

Physics Programme
IISER Pune

2015





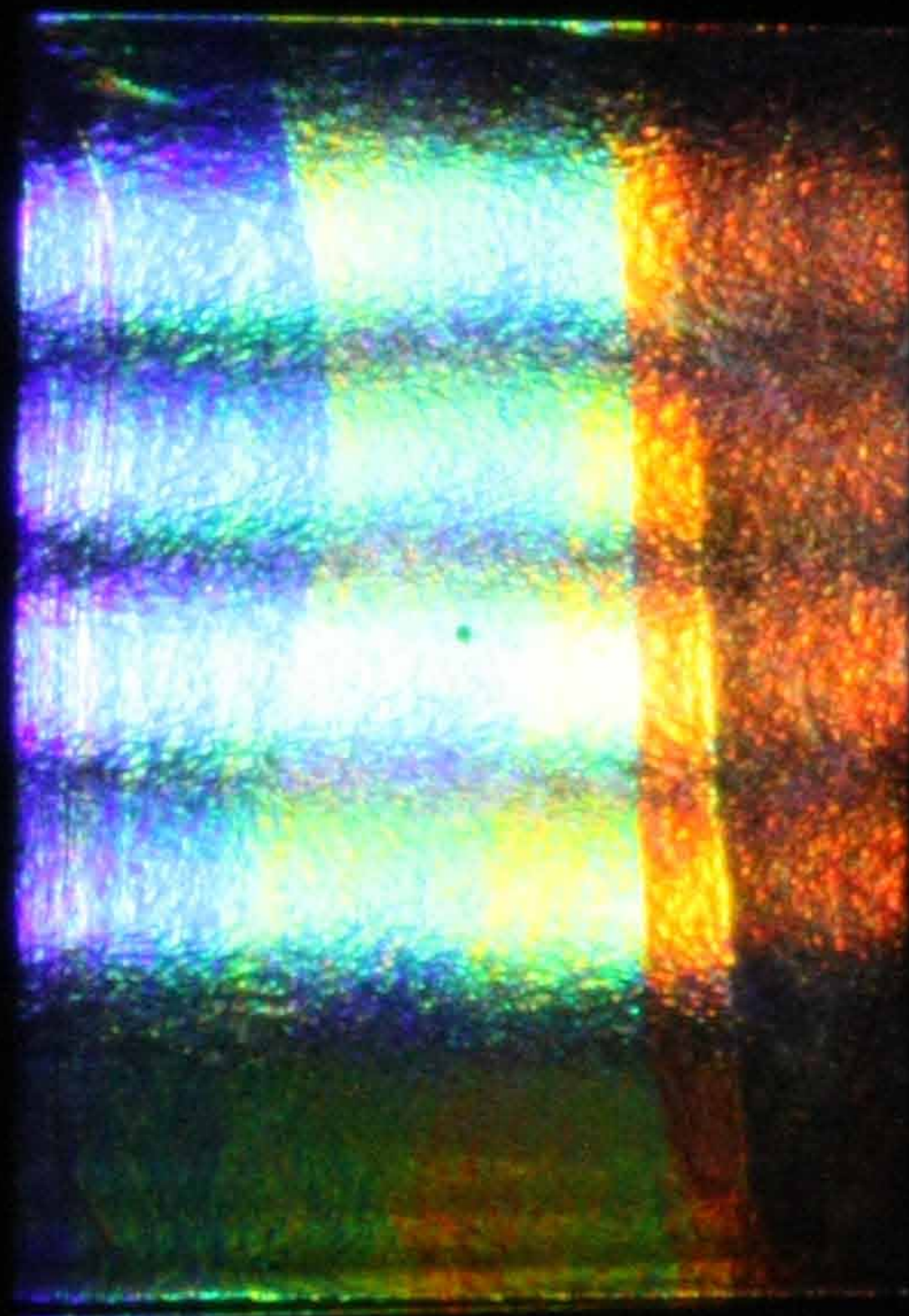
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Contents

Welcome from the Chair	11
The Physics Programme	13
Faculty Members	16
Postdoctoral Fellows	58
Ph.D. Students	62
Seminars and Colloquia	84
Academic Events and Special Lectures	94
Facilities and Equipment	98
Teaching Programme	108



Welcome from the Chair



The Physics Programme at IISER Pune is built on the twin pillars of research and education, in keeping with the overall philosophy of IISER. We see this as a mutually beneficial arrangement for faculty and students alike.

Faculty members find it invigorating to have strongly motivated students participating in their laboratory-based or theoretical research. Students, in turn, benefit from the strong research background of their teachers, who bring a confident and modern understanding of their subject to the classroom and the teaching laboratory. The involvement of undergraduates in research work, often leading to publications, is a key feature of IISER's programme.

Our programme is still youthful. It is in a phase where strengths are being consolidated and plans starting to bear fruit. Our research goals span all the profound and challenging questions in physical science, from the micro-world to the cosmos. We are equally at home pursuing fundamental principles of long-term relevance and seeking solutions with a more immediate social impact. Rather than compartmentalising our programme, we emphasise the unity of all of physics and encourage research across traditional boundaries.

Over the next decade, I am confident that we will be seen as a leading player in Indian and global science, and a force to reckon with.

Sunil Mukhi



The Physics Programme

Research in Physics at IISER Pune is broad-based and spans virtually all contemporary areas of global excitement in the field.

From the outset, the goal has been to put together exceptionally skilled and innovative faculty with state-of-the-art facilities to pursue the most challenging questions in both experimental and theoretical Physics. Experimental research has been generously supported, both in terms of funding and infrastructure.

The Physics research laboratory, named h-bar, is a pre-engineered building that was rapidly built to kickstart experimental research while the rest of the IISER campus was still under construction. This may have initially been conceived as a temporary measure, but today this smart and spacious building functions smoothly and houses nearly a dozen major laboratories and facilities, most of which will continue to function there in the near future. Additional space has recently become available in the new Main Building to house future research laboratories. On the theoretical side, plans are also under way for a new High Performance Computing Centre. All Physics faculty and Ph.D. student offices are located within the Main Building.

Research in Physics at IISER Pune can broadly be classified into Complex Systems and Nonlinear Dynamics, Condensed Matter and Statistical Physics, Soft Condensed Matter, