in the direction of obtaining answers to a few important questions floating around in the industry. The program concluded with a ‘Plan of Action’ session laying down the road-map of activities addressing the issues of the industry by few key industry development organisations.



Targeted
Programs

Indo-French Centre for Applied Mathematics

Background

As a bilateral initiative through CEFIPRA the Department of Science & Technology, India and CNRS, France had established an Indo-French Centre for Applied Mathematics (IFCAM) in November 2012. The programme has the objective of facilitating interactions between the communities of Mathematics of the two countries. While the programmes of this centre are decided by an independent scientific advisory body, the centre provides an administrative platform for the programme and currently 12 projects are under consideration.

S. No.	Project	Indian and French PI	Institution Name
1	Homogenization and composite materials	M. Vanninathan	TIFR Centre for Applicable Mathematics, Bangalore
		M. Bariance	IRMAR, INSA de Rennes, Rennes
2	Analysis of Turbulence Models Based on Kinetic Theory and the Development of Asymptotic Preserving Numerical Methods	S. V. Raghurama Rao	Indian Institute of Science, Bangalore
		Mohammed Lemou	IRMAR, INSA de Rennes, Rennes
3	Composite Structures with Highly Contrasting Properties	A. K. Nandkumaran	Indian Institute of Science, Bangalore
		Ali Sili	LATP, Marseille
4	Smart Structure maintenance strategies based on Structural Health Monitoring damage indicators	Ranjan Ganguli	Indian Institute of Science, Bangalore
		BES Christian	Universite Paul Sabatier, Toulouse
5	Theoretical and numerical study of Kirschner-Panetta equations in immunotherapy of cancer	Sandip Banerje	Indian Institute of Technology, Roorkee
		Alexei Tsygvintsev	Ecole Normale Superieure de Lyon, Lyon
6	Study of discrete Painleve equations and related systems	K. M. Tamizhmani	Pondicherry University, Puducherry
		Basile Grammaticos	IMNC, Universite de Paris, Paris
7	Application of optimal control and theory in communication networks	Rajesh Sundaresan	Indian Institute of Science, Bangalore
		Eitan Altman	INRIA, Sophia Antipolis
8	Singular phenomena in reaction diffusion equations and in conservation laws	Konijeti Sreenadh	Indian Institute of Technology, Delhi
		Jacques Giacomoni	University de Pau, Pau
9	Modeling the origin of coherent activity in gravid uterus	Sitabhra Sinha	Institute of Mathematical Science, Chennai
		Alain Pumir	Lab. De Physique, Ecole Normale Superieure Lyon, Lyon
10	PDE Control	Mythily Ramaswamy	TIFR Centre for Applicable Mathematics, Bangalore
		Sylvain Ervedoza	University Paul Sabatier, Toulouse
11	Observers and data as simulation	Amit Apte	TIFR Centre for Applicable Mathematics, Bangalore
		Didier Auroux	University de Nice-Sophia Antipolis et Observatoire Cote d'Azur, Nice
12	Theoretical and Numerical Studies of Turbulence in Fluids	Rahul Pandit	Indian Institute of Science, Bangalore
		Marc Etienne Brachet	LPS< Ecole Normale Superieure, Paris

DST-INRA TARGETED PROGRAM

(Adaptation of Irrigated Agriculture to Climate Change)

Background

Likely impact of climate change on agriculture and water resources is of great significance. The problem of excessive groundwater extraction has resulted in declining groundwater levels, water quality deterioration, rise in extraction costs, depletion of well yield and failure of wells in peninsular India. To address this problem requires an understanding of the interactions between all the components of the system, including hydrology, economics and agronomy. Attempts for integrative assessment using coupled economic and agro-hydrogeological models for optimizing the economic benefits of agriculture and sustainable groundwater levels are few. Adoption of innovation in agriculture has been studied in India rather extensively, the impact of climate change on local agricultural producers has been addressed in some cases, There is inadequate integration between water management, the agronomic aspects, and the prospect of climate change.



Presentation & discussions of the project held at the field site (Berambadi catchment).

Objectives

The main objective of project is to enable India In the context of climate change and of agriculture increasingly relying on groundwater irrigation, it is crucial to develop reliable methods for sustainability assessment of current and alternative agricultural systems. The project aims to develop an integrated model (in agronomy, hydrogeology and economics) and scenarios of evolution of agricultural systems and water management policies, which will be tested both at the farm scale and the watershed scale in the case of an experimental watershed in Peninsular India. It is proposed to combine both economic impacts on the crop production and hydrogeological regime and hydro-economic feedbacks on the future land use and productivity. A methodology combining remote sensing, field surveys and inverse modeling for retrieving spatially distributed relevant biophysical parameters and factors determining cropping systems will be used. A farmer decision model will be developed to investigate the farming system adaptability to changing climate or economic context.

Principal Collaborators



Sekhar Muddu
Indian Institute of Science
Bangalore



Laurent Ruiz
Institut National de la
Recherche Agronomique
Rennes-Quimper

Annual Accounts



2012-13

Financial Report

The financial resources of CEFIPRA for its core programmes are grants provided by the Government of India (Department of Science & Technology) and the Government of France (Ministere des Affaires Etrangeres) against annual budgetary projections made by CEFIPRA. The details of grants-in-aid received from Government of India & Government of France for the last ten years is given in Table 6 & 7. The Scientific Council had gone through a rigorous selection process for projects and only those projects which were of excellent scientific merit and had strong complementarity between research groups were recommended. During the year, 22 projects have been approved. The scholarship amounts to be paid to students from India working in French laboratories were routed through Campus France in France.

As per its expanded mandate CEFIPRA has strived to encourage major stake holders from India and France to make use of CEFIPRA as a mechanism for promoting collaboration between scientists and S&T institutions of two countries. This has been done while maintaining the core strength of CEFIPRA i.e. promoting collaborative research. Some significant achievements in this context are (1) Targeted programme between CNRS and DST in the areas of Pure and Applied Mathematics (IFCAM), (2) Targeted Programme of Cooperation between DST and INRA and (3) Launching of "Raman Charpak Fellowship" programme for students from India and France. Table 8 depicts the amount received for the noncore programmes.

The number of project proposal considered and approved for the last five years is given in Table 9. It is evident that there has been a reduction in the number of projects approved by the Scientific Council in year 2009-10 and 2010-11. This is reflected in a reduced overall expenditure by CEFIPRA during years 2010-11 and 2011-12. The details of the expenditure incurred during the Financial Year, under various budget heads are given in Table 10. A comparison with the previous two years is also provided. Table 11 depicts the expenditure pattern under various heads over the last ten years. Table 12 shows expenditures incurred during the financial year 2012-13 for non core programmes.

Centre's Premises

During the year, Rs. 1.120 million (~0.016 M. Euro) has been incurred on account of maintenance charges, equipment & municipal tax.

Financial Audit

The statutory audit of the accounts of the Centre was carried out by M/s. SSAS & Associates, Chartered Accountants. The Auditors' Report with its attachments viz. Receipt & Payment Account, Income & Expenditure Account and Balance Sheet are given. These accounts, as certified by the Auditors, show all transactions in Rupees after converting the transactions in Euro into Rupees. However, as required by the Bye-laws, the Euro versions of all these accounts has also been prepared and certified by the Auditors.

The rate prescribed by the Reserve Bank of India on the last working day of the year, i.e. 31st March 2012 has been adopted for conversion of the transactions in Euro into Rupee and vice versa during the year 2012-13 in pursuance of the decision of the Governing Body of the Centre. While, the accounts of the earlier year 2011-12 was based on exchange rate in relation to Rupee and Euro of Rs. 63.24, the rate adopted during 2012-13 is Rs. 68.3403.

Table 6 Grants-in-aid received over the year for Core Programme (million Rs.)

	03-04	04-05	05-06	06-07	07-08	08-09	09-10	10-11	11-12	12-13
Government of India	60.00	65.50	103.10	78.60	85.00	100.00	101.30	93.60	97.84	82.73
Government of France	75.87	78.62	81.99	78.63	86.68	94.56	94.53	99.64	91.70	112.76
TOTAL	135.87	144.12	185.09	157.23	171.68	194.56	195.83	193.24	189.54	195.49

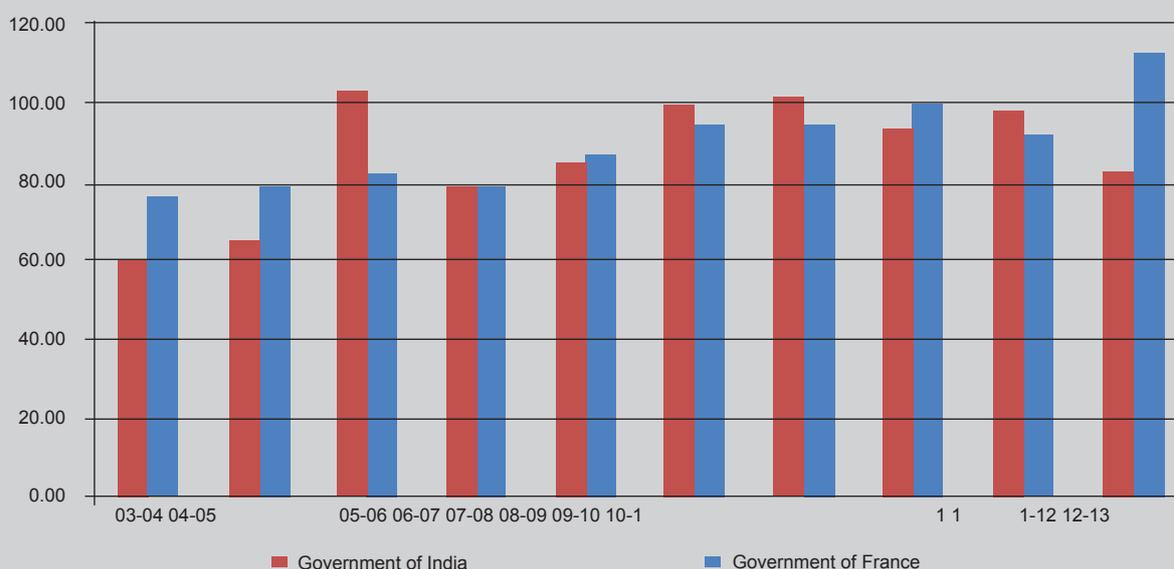


Table 7 Grant-in-aid received from Government of India & Government of France for Core Programmes (million Rs.)

Financial Year	Grant-in-aid received from Govt. of India	Grant-in-aid received from Govt. of France	Total amount received
2012-13 (Euro 1=Rs. 68.3403)	Rs. 82.73 (1,21 M. Euro)	Rs.112.76 (1,65 M. Euro)	Rs. 195.49 (2,86 M. Euro)
2011-12 (Euro 1 = Rs. 63.24)	Rs. 97.84 (1,55 M Euro)	Rs. 91.70 (1,45M. Euro)	Rs. 189.54 (3,00 M. Euro)
2010-11 (Euro 1 = Rs. 60.3850)	Rs. 93.60 (1,55 M Euro)	Rs. 99.64 (1,65M. Euro)	Rs. 193.24 (3,20 M. Euro)

Table 8 Non-Core Programmes : Receipts for the year 2012-13 (million Rs.)

	Indian Side	French Side	Total
IFCAM (DST-CNRS)	14.52	0.00	14.52
DST-INRA PROJECTS	3.30	3.42	6.72
RAMAN-CHARPAK FELLOWSHIP	7.50	0.00	7.50
Total	25.32	3.42	28.74

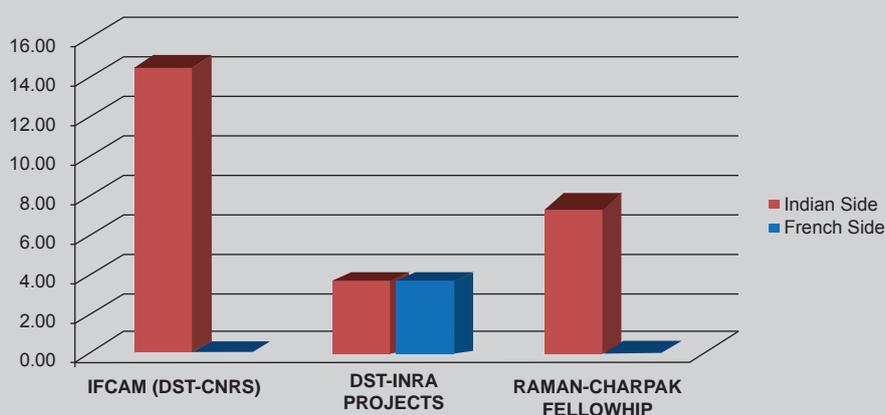


Table 9 Number of project proposals considered and approved – year-wise

Year	Number of proposals received	Number of proposals approved	Percentage of proposals approved
2012-13	65	22	34
2011-12	80	26	33
2010-11	66	16	24
2009-10	62	13	21
2008-09	68	20	29

	Budgetary Components	2010-2011		2011-2012		2012-2013	
		Expenditure in Rs.	% of total	Expenditure in Rs.	% of total	Expenditure in Rs.	% of total
1.	Research Projects	123.04 (2,04 M Euro)	71.21%	90.45 (1,43 M Euro)	63.41%	144.20 (2,11 M Euro)	66.40%
2.	Industrial Research expenses	6.14 (0,10 M Euro)	3.55%	7.42 (0,12 M Euro)	5.20%	18.57 (0,27 M Euro)	8.55%
3.	Seminars & Workshops	13.16 (0,22 M Euro)	7.62%	14.33 (0,23 M Euro)	10.05%	17.91 (0,26 M Euro)	8.25%
4.	General Scientific Expenses (activities like publication of research papers, short visits of scientists other than project visits etc.)	2.15 (0,04 M Euro)	1.25%	1.59 (0,03 M Euro)	1.11%	3.89 (0,06 M Euro)	1.79%
5.	Governing Body & Scientific Council Expenses	13.48 (0,22 M Euro)	7.80%	11.89 (0,19 M Euro)	8.34%	13.19 (0,19 M Euro)	6.07%
6.	Running expenses of the Centre (Salaries and Office expenses)	14.80 (0,25 M Euro)	8.57%	16.96 (0,27 M Euro)	11.89%	19.41 (0,28 M Euro)	8.94%
	TOTAL	172.77 (2,87 M Euro) @ 1Euro = Rs. 60.385		142.64 (2,27 M Euro) @ 1Euro = Rs. 63.24		217.17 (3,17 M Euro) @ 1Euro = Rs. 68.3403	

	03-04	04-05	05-06	06-07	07-08	08-09	09-10	10-11	11-12	12-13
PROJECTS	90.35	106.00	124.93	123.39	131.81	137.59	154.08	123.04	90.45	144.20
INDUSTRY	9.77	10.37	11.96	12.59	14.35	8.71	8.42	6.14	7.42	18.57
SEMINARS ETC.	5.36	11.27	14.72	9.69	15.14	14.57	15.61	15.31	15.92	21.80
GB & SC	6.98	7.44	14.37	11.28	10.39	14.04	11.45	13.48	11.89	13.19
RUNNING EXP.	7.73	7.23	15.35	12.07	9.68	13.93	17.15	14.80	16.96	19.41
TOTAL	120.19	142.31	181.33	169.02	181.37	188.84	206.71	172.77	142.64	217.17

Annual Expenditure over the years for Core Programmes

(million Rs.)

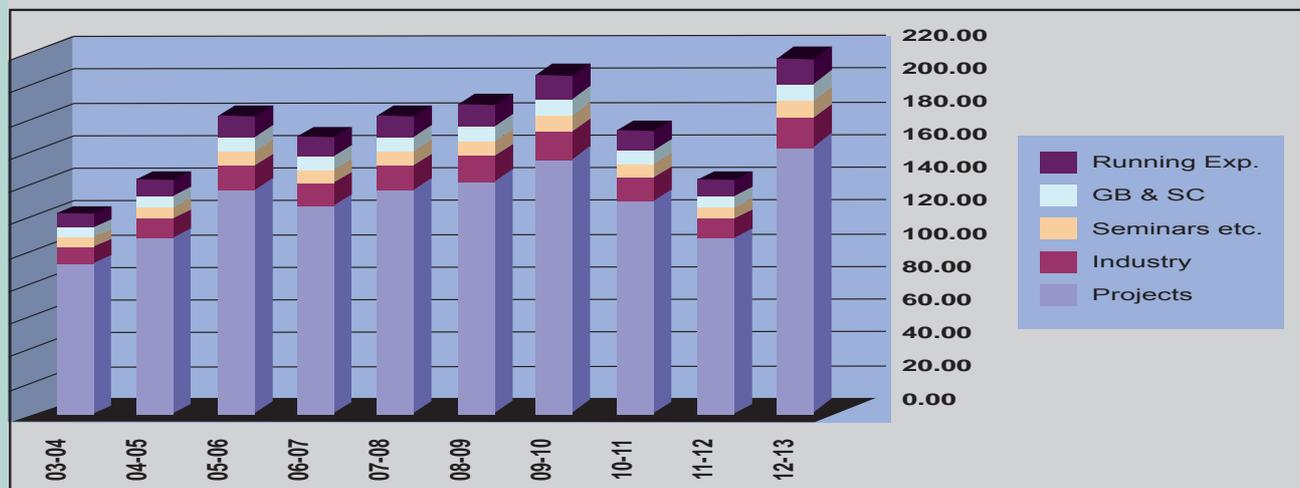
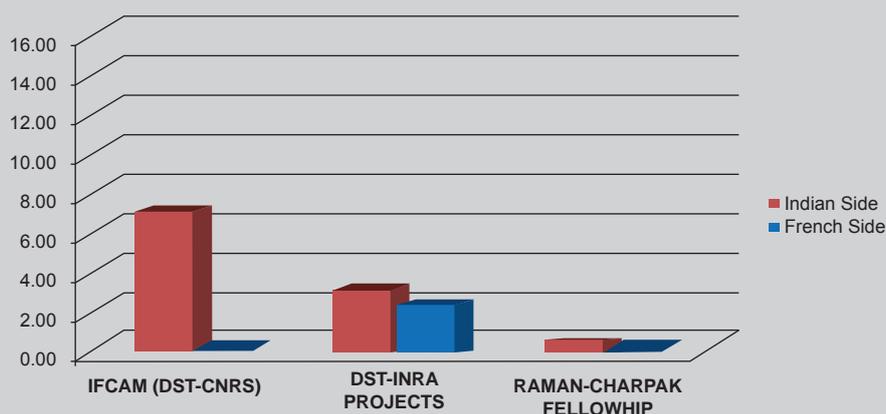


Table 12
Non-Core Programmes: EXPENSES

(million Rs.)

	Indian Side	French Side	Total
IFCAM (DST-CNRS)	6.72	0.00	6.72
DST-INRA PROJECTS	3.59	2.80	6.39
RAMAN-CHARPAK FELLOWSHIP	0.06	0.00	0.06
Total	10.37	2.80	13.17



Auditors Report

The Auditors Report comprises the following:

- Report of the Auditor.
- Balance Sheet as at 31st March, 2013 (Rupee version)
- Income & Expenditure Account for the year ended on 31.03.2013 (Rupee version)
- Receipt & Payment Account for the year ended on 31.03.2013 (Rupee version)
- Balance Sheet as at 31st March, 2013 (Euro version)
- Income & Expenditure Account for the year ended on 31.03.2013 (Euro version)
- Receipt & Payment Account for the year ended on 31.03.2013 (Euro version)
- Receipt & Payment Account for the year ended on 31.03.2013 (in respective currencies i.e.-Rupee/Euro)
- Accounting Policies and Notes on Accounts to Balance Sheet & Income and Expenditure Account.
- Receipt & Payment Account in respect of IFCPAR Gratuity Fund for the year ended on 31.03.2013.
- Receipt & Payment Account in respect of IFCPAR General Provident Fund for the year ended on 31.03.2013.

This is based on the accounting practices of India, and has taken into consideration, the requirements of the Government of India & Government of France as per the norms of IFCPAR/CEFIPRA.

SSAS & Associates

CHARTERED ACCOUNTANTS

Branch- D/147, Pushpanjali Enclave; Pitampura, Delhi-110034
Tel: 91.11.27010841; 91.9868144009, email- sansaxonline@gmail.com

Auditors' Report

To the Members of Governing Body of The Indo French Centre for the Promotion of Advanced Research, New Delhi

We have audited attached Balance sheet of the Indo French Centre for the Promotion of Advanced Research, New Delhi ("the Society") registered under Societies Registration Act , 1860 as at 31st March 2013, the Income and Expenditure account and Receipt and Payment Account of the Society for the year ended on that date annexed thereto. These financial statements are the responsibility of the Society Management. Our responsibility is to express an opinion on these financial statements based on our audit.

We conducted our audit in accordance with auditing standards generally accepted in India. Those Standards require that we plan and perform the audit to obtain reasonable assurance about whether the financial statements are free of material misstatement. An audit includes performing procedures to obtain evidence about the amounts and disclosures in the financial statements. The procedure selected depend on the auditor's judgement including the assessments of risks and material misstatement of financial statement. An audit also includes assessing the accounting principles used and significant estimates made by management, as well as evaluating the overall financial statement presentation. We believe that our audit provides a reasonable basis of our opinion.

We report that:

- (a) we have obtained all the information and explanations which to the best of our knowledge and belief were necessary for the purpose of our audit;
- (b) in our opinion, proper books of accounts have been kept by the Society so far as appears from our examination of those books;
- (c) the balance sheet and income and expenditure account dealt with by this report are in agreement with the books of accounts;
- (d) in our opinion and to the best of our information, and according to the explanations given to us, the said accounts are in accordance with the accounting principles generally accepted in India and give a true and fair view:
 - (i) in the case of the balance sheet, of the state of affairs of the Society as at 31st March 2013; and
 - (ii) in the case of the Receipt and Payment Account together with Income and expenditure Accounts, of the Surplus of income over expenditure for the accounting year ending 31st March 2013.

For SSAS and Associates,
Chartered Accountants
Firm Registration No : 08550N

Alpina Saxena

ALPINA SAXENA
Partner
Membership No. 095837
Place : New Delhi
Date : 28.09.2013



Head Office- U 52/62, DLF Phase III, Gurgaon, Haryana

INDO-FRENCH CENTRE FOR THE PROMOTION OF ADVANCED RESEARCH, NEW DELHI

BALANCE SHEET AS AT 31ST MARCH 2013

Rupee Version
(Conversion Factor 1 Euro.= Rs. 68.3403)
(Conversion Factor 1 Euro.= Rs. 63.2400 for the year 2011-12)

Schedule	Amount as at March 31, 2013 Total	Amount as at March 31, 2012 Total
SOURCE OF FUNDS		
Capital Fund		
Opening Balance	145,619,438.06	96,726,129.72
Add : Surplus/(Deficit)	<u>(15,835,888.91)</u>	<u>48,893,308.34</u>
	129,783,549.15	145,619,438.06
Funds for Specific Programmes		
Frech Season in India-C/F amount of grant received from Govt. of France - Embassy of France	1,335,983.00	1,335,983.00
IFCAM Projects	7,800,000.00	-
DST-INRA Projects	273,247.70	-
Raman Charpak Fellowship	7,440,000.00	-
Economic Diplomacy-R&D Programmes	2,276,732.04	-
Project with IIT Rajasthan	1,719,646.97	-
India Science & Innovation House Project	<u>932,419.03</u>	<u>-</u>
	21,778,028.74	1,335,983.00
TOTAL	<u>151,561,577.89</u>	<u>146,955,421.06</u>
APPLICATION OF FUNDS		
Fixed Assets		
Gross Block	6,085,696.61	6,493,131.00
Less: Depreciation to date	<u>968,331.00</u>	<u>1,110,988.00</u>
Net Block	5,117,365.61	5,382,143.00
Current Assets		
Security Deposits		
Rent	180,000.00	126,000.00
Cellular Connection	<u>17,220.00</u>	<u>16,500.00</u>
	197,220.00	142,500.00
Other Deposits		
Income Tax and TDS	4,293,913.44	21,366,060.44
Bank Balances		
In Indian Rupees Saving Bank Account		
Union Bank of India	8,054,715.95	222,219.95
State Bank of Hyderabad	53,120,317.49	73,586,714.11
Axis Bank	747,665.00	718,492.00
State Bank of Hyderabad (Gratuity Fund)	2,563,116.47	2,733,065.47
In Euro Account		
Credit Industrielle et Commercial, Paris, France	<u>77,467,263.93</u>	<u>42,804,226.09</u>
	141,953,078.84	120,064,176.62
TOTAL	<u>151,561,577.89</u>	<u>146,955,421.06</u>

Accounting policies and notes on accounts M

As per our report of even date.

For SSAS AND ASSOCIATES
Firm Registration No. 08550N
Chartered Accountants

Alpana Saxena

ALPANA SAXENA
Partner
Membership No. 095837



Davinder Kambuj
DAVINDER KAMBUJ
MANAGER (ADMN. & ACCTS.)

Debapriya Dutta
DR. DEBAPRIYA DUTTA
DIRECTOR

Place : New Delhi
Date : 28.09.2013

INDO-FRENCH CENTRE FOR THE PROMOTION OF ADVANCED RESEARCH, NEW DELHI

INCOME AND EXPENDITURE ACCOUNT FOR THE YEAR ENDED 31ST MARCH, 2013

Rupee Version
(Conversion Factor 1 Euro.= Rs. 68.3403)
(Conversion Factor 1 Euro.= Rs. 63.2400 for the year 2011-12)

Schedule	Amount as at March 31, 2013		Amount as at March 31, 2012	
	Total		Total	
INCOME				
Grant-in-aid				
Contribution from Department of Science and Technology, Govt. of India	82,727,465.00		97,836,000.00	
Contribution from Govt. of France	112,761,495.00	195,488,960.00	91,698,000.00	189,534,000.00
Grant-in-aid-Targetted Programmes				
IFCAM Projects	14,515,000.00		-	
DST-INRA Projects	6,667,015.00		-	
Raman Charpak Fellowship	7,500,000.00	28,682,015.00	-	
Extramural Activities				
Economic Diplomacy-R&D Programmes	2,354,665.04			
Project with IIT Rajasthan	1,719,646.97			
India Science & Innovation House Project	1,833,495.07	5,907,807.08		
Interest from Bank Accounts				
Banks in India		3,125,765.00		1,954,085.00
Interest received from Income Tax		3,844,574.00		1,392,500.00
Gratuity Fund - Bank Interest		135,209.00		173,734.00
Gain on Exchange Rate Fluctuation				
In conversion of opening balance of CIC, Paris		3,452,156.14		541,452.92
TOTAL		240,636,486.22		193,595,771.92
PAYMENTS				
Scientific Expenses of the Centre	B	184,567,752.55		113,791,100.86
Governing Body/ Scientific Council Expenses	C	13,193,335.65		11,889,375.80
Travelling Expenses	D	2,038,338.45		1,680,501.56
Office Expenses - Shareable	E	3,981,936.40		3,477,088.36
Salaries	F	13,155,543.00		11,226,256.00
Office Expenses - Non-shareable	G	3,672,158.00		1,188,132.00
Targetted Scientific Programmes	H	13,168,767.30		-
Extramural Activities	I	979,009.67		-
Gratuity Fund	J	305,158.00		339,021.00
Depreciation on Fixed Assets		968,331.00		1,110,988.00
TOTAL		236,030,330.02		144,702,463.58
Balance of Surplus Funds		4,606,156.20		48,893,308.34
Less: Appropriation of Unutilised Funds for Targetted/Extramural Programmes				
IFCAM Projects		7,800,000.00		-
DST-INRA Projects		273,247.70		-
Raman Charpak Fellowship		7,440,000.00		-
Economic Diplomacy-R&D Programmes		2,276,732.04		-
Project with IIT Rajasthan		1,719,646.97		-
India Science & Innovation House Project		932,418.40	20,442,045.11	-
Surplus/(Deficit) of Income over expenditure carried over to Balance Sheet		(15,835,888.91)		48,893,308.34

Accounting policies and notes on accounts M

As per our report of even date.

For SSAS AND ASSOCIATES
Firm Registration No. 08550N
Chartered Accountants

Alpana Saxena
ALPANA SAXENA
Partner
Membership No. 095837



Davinder Kamboj
DAVINDER KAMBOJ
MANAGER (ADMN. & ACCTS.)

Debapriya Dutta
DR. DEBAPRIYA DUTTA
DIRECTOR

Place: New Delhi
Date: 28.09.2013

INDO-FRENCH CENTRE FOR THE PROMOTION OF ADVANCED RESEARCH, NEW DELHI

RECEIPT AND PAYMENT ACCOUNT FOR THE YEAR ENDED ON 31ST MARCH, 2013

Rupee Version
(Conversion Factor 1 Euro.= Rs. 68.3403)
(Conversion Factor 1 Euro.= Rs. 63.2400 for the year 2011-12)

Schedule	Amount as at March 31, 2013		Amount as at March 31, 2012	
	Total		Total	
A. Opening balance				
Bank Balances				
In Indian Rupees S B Account				
Union Bank of India	222,219.95		213,853.95	
State Bank of Hyderabad	73,586,714.11		40,207,376.72	
Axis Bank	718,492.00		669,339.00	
Bank of Tokyo Mitsubishi Ltd.	-		1,805.00	
State Bank of Hyderabad (Gratuity Fund)	2,733,065.47		4,617,336.47	
In Euro Account				
Credit Industriel et Commercial, Paris, France	42,804,226.72	120,064,718.25	11,452,061.14	57,161,772.28
B. Receipts				
Grant-in-aid				
Contribution from Dept. of Science and Technology, Govt. of India	82,727,465.00		97,836,000.00	
Contribution from Govt. of France	112,761,495.00	195,488,960.00	91,698,000.00	189,534,000.00
Grant-in-aid - Targetted Programmes				
IFCAM Projects	14,515,000.00		-	
DST-INRA Projects	6,667,015.00		-	
Raman Charpak Fellowship	7,500,000.00	28,682,015.00	-	
Extramural Activities				
Economic Diplomacy-R&D Programmes	2,354,665.04		-	
Project with IIT Rajasthan	1,719,646.97		-	
India Science & Innovation House Project	1,833,495.07	5,907,807.08	-	
Interest from Bank Accounts				
Banks in India		3,125,765.00		1,954,085.00
Interest received from Income Tax		3,844,574.00		1,392,500.00
Refund of Income Tax/TDS		20,537,714.00		14,500,000.00
Gratuity Fund - Bank Interest		135,209.00		173,734.00
Gain on Exchange Rate Fluctuation				
In conversion of opening balance of CIC, Paris		3,452,156.14		541,452.92
Amount deducted from Salaries				
Tax Deducted at Source	1,000,334.00		888,917.00	
Group Insurance Premium	9,360.00		7,440.00	
Contributory Provident Fund	1,449,621.00	2,459,315.00	1,490,250.00	2,386,607.00
TDS deducted-Bills/Contractors etc.		340,874.00		191,956.00
Amount recovered on behalf of CLRI, Chennai		43,940.00		96,668.00
Amount recovered on behalf of DST		110,520.00		-
Total		<u>384,193,567.47</u>		<u>267,932,775.20</u>



Debabritya Dutta

RECEIPT AND PAYMENT ACCOUNT FOR THE YEAR ENDED ON 31ST MARCH, 2013

Rupee Version
(Conversion Factor 1 Euro.= Rs. 68.3403)
(Conversion Factor 1 Euro.= Rs. 63.2400 for the year 2011-12)

	Schedule	Amount for the year ended March 31, 2013	Amount for the year ended March 31, 2012
Payments			
C. Shareable Expenses			
Scientific expenses of the Centre	B	184,567,752.55	113,791,100.86
Governing Body/ Scientific Council Expenses	C	13,193,335.65	11,889,375.80
Travelling Expenses	D	2,038,338.45	1,680,501.56
Office Expenses - Shareable	E	3,981,936.40	3,477,088.36
Salaries	F	13,155,543.00	11,226,256.00
Purchase of Office Equipment		53,927.61	34,450.00
Purchase of Furniture & Fixtures		167,182.00	-
Purchase of Staff Car		-	604,763.00
Security Deposit-Director's residence		54,000.00	-
Security Deposit-Cellphone		720.00	-
Sale of Old Staff Car		-	(50,000.00)
Furniture & Fixture (Sold)		(23,764.00)	-
Office Equipment (Sold)		(21,314.00)	-
Advance paid to suppliers		-	(10,000.00)
		<u>217,167,657.66</u>	<u>142,643,535.58</u>
D. Non-shareable Expenses			
Office Expenses - Non-shareable	G	3,672,158.00	1,188,132.00
Computer System		568,810.00	534,400.00
Computer System (Sold)		(41,288.00)	(7,500.00)
Furniture & Fixture		-	-
		<u>4,199,680.00</u>	<u>1,715,032.00</u>
E. Targetted Scientific Programmes			
	H	13,168,767.30	-
F. Extramural Activities			
	I	979,009.67	-
G. Gratuity Fund			
	J	305,158.00	339,021.00
H. Peer Review Committee (Bhopal Gas)			
	K	-	112,335.00
I. Miscellaneous Payments			
	L	<u>6,420,216.00</u>	<u>3,058,134.00</u>
Total (C+D+E+F+G+H+I)		242,240,488.63	147,868,057.58
J. Closing Balance			
Bank Balances			
In Indian Rupees Saving Bank Account			
Union Bank of India		8,054,715.95	222,219.95
State Bank of Hyderabad		53,120,317.49	73,586,714.11
Axis Bank		747,665.00	718,492.00
State Bank of Hyderabad (Gratuity Fund)		2,563,116.47	2,733,065.47
In Euro Account			
Credit Industriel et Commercial, Paris, France		<u>77,467,263.93</u>	<u>42,804,226.09</u>
TOTAL (C+D+E+F+G+H+I+J)		<u>384,193,567.47</u>	<u>267,932,775.20</u>

Accounting policies and notes on accounts M

As per our report of even date.

For **SSAS AND ASSOCIATES**
Firm Registration No. 08550N
Chartered Accountants

Alpana Saxena
ALPANA SAXENA
Partner
Membership No. 095837



DAVINDER KAMBOJ
DAVINDER KAMBOJ
MANAGER (ADMN. & ACCTS.)

Debapriya Dutta
DR. DEBAPRIYA DUTTA
DIRECTOR

Place : New Delhi
Date : 28.09.2013

INDO-FRENCH CENTRE FOR THE PROMOTION OF ADVANCED RESEARCH, NEW DELHI

BALANCE SHEET AS AT 31ST MARCH 2013

Euro Version
(Conversion Factor 1 Euro.= Rs. 68.3403)
(Conversion Factor 1 Euro.= Rs. 63.2400 for the year 2011-12)

Schedule	Amount as at March 31, 2013 Total	Amount as at March 31, 2012 Total
SOURCE OF FUNDS		
Capital Fund		
Opening Balance	2,302,647.64	1,601,823.77
Less: Exchange Fluctuation in Opening Balance	(171,848.74)	(72,315.08)
Add : Surplus/(Deficit)	<u>(231,721.08)</u>	<u>773,138.95</u>
	1,899,077.82	2,302,647.64
Funds for Specific Programmes		
Fresh Season in India-C/F amount of grant received from Govt. of France - Embassy of France	19,548.98	21,125.60
IFCAM Projects	114,134.70	-
DST-INRA Projects	3,998.34	-
Raman Charpak Fellowship	108,866.95	-
Economic Diplomacy-R&D Programmes	33,314.63	-
Project with IIT Rajasthan	25,163.00	-
India Science & Innovation House Project	<u>13,643.76</u>	<u>-</u>
	318,670.36	21,125.60
TOTAL	<u>2,217,748.18</u>	<u>2,323,773.24</u>
APPLICATION OF FUNDS		
Fixed Assets		
Gross Block	89,049.89	102,674.43
Less: Depreciation to date	<u>14,169.27</u>	<u>17,567.81</u>
Net Block	74,880.62	85,106.62
Current Assets		
Security Deposits		
Rent	2,633.87	1,992.41
Cellular Connection	<u>251.98</u>	<u>260.91</u>
	2,885.85	2,253.32
Other Deposits		
Income Tax and TDS	62,831.35	337,856.75
Bank Balances		
In Indian Rupees Saving Bank Account		
Union Bank of India	117,861.88	3,513.91
State Bank of Hyderabad	777,291.25	1,163,610.27
Axis Bank	10,940.32	11,361.35
Bank of Tokyo Mitsubishi Ltd.	-	-
State Bank of Hyderabad (Gratuity Fund)	37,505.20	43,217.35
In Euro Account		
Credit Industriel et Commercial, Paris, France	<u>1,133,551.71</u>	<u>676,853.67</u>
	2,077,150.36	1,898,556.55
TOTAL	<u>2,217,748.18</u>	<u>2,323,773.24</u>

Accounting policies and notes on accounts M

As per our report of even date.

For SSAS AND ASSOCIATES
Firm Registration No. 08550N
Chartered Accountants

Alpana Saxena
ALPANA SAXENA
Partner
Membership No. 095837



Davinder Kamboj
DAVINDER KAMBOJ
MANAGER (ADMN. & ACCTS.)

Debapriya Dutta
DR. DEBAPRIYA DUTTA
DIRECTOR

Place : New Delhi
Date : 28.09.2013

INDO-FRENCH CENTRE FOR THE PROMOTION OF ADVANCED RESEARCH, NEW DELHI

INCOME AND EXPENDITURE ACCOUNT FOR THE YEAR ENDED ON 31ST MARCH, 2013

Euro Version
(Conversion Factor 1 Euro.= Rs. 68.3403)
(Conversion Factor 1 Euro.= Rs. 63.2400 for the year 2011-12)

	Schedule	Amount as at March 31, 2013 Total	Amount as at March 31, 2012 Total
INCOME			
Grant-in-aid			
Contribution from Department of Science and Technology, Govt. of India		1,210,522.42	1,547,058.82
Contribution from Govt. of France		1,650,000.00	2,997,058.82
Grant-in-aid - Targetted Programmes			
IFCAM Projects		212,392.98	-
DST-INRA Projects		97,556.13	-
Raman Charpak Fellowship		109,744.91	-
Extramural Activities			
Economic Diplomacy-R&D Programmes		34,455.00	-
Project with IIT Rajasthan		25,163.00	-
India Science & Innovation House Project		26,828.90	-
Interest from Bank Accounts			
Banks in India		45,738.24	30,899.51
Interest received from Income Tax		56,256.32	22,019.29
Gratuity Fund-Bank Interest		1,978.47	2,747.22
Gain on Exchange Rate Fluctuation In conversion of opening balance of CIC, Paris		50,514.22	8,561.87
TOTAL		3,521,150.59	3,061,286.71
PAYMENTS			
Scientific expenses of the Centre	B	2,700,716.15	1,799,353.27
Governing Body/ Scientific Council Expenses	C	193,053.52	188,004.05
Travelling Expenses	D	29,826.30	26,573.40
Office Expenses - Shareable	E	58,266.30	54,982.42
Salaries	F	192,500.52	177,518.28
Office Expenses - Non-shareable	G	53,733.42	18,787.67
Targetted Scientific Programmes	H	192,694.03	-
Extramural Activities	I	14,325.51	-
Gratuity Fund	J	4,465.27	5,360.86
Depreciation on Fixed Assets		14,169.27	17,567.81
TOTAL		3,453,750.29	2,288,147.76
Balance of Surplus Funds		67,400.30	773,138.95
Less: Appropriation of Unutilised Funds for Targetted/Extramural Programmes			
IFCAM Projects		114,134.70	-
DST-INRA Projects		3,998.34	-
Raman Charpak Fellowship		108,866.95	-
Economic Diplomacy-R&D Programmes		33,314.63	-
Project with IIT Rajasthan		25,163.00	-
India Science & Innovation House Project		13,643.76	-
Surplus/(Deficit) of Income over expenditure carried over to Balance Sheet		(231,721.08)	773,138.95
Accounting policies and notes on accounts	M		.

As per our report of even date.

For **SSAS AND ASSOCIATES**
Firm Registration No. 08550N
Chartered Accountants

Alpana Saxena
ALPANA SAXENA
Partner
Membership No. 095837



DAVINDER KAMBOJ
DAVINDER KAMBOJ
MANAGER (ADMN. & ACCTS.)

Debapriya Dutta
DR. DEBAPRIYA DUTTA
DIRECTOR

Place : New Delhi
Date : 28.09.2013

INDO-FRENCH CENTRE FOR THE PROMOTION OF ADVANCED RESEARCH, NEW DELHI

RECEIPT AND PAYMENT ACCOUNT FOR THE YEAR ENDED ON 31ST MARCH, 2013

Euro Version

(Conversion Factor 1 Euro.= Rs. 68.3403)

(Conversion Factor 1 Euro.= Rs. 63.2400 for the year 2011-12)

Schedule	Amount as at March 31, 2013 Total	Amount as at March 31, 2012 Total
A. Opening balance		
Bank Balances		
In Indian Rupees S B Account		
Union Bank of India	3,251.66	3,381.63
State Bank of Hyderabad	1,076,768.97	635,790.28
Axis Bank	10,513.44	10,584.10
Bank of Tokyo Mitsubishi Ltd.	-	28.54
State Bank of Hyderabad (Gratuity Fund)	39,992.00	73,012.90
Cheque in Hand	-	-
In Euro Account		
Credit Industriel et Commercial, Paris, France	<u>626,339.45</u>	<u>181,088.89</u>
	1,756,865.52	903,886.34
B. Receipts		
Grant-in-aid		
Contribution from Dept. of Science and Technology, Govt. of India	1,210,522.42	1,547,058.82
Contribution from Govt. of France	<u>1,650,000.00</u>	<u>1,450,000.00</u>
	2,860,522.42	2,997,058.82
Grant-in-aid - Targetted Programmes		
IFCAM Projects	212,392.98	-
DST-INRA Projects	97,556.13	-
Raman Charpak Fellowship	<u>109,744.91</u>	-
	419,694.02	-
Extramural Activities		
Economic Diplomacy-R&D Programmes	34,455.00	-
Project with IIT Rajasthan	25,163.00	-
India Science & Innovation House Project	<u>26,828.90</u>	-
	86,446.90	-
Interest from Bank Accounts		
Banks in India	45,738.24	30,899.51
Interest received from Income Tax		
	56,256.32	22,019.29
Refund of Income Tax / TDS		
	300,521.27	229,285.26
Gratuity Fund - Bank Interest		
	1,978.47	2,747.22
Gain on Exchange Rate Fluctuation		
In conversion of opening balance of CIC, Paris	50,514.22	8,561.87
Amount deducted from Salaries		
Tax Deducted at Source	14,637.54	14,056.25
Group Insurance Premium	136.96	117.65
Contributory Provident Fund	<u>21,211.80</u>	<u>23,564.99</u>
	35,986.30	37,738.89
TDS deducted-Bills/Contractors etc.		
	4,987.89	3,035.36
Amount recovered on behalf of CLRI, Chennai		
	642.96	1,528.59
Amount recovered on behalf of DST		
	1,617.20	-
Total	<u><u>5,621,771.73</u></u>	<u><u>4,236,761.15</u></u>



Debapriya Dutta

RECEIPT AND PAYMENT ACCOUNT FOR THE YEAR ENDED ON 31ST MARCH, 2013

Euro Version

(Conversion Factor 1 Euro.= Rs. 68.3403)

(Conversion Factor 1 Euro.= Rs. 63.2400 for the year 2011-12)

Schedule	Amount for the year ended March 31, 2013	Amount for the year ended March 31, 2012
PAYMENTS		
C. Shareable Expenses		
Scientific Expenses of the Centre	B 2,700,716.15	1,799,353.27
Governing Body/ Scientific Council Expenses	C 193,053.52	188,004.05
Travelling Expenses	D 29,826.30	26,573.40
Office Expenses - Shareable	E 58,266.30	54,982.42
Salaries	F 192,500.52	177,518.28
Purchase of Office Equipment.	789.10	544.75
Purchase of Furniture & Fixture	2,446.32	-
Purchase of Staff Car	-	9,562.98
Security Deposit-Director's residence	790.16	-
Security Deposit-Cellphone	10.54	-
Sale of Old Staff Car	-	(790.64)
Furniture & Fixture (Sold)	(347.73)	-
Office Equipment (Sold)	(311.88)	-
Advance paid to suppliers	-	-
	<u>3,177,739.30</u>	<u>(158.13)</u>
		2,255,590.38
D. Non-shareable Expenses		
Office Expenses - Non-shareable	G 53,733.42	18,787.67
Computer System.	8,323.20	8,450.35
Computer System (Sold)	(604.15)	(118.60)
Furniture & Fixture	-	-
	<u>61,452.47</u>	<u>-</u>
		27,119.42
E. Targetted Scientific Programmes	H 192,694.03	-
F. Extramural Activities	I 14,325.51	-
G. Gratuity Fund	J 4,465.27	5,360.86
H. Peer Review Committee (Bhopal Gas)	K -	1,776.33
J. Miscellaneous Payments	L 93,944.79	48,357.61
	<u>3,544,621.37</u>	<u>2,338,204.60</u>
Total = (C+D+E+F+G+H+I)		
J. Closing Balance		
Bank Balances		
In Indian Rupees Saving Bank Account		
Union Bank of India	117,861.88	3,513.91
State Bank of Hyderabad	777,291.25	1,163,610.27
Axis Bank	10,940.32	11,361.35
State Bank of Hyderabad (Gratuity Fund)	37,505.20	43,217.35
In Euro Account		
Credit Industriel et Commercial, Paris, France	<u>1,133,551.71</u>	<u>676,853.67</u>
	2,077,150.36	1,898,556.55
TOTAL (C+D+E+F+G+H+I+J)	<u><u>5,621,771.73</u></u>	<u><u>4,236,761.15</u></u>

Accounting policies and notes on accounts M

As per our report of even date.

For **SSAS AND ASSOCIATES**
Firm Registration No. 08550N
Chartered Accountants

Alpana Saxena
ALPANA SAXENA
Partner
Membership No. 095837



DAVINDER KAMBOJ
DAVINDER KAMBOJ
MANAGER (ADMN. & ACCTS.)

Debapriya Dutta
DR. DEBAPRIYA DUTTA
DIRECTOR

Place : New Delhi
Date : 28.09.2013

INDO-FRENCH CENTRE FOR THE PROMOTION OF ADVANCED RESEARCH, NEW DELHI

RECEIPT AND PAYMENT ACCOUNT FOR THE YEAR ENDED ON 31ST MARCH, 2013

(Conversion Factor 1 Euro.= Rs. 68.3403)
(Conversion Factor 1 Euro.= Rs. 63.24 for the year 2011-12)

Schedule	Amount for the year ended March 31, 2013		Amount for the year ended March 31, 2012	
	Transaction in		Transaction in	
	Transaction in Rs	Euro	Transaction in Rs	Euro
A. Opening balance				
Bank Balances				
In Indian Rupees S B Account				
Union Bank of India	222,219.95	-	213,853.95	-
State Bank of Hyderabad	73,586,714.11	-	40,207,376.72	-
Axis Bank	718,492.00	-	669,339.00	-
Bank of Tokyo Mitsubishi Ltd.	-	-	1,805.00	-
State Bank of Hyderabad (Gratuity Fund)	2,733,065.47	-	4,617,336.47	-
In Euro Account				
Credit Industriel et Commercial, Paris, France	-	676,853.67	-	189,650.76
Total (A)	77,260,491.53	676,853.67	45,709,711.14	189,650.76
B. Receipts				
Grant-in-aid				
Contribution from Dept. of Science and Technology, Govt. of India	82,727,465.00	-	97,836,000.00	-
Contribution from Govt. of France	-	1,650,000.00	-	1,450,000.00
Grant-in-aid - Targetted Programmes				
IFCAM Projects	14,515,000.00	-	-	-
DST-INRA Projects	3,250,000.00	50,000.00	-	-
Raman Charpak Fellowship	7,500,000.00	-	-	-
Extramural Activities				
Economic Diplomacy-R&D Programmes	-	34,455.00	-	-
Project with IIT Rajasthan	-	25,163.00	-	-
India Science & Innovation House Project	-	26,828.90	-	-
Interest from Bank Accounts				
Banks in India	3,125,765.00	-	1,954,085.00	-
Interest received from Income Tax	3,844,574.00	-	1,392,500.00	-
Refund of Income Tax / TDS	20,537,714.00	-	14,500,000.00	-
Gratuity Fund-Bank Interest	135,209.00	-	173,734.00	-
Amount deducted from Salaries				
Tax Deducted at Source	1,000,334.00	-	888,917.00	-
Group Insurance Premium	9,360.00	-	7,440.00	-
Contributory Provident Fund	1,449,621.00	-	1,490,250.00	-
TDS deducted-Bills/Contractors etc.	340,874.00	-	191,956.00	-
Amount recovered on behalf of CLRI, Chennai	43,940.00	-	96,668.00	-
Amount recovered on behalf of DST	110,520.00	-	-	-
Total (B)	138,590,376.00	1,786,446.90	118,531,550.00	1,450,000.00
Total (A + B)	215,850,867.53	2,463,300.57	164,241,261.14	1,639,650.76



Debapriya Dutta

RECEIPT AND PAYMENT ACCOUNT FOR THE YEAR ENDED ON 31ST MARCH, 2013

	Schedule	Amount for the year ended March 31, 2013		Amount for the year ended March 31, 2012	
		Transaction in Rs	Transaction in Euro	Transaction in Rs	Transaction in Euro
PAYMENTS					
C. Shareable Expenses					
Scientific Expenses of the Centre	B	100,960,423.62	1,223,397.16	57,023,362.61	897,655.57
Governing Body/ Scientific Council Expenses	C	9,212,928.00	58,243.93	8,126,549.00	59,500.74
Travelling Expenses	D	1,717,750.00	4,691.06	1,438,336.00	3,829.31
Office Expenses - Shareable	E	3,844,107.00	2,016.81	3,362,531.00	1,811.47
Salaries	F	13,155,543.00	-	11,226,256.00	-
Purchase of Office Equipment		43,000.00	159.90	34,450.00	-
Purchase of Furniture & Fixtures		167,182.00	-	-	-
Purchase of Staff Car		-	-	604,763.00	-
Security Deposit-Director's residence		54,000.00	-	-	-
Security Deposit-Cellphone		720.00	-	-	-
Sale of Old Staff Car		-	-	(50,000.00)	-
Furniture & Fixture (Sold)		(23,764.00)	-	-	-
Office Equipment (Sold)		(21,314.00)	-	-	-
Advance paid to suppliers		-	-	(10,000.00)	-
Total (C)		129,110,575.62	1,288,508.86	81,756,247.61	962,797.09
D. Non-shareable Expenses					
Office Expenses - Non-shareable	G	3,672,158.00	-	1,188,132.00	-
Computer System.		568,810.00	-	534,400.00	-
Computer System (Sold)		(41,288.00)	-	(7,500.00)	-
Total (D)		4,199,680.00	-	1,715,032.00	-
E. Targetted Scientific Programmes	H	10,366,815.00	41,000.00	-	-
F. Extramural Activities	I	962,608.00	240.00	-	-
G. Gratuity Fund	J	305,158.00	-	339,021.00	-
II. Peer Review Committee (Bhopal Gas)	K	-	-	112,335.00	-
I. Miscellaneous Payments	L	6,420,216.00	-	3,058,134.00	-
Total (C+D+E+F+G+H+I)		151,365,052.62	1,329,748.86	86,980,769.61	962,797.09
J. Closing Balance					
Bank Balances					
In Indian Rupees Saving Bank Account					
Union Bank of India		8,054,715.95	-	222,219.95	-
State Bank of Hyderabad		53,120,317.49	-	73,586,714.11	-
Axis Bank		747,665.00	-	718,492.00	-
State Bank of Hyderabad (Gratuity Fund)		2,563,116.47	-	2,733,065.47	-
In Euro Account					
Credit Industriel et Commercial, Paris, France		-	1,133,551.71	-	676,853.67
Total (J)		64,485,814.91	1,133,551.71	77,260,491.53	676,853.67
TOTAL (C+D+E+F+G+H+I+J)		215,850,867.53	2,463,300.57	164,241,261.14	1,639,650.76

Accounting policies and notes on accounts M

As per our report of even date.

For SSAS AND ASSOCIATES
Firm Registration No. 08550N
Chartered Accountants

Alpina Saxena
ALPINA SAXENA
Partner
Membership No. 095837



DAVINDER KAMBOJ
DAVINDER KAMBOJ
MANAGER (ADMN. & ACCTS.)

Debapriya Dutt
DR. DEBAPRIYA DUTTA
DIRECTOR

Place : New Delhi
Date : 28.09.2013

INDO-FRENCH CENTRE FOR THE PROMOTION OF ADVANCED RESEARCH, NEW DELHI

SCHEDULE FORMING PART OF BALANCE SHEET AS AT 31ST MARCH, 2013

Rupee Version
(Conversion Factor: Euro 1 = Rs. 68.3403)

Schedule 'A'

Fixed Assets

S. No.	Particulars	Rate of Depn.	GROSS BLOCK				DEPRECIATION For the Year	NET BLOCK Balance as on 31.03.2013	
			Balance as on 01.04.2012	Additions during the Year		Sold during the year			Total
				upto 30.09.2011	after 30.09.2012				
1	Land & Building	10%	2,459,961.00	-	-	-	2,459,961.00	245,996.00	2,213,965.00
2	Computer	60%	336,530.00	135,000.00	433,810.00	41,288.00	864,052.00	388,288.00	475,764.00
3	Office Equipment	15%	297,213.00	-	53,927.61	21,314.00	329,826.61	45,429.00	284,397.61
4	Photocopier	15%	216,839.00	-	-	-	216,839.00	32,526.00	184,313.00
5	Telephone system	15%	193,500.00	-	-	-	193,500.00	29,025.00	164,475.00
6	Furniture & Fixtures	10%	1,274,320.00	61,713.00	105,469.00	23,764.00	1,417,738.00	136,500.00	1,281,238.00
7	Car	15%	603,780.00	-	-	-	603,780.00	90,567.00	513,213.00
	Total		5,382,143.00	196,713.00	593,206.61	86,366.00	6,085,696.61	968,331.00	5,117,365.61
	Previous Year		5,377,018.00	1,106,463.00	67,150.00	57,500.00	6,493,131.00	1,110,988.00	5,382,143.00

Euro Version

Rate of Depn.	Balance as on 01.04.2012	Change due to Exchange Rate	Net Balance as on 01.04.2012	GROSS BLOCK		Sold during the	Total	DEPRECIATION For the Year	NET BLOCK Balance as on 31.03.2013
				Additions during the Year					
				upto 30.09.12	after 30.09.12				
10%	38,898.83	(2,903.05)	35,995.78	-	-	-	35,995.78	3,599.58	32,396.20
60%	5,321.47	(397.15)	4,924.32	1,975.41	6,347.79	604.15	12,643.37	5,681.69	6,961.68
15%	4,699.76	(350.75)	4,349.01	-	789.10	311.88	4,826.23	664.75	4,161.48
15%	3,428.83	(255.90)	3,172.93	-	-	-	3,172.93	475.94	2,696.99
15%	3,059.76	(228.35)	2,831.41	-	-	-	2,831.41	424.71	2,406.70
10%	20,150.52	(1,503.85)	18,646.67	903.03	1,543.29	347.73	20,745.26	1,997.36	18,747.90
15%	9,547.45	(712.54)	8,834.91	-	-	-	8,834.91	1,325.24	7,509.67
	85,106.62	(6,351.59)	78,755.03	2,878.44	8,680.18	1,263.76	89,049.89	14,169.27	74,880.62
	89,045.58	(4,019.99)	85,025.59	17,496.25	1,061.83	909.24	102,674.43	17,567.81	85,106.62

Debarajita Gupta



INDO-FRENCH CENTRE FOR THE PROMOTION OF ADVANCED RESEARCH, NEW DELHI

SCHEDULES FORMING PART OF THE INCOME & EXPENDITURE ACCOUNT AND
RECEIPT & PAYMENT ACCOUNT FOR THE YEAR ENDED ON 31ST MARCH 2013

Amount for the year ended March 31, 2013
(Conversion Factor 1 Euro = Rs. 68.3403)

	Transaction in Rs	Transaction in Euro	Total Transaction converted in Rs	Total Transaction converted in Euro
Schedule ' B '				
Scientific Expenses of the Centre				
Research Projects	80,369,373.34	933,951.79	144,195,918.85	2,109,969.06
Industrial Research Projects	6,323,256.00	179,211.01	18,570,590.19	271,737.03
Seminars & Workshops	10,450,732.00	109,174.36	17,911,740.51	262,096.31
Professional & Other Scientific Expenses	191,049.00	-	191,049.00	2,795.55
Expenses on Outreach	2,033,747.28	1,060.00	2,106,188.00	30,819.12
Publication Etc.	1,516,416.00	-	1,516,416.00	22,189.19
Expenses on Patents	75,850.00	-	75,850.00	1,109.89
	<u>100,960,423.62</u>	<u>1,223,397.16</u>	<u>184,567,752.55</u>	<u>2,700,716.15</u>
Schedule ' C '				
Governing Body/ Scientific Council Expenses				
Governing Body	2,984,195.00	7,178.10	3,474,748.51	50,844.79
Scientific Council	6,228,733.00	51,065.83	9,718,587.14	142,208.73
	<u>9,212,928.00</u>	<u>58,243.93</u>	<u>13,193,335.65</u>	<u>193,053.52</u>
Schedule ' D '				
Travelling Expenses				
Travel in India	740,612.00	-	740,612.00	10,837.12
Travel Abroad	977,138.00	4,691.06	1,297,726.45	18,989.18
	<u>1,717,750.00</u>	<u>4,691.06</u>	<u>2,038,338.45</u>	<u>29,826.30</u>
Schedule ' E '				
Office Expenses - Shareable				
Car Hire Charges	169,953.00	-	169,953.00	2,486.86
Conveyance Expenses	98,890.00	-	98,890.00	1,447.02
Staff Car Expenses	162,182.00	-	162,182.00	2,373.15
Office Equipment-Maintenance\Consumables	672,866.00	-	672,866.00	9,845.82
Telephones & Internet expenses	356,391.00	-	356,391.00	5,214.95
Stationery	201,534.00	-	201,534.00	2,948.98
Newspapers and Periodicals	19,514.00	-	19,514.00	285.54
Books - Others	6,600.00	-	6,600.00	96.58
Postage and Courier Expenses	307,880.00	-	307,880.00	4,505.10
Miscellaneous Office Expenses	204,796.00	-	204,796.00	2,996.71
Security Charges	314,895.00	-	314,895.00	4,607.75
Rent	721,250.00	-	721,250.00	10,553.80
Entertainment Expenses	18,783.00	403.70	46,371.98	678.55
Liveries	-	-	-	-
Other Establishment Charges	64,098.00	-	64,098.00	937.92
Audit Fee	44,944.00	-	44,944.00	657.65
Bank Charges	6,150.00	1,613.11	116,390.42	1,703.10
Electricity Charges	193,142.00	-	193,142.00	2,826.18
Professional Service Charges	278,654.00	-	278,654.00	4,077.45
Interest on Late payment of TDS	1,585.00	-	1,585.00	23.19
	<u>3,844,107.00</u>	<u>2,016.81</u>	<u>3,981,936.40</u>	<u>58,266.30</u>
Schedule ' F '				
Salaries	13,155,543.00	-	13,155,543.00	192,500.52



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Sebapriya Dutta

INDO-FRENCH CENTRE FOR THE PROMOTION OF ADVANCED RESEARCH, NEW DELHI

SCHEDULE FORMING PART OF THE INCOME & EXPENDITURE ACCOUNT AND
RECEIPT & PAYMENT ACCOUNT FOR THE YEAR ENDED ON 31ST MARCH 2013

Amount for the year ended March 31, 2013
(Conversion Factor 1 Euro = Rs. 68.3403)

	Transaction in Rs	Transaction in Euro	Total Transaction converted in Rs	Total Transaction converted in Euro
Schedule ' G '				
Office Expenses - Non-shareable				
Maintenance Charges to IHC	634,902.00	-	634,902.00	9,290.30
Maintenance - Office Premises	273,027.00	-	273,027.00	3,995.11
Municipal Tax	209,093.00	-	209,093.00	3,059.59
25th Anniversary Expenses	2,555,136.00	-	2,555,136.00	37,388.42
	3,672,158.00	-	3,672,158.00	53,733.42
Schedule ' H '				
Targetted Scientific Programmes				
IFCAM Projects	6,715,000.00	-	6,715,000.00	98,258.28
DST-INRA Projects	3,591,815.00	41,000.00	6,393,767.30	93,557.79
Raman Charpak Fellowship	60,000.00	-	60,000.00	877.96
	10,366,815.00	41,000.00	13,168,767.30	192,694.03
Schedule ' I '				
Extramural Activities				
Economic Diplomacy-R&D Programmes	77,933.00	-	77,933.00	1,140.37
Project with IIT Rajasthan	-	-	-	-
India Science & Innovation House Project	884,675.00	240.00	901,076.67	13,185.14
	962,608.00	240.00	979,009.67	14,325.51
Schedule ' J '				
Gratuity Fund				
Paid to LIC for maintaining the-Gratuity Fund	305,158.00	-	305,158.00	4,465.27
	305,158.00	-	305,158.00	4,465.27
Schedule ' K '				
Peer Review Committee (Bhopal Gas)				
Refund of Grant to DST	-	-	-	-
Expenses Incurred	-	-	-	-
	-	-	-	-
Schedule ' L '				
Other Payments				
TDS deposited-Salaries	1,000,334.00	-	1,000,334.00	14,637.54
TDS deposited-Bills/Contractors etc.	340,874.00	-	340,874.00	4,987.89
Group Insurance - Paid to LIC	9,360.00	-	9,360.00	136.96
C.P. Fund-Transferred to CPF	1,449,621.00	-	1,449,621.00	21,211.80
Income Tax Demand and TDS	-	-	-	-
IFCPAR CP Fund	-	-	-	-
Amount paid to CLRI, Chennai	43,940.00	-	43,940.00	642.96
Income Tax Demand	3,465,567.00	-	3,465,567.00	50,710.44
Amount paid to DST	110,520.00	-	110,520.00	1,617.20
	6,420,216.00	-	6,420,216.00	93,944.79



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INDO-FRENCH CENTRE FOR THE PROMOTION OF ADVANCED RESEARCH, NEW DELHI

**SCHEDULES FORMING PART OF THE INCOME & EXPENDITURE ACCOUNT AND
RECEIPT & PAYMENT ACCOUNT FOR THE YEAR ENDED ON 31ST MARCH 2013**

Amount for the year ended March 31, 2012
(Conversion Factor 1 Euro = Rs. 63.24000)

	Transaction in Rs	Transaction in Euro	Total Transaction converted in Rs	Total Transaction converted in Euro
Schedule ' B '				
Scientific Expenses of the Centre				
Research Projects	43,370,128.61	744,391.37	90,445,438.85	1,430,193.53
Industrial Research Projects	4,773,303.00	41,843.24	7,419,469.50	117,322.41
Seminars & Workshops	7,343,746.00	110,520.96	14,333,091.51	226,645.98
Professional & Other Scientific Expenses	487,280.00	900.00	544,196.00	8,605.25
Expenses on Outreach	-	-	-	-
Publication Etc.	939,691.00	-	939,691.00	14,859.12
Expenses on Patents	109,214.00	-	109,214.00	1,726.98
	<u>57,023,362.61</u>	<u>897,655.57</u>	<u>113,791,100.86</u>	<u>1,799,353.27</u>
Schedule ' C '				
Governing Body/ Scientific Council Expenses				
Governing Body	2,725,711.00	12,739.91	3,531,382.91	55,840.97
Scientific Council	5,400,838.00	46,760.83	8,357,992.89	132,163.08
	<u>8,126,549.00</u>	<u>59,500.74</u>	<u>11,889,375.80</u>	<u>188,004.05</u>
Schedule ' D '				
Travelling Expenses				
Travel in India	744,578.00	-	744,578.00	11,773.85
Travel Abroad	693,758.00	3,829.31	935,923.56	14,799.55
	<u>1,438,336.00</u>	<u>3,829.31</u>	<u>1,680,501.56</u>	<u>26,573.40</u>
Schedule ' E '				
Office Expenses - Shareable				
Car Hire Charges	223,779.00	-	223,779.00	3,538.57
Conveyance Expenses	83,773.00	-	83,773.00	1,324.68
Staff Car Expenses	101,109.00	-	101,109.00	1,598.81
Office Equipment-Maintenance\Consumables	501,436.00	-	501,436.00	7,929.10
Telephones & Internet expenses	314,119.00	-	314,119.00	4,967.09
Stationery	138,200.00	-	138,200.00	2,185.33
Newspapers and Periodicals	13,835.00	-	13,835.00	218.77
Books - Others	4,923.00	-	4,923.00	77.85
Postage and Courier Expenses	499,582.00	-	499,582.00	7,899.78
Miscellaneous Office Expenses	207,365.00	-	207,365.00	3,279.02
Security Charges	385,320.00	-	385,320.00	6,092.98
Rent	499,361.00	-	499,361.00	7,896.28
Entertainment Expenses	42,937.00	-	42,937.00	678.95
Liveries	18,027.00	-	18,027.00	285.06
Other Establishment Charges	132,517.00	-	132,517.00	2,095.46
Audit Fee	33,090.00	-	33,090.00	523.24
Bank Charges	6,434.00	1,811.47	120,991.36	1,913.21
Electricity Charges	156,590.00	-	156,590.00	2,476.12
Professional Service Charges	-	-	-	-
Interest on Late payment of TDS	134.00	-	134.00	2.12
	<u>3,362,531.00</u>	<u>1,811.47</u>	<u>3,477,088.36</u>	<u>54,982.42</u>
Schedule ' F '				
Salaries	11,226,256.00	-	11,226,256.00	177,518.28



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Sebanpreya Datta

INDO-FRENCH CENTRE FOR THE PROMOTION OF ADVANCED RESEARCH, NEW DELHI

SCHEDULE FORMING PART OF THE INCOME & EXPENDITURE ACCOUNT AND
RECEIPT & PAYMENT ACCOUNT FOR THE YEAR ENDED ON 31ST MARCH 2013

Amount for the year ended March 31, 2012
(Conversion Factor 1 Euro = Rs. 63.2400)

	Transaction in Rs	Transaction in Euro	Total Transaction converted in Rs	Total Transaction converted in Euro
Schedule ' G '				
Office Expenses - Non-shareable				
Maintenance Charges to IHC	581,040.00	-	581,040.00	9,187.86
Maintenance - Office Premises	225,592.00	-	225,592.00	3,567.24
Municipal Tax	209,093.00	-	209,093.00	3,306.34
Professional Charges	172,407.00	-	172,407.00	2,726.23
25th Anniversary Expenses				
	1,188,132.00	-	1,188,132.00	18,787.67
Schedule ' H '				
Targetted Scientific Programmes				
IFCAM Projects	-	-	-	-
DST-INRA Proects	-	-	-	-
Raman Charpak Fellowship	-	-	-	-
	-	-	-	-
Schedule ' I '				
Extramural Activities				
Economic Diplomacy-R&D Programmes	-	-	-	-
Project with IIT Rajasthan	-	-	-	-
India Science & Innovation House Project	-	-	-	-
	-	-	-	-
Schedule ' J '				
Gratuity Fund				
Paid to LIC for maintaining the-Gratuity Fund	339,021.00	-	339,021.00	5,360.86
	339,021.00	-	339,021.00	5,360.86
Schedule ' K '				
Peer Review Committee (Bhopal Gas)				
Refund of Grant to DST	112,335.00	-	112,335.00	1,776.33
Expenses Incurred	-	-	-	-
	112,335.00	-	112,335.00	1,776.33
Schedule ' L '				
Other Payments				
TDS deposited-Salaries	888,917.00	-	888,917.00	14,056.25
TDS deposited-Bills/Contractors etc.	191,956.00	-	191,956.00	3,035.36
Group Insurance - Paid to LIC	7,440.00	-	7,440.00	117.65
C.P. Fund-Transferred to CPF	1,490,250.00	-	1,490,250.00	23,564.99
Income Tax Demand and TDS	1,028.00	-	1,028.00	16.26
IFCPAR CP Fund	(133,076.00)	-	(133,076.00)	(2,104.30)
Amount paid to CLRI, Chennai	96,668.00	-	96,668.00	1,528.59
Income Tax Demand	514,951.00	-	514,951.00	8,142.81
Amount paid to DST	-	-	-	-
	3,058,134.00	-	3,058,134.00	48,357.61



[Signature]

Sebapriya D.

INDO-FRENCH CENTRE FOR THE PROMOTION OF ADVANCED RESEARCH (IFCPAR)

SCHEDULE ANNEXED TO AND FORMING PART OF THE BALANCE SHEET, INCOME & EXPENDITURE ACCOUNT AND RECEIPT & PAYMENT ACCOUNT FOR THE YEAR ENDED 31ST MARCH, 2013

SCHEDULE- ' M '

ACCOUNTING POLICIES AND NOTES ON ACCOUNTS

Organisation Overview

The Indo French Centre for the Promotion of Advanced Research (the Society) was registered on 16th day of April, 1986 under Societies Registration Act, 1860. The Society involves in the activities to (i) promote cooperation between India and France in advanced areas of fundamental and applied scientific research. (ii) develop cooperation by identifying scientist and scientific institutions of India and France. (iii) provide assistance in the form of grants and equipment as well as other appropriate means for the pursuit of advanced scientific research.

A. SIGNIFICANT ACCOUNTING POLICIES

1. **Accounting Period:** Financials are reported from 01st April of a year to 31st March of the following year for both Indian Rupees & Euro Transactions.
2. **Basis of preparation :** The financial statements are prepared under the historical cost convention and on cash basis.
3. Any surplus of Income over Expenditure carried forward to next year for utilization as per objectives of the Centre.
4. Grants released for various research projects have been shown under the head "Scientific Expenses" in the "Income & Expenditure Account" on the basis of disbursements made by the Centre. First year releases are made on the basis of the approved Budget. However, subsequent releases are made only on receipt of the statement of expenditure of the previous years from the institutions.
5. All the assets acquired for research projects remain with the institution where the research work is carried on. The Centre has however retained the right to transfer these assets to other institutions, if so required, on completion of the projects for which these assets were purchased. The expenditure on these assets has been accounted for in the Income and Expenditure Account under the head "Scientific Expenses". Hence, these assets have not been taken in the Balance Sheet of the Centre.
6. **Reporting currency & Foreign Currency Transactions :**

The accounting currency of the Society is Indian Rupee and Euro. Separate books of accounts are maintained for recording respective transactions occurring in Rupee and Euro currencies.

In Euro version of the accounts the opening balances have been adjusted on the basis of the exchange rate adopted during the year. The difference arising from the restatement of monetary foreign currency assets (Bank Balance) is recognised as exchange fluctuation reserve in the Income and Expenditure Account. The difference arising from the restatement of other assets & liabilities are adjusted to Capital Fund in the Balance sheet.

Euro accounts at the year end are being converted at the market rate of exchange obtained on the last working day of the previous financial year as prescribed by the Reserve Bank of India and vice versa. The rate adopted during the year 2012-13 is Euro 1 = Rs. 68.3403 and the consolidated statement of accounts in Rupee & Euro Versions are made on the basis of the above rate.



7. **Grants Awarded - Recognition:** Grants to an awardee are recognised on the recommendation of the Scientific Council, approval by the Governing Body and with the final approval of both Indian and French Governments. Based on the commitments made to awardees in a year, aggregate grants are recognised as expenditure to the extent of payment made to each awardee during the year.
8. **Income Recognition:**
Grants-in-aid : Grants received from Department of Science & Technology, Government of India and from Government of France are shown as Grant in Aid under the head Income in the Income and Expenditure Account.
9. **Fixed Assets:**
 - a) Fixed assets are stated at cost of acquisition less accumulated depreciation. The cost of an asset comprises of its purchase price and directly attributable costs of bringing the asset to working condition for its intended use.
 - b) Depreciation on fixed assets has been provided at the rates and in the manner specified in Income Tax Rules, 1962.
 - c) The office premise is owned by the Centre. However, the formalities in respect of the registration of the documents are pending on the part of Land & Development Office, Delhi.

B. NOTES TO ACCOUNTS:

1. Grants-in-Aid

- a. IFCPAR has received a sum of Euro 1,650,000 from Government of France towards grants-in-aid for the financial year 2012-13 for normal activities of the Centre. A sum of Euro 100,000 was sanctioned by Government of France towards grants-in-aid for the financial year 2011-12 which remained to be received and was credited to the Centre's bank account in April 2012. This amount has been taken in the receipt of the current financial year 2012-13. In addition, an amount of Euro 50,000 received during the year towards the Targetted Scientific Programmes from Government of France.
- b. IFCPAR has received a sum of Rs. 82,727,465/- as Grants- in-aid from Government of India, Ministry of Science and Technology, Department of Science and Technology during the year for normal activities of the Centre. In addition, an amount of Rs. 25,265,000/- received during the year towards the Targetted Scientific Programmes from Government of India.

2. **Income Tax :** The Centre was granted exemption under section 11(1)(c) of the Income Tax Act for the financial years 2004-05 to 2008-09. An amount of Rs. 2.05 crores was refunded by the IT Dept. during the financial year 2012-13 towards tax deposited by the Centre against the Income Tax Demand for the A.Y. 2005-06. The amount of interest received from Income Tax Department has been booked as "Interest received from Income Tax Department" in the Income & Expenditure Account.

Application for exemption under section 11(1)(c) of the IT Act for the financial years 2009-10 onwards is pending with CBDT. One Income Tax demand has been raised against the Centre for the financial year 2009-10 amounting to Rs. 7.31 crore. No provision has been made in this regard as the matter regarding legality of Income Tax liability of the Centre is being contested at appropriate forums.

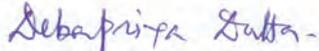


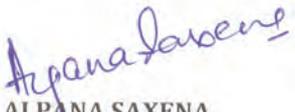
4. Employee Benefits

- a. **Gratuity:** An amount of Rs. 305,158/- was paid to LIC of India towards annual premium for the Group Gratuity Cash Accumulation Scheme maintained with LIC of India.
 - b. **Contributory Provident Fund & Super Annuation Scheme (Pension):**The Centre has been maintaining a Super Annuation Scheme with LIC of India for the Pension scheme for its employees. During the year an amount of Rs. 1,604,871/- was paid to LIC of India towards annual contribution for the Superannuation Scheme for the employees/ex-employees of the Centre, is debited to Income & Expenditure Account under the head "Salaries".
5. **Related parties Disclosures:** During the year no trust funds were utilized for the benefits of the trustees other than reimbursement of expenses incurred by them.
6. Previous years' figures are regrouped wherever necessary.

For **SSAS AND ASSOCIATES**
Firm Registration No. 08550N
Chartered Accountants


DAVINDER KAMBOJ
MANAGER (ADMN. & ACCTS.)


DR. DEBAPRIYA DUTTA
DIRECTOR


ALPANA SAXENA
Partner
Membership No. 095837



Place : New Delhi
Date : 28.09.2013

**INDO-FRENCH CENTRE
FOR THE PROMOTION OF ADVANCED RESEARCH
New Delhi**

RECEIPT AND PAYMENT ACCOUNT IN RESPECT OF
IFCPAR GRATUITY FUND FOR THE YEAR ENDED 31ST MARCH, 2013

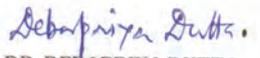
RECEIPTS	AMOUNT (Rs.)	PAYMENTS	AMOUNT (Rs.)
Opening balance Balance with State Bank of Hyderabad, IHC	2,733,065.47	Annual Contribution paid to LIC of India towards contribution to Gratuity Fund	305,158.00
Amount Receivable from IFCPAR towards TDS deducted by Bank on Interest	92,709.00		
Interest from Bank on Saving Bank and Short Term Deposits	135,209.00	Closing balance State Bank of Hyderabad Savings Bank Account	2,563,116.47
		TDS deducted by Bank on Interest	92,709.00
TOTAL	2,960,983.47	TOTAL	2,960,983.47

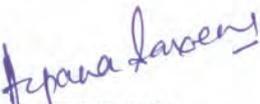
The above transactions/balances are included in the Receipt & Payment account of IFCPAR for the year 2012-2013.

Compiled from the books of accounts
and records as produced before us

For **SSAS AND ASSOCIATES**
Firm Registration No. 08550N
Chartered Accountants


DAVINDER KAMBOJ
MANAGER (ADMN. & ACCTS.)


DR. DEBAPRIYA DUTTA
DIRECTOR


ALPANA SAXENA
Partner
Membership No. 095837



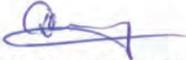
Place : New Delhi
Date : 28.09.2013

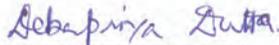
**INDO-FRENCH CENTRE
FOR THE PROMOTION OF ADVANCED RESEARCH**
New Delhi
**RECEIPT AND PAYMENT ACCOUNT IN RESPECT OF
IFCPAR CONTRIBUTORY PROVIDENT FUND FOR THE YEAR ENDED 31ST MARCH, 2013**

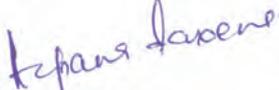
RECEIPTS	Amount (Rs.)	PAYMENTS	Amount (Rs.)
<u>Opening Balance:</u>		<u>Advance paid to:</u>	
Balance with State Bank of Hyderabad, IHC	3,899,313.27	Mr. V.V. Rao	252,000.00
Special Deposit Scheme Account with Union Bank of India, Connaught Place	514,769.00	Mr. Deepankar Barua	50,100.00
PF contributions received from employees for the year 2012-2013	1,276,496.00	<u>Final withdrawal by:</u>	
Refund of advances by the employees	188,525.00	Mr. T. Nadarajan	180,000.00
<u>Interest earned by the fund on:</u>		Mr. R. Murali	575,000.00
Special deposits with UBI	45,429.00		
Short-term deposits and SB deposits with SBH	<u>169,649.00</u>		
	215,078.00		
Interest paid by the Centre on Employees contribution (after adjusting interest earned by IFCPAR CP Fund A/c.)	208,825.00	<u>Closing Balance:</u>	
		Balance with State Bank of Hyderabad, IHC	4,731,137.27
		Special Deposit Scheme Account with Union Bank of India, Connaught Place	514,769.00
TOTAL	6,303,006.27	TOTAL	6,303,006.27

Compiled from the books of accounts
and records as produced before us

For **SSAS AND ASSOCIATES**
Firm Registration No. 08550N
Chartered Accountants


DAVINDER KAMBOJ
MANAGER (ADMN. & ACCTS.)


DR. DEBAPRIYA DUTTA
DIRECTOR


ALPANA SAXENA
Partner
Membership No. 095837

Place : New Delhi
Date : 28.09.2013







Indo-French Centre for the Promotion of Advanced Research (CEFIPRA) is a model for international collaborative research in advanced areas of science and technology. The centre was established in 1987 with support from Department of Science & Technology, Government of India and the Ministry of Foreign Affairs, Government of France.



For further information please contact:
Pour toute information complémentaire, veuillez contacter:

Director

Indo-French Centre for the Promotion of Advanced Research

5B, Ground Floor, Indio Habitat Centre, Lodhi Road, New Delhi-110 003 INDIA

Direct: +91-11 -24682252, PBX: +91 -11 -24682251 /2463 3567/4352 6261

Fax: +91 -11-24648632

E-mail: director@cefipra.org | Web: www.cefipra.org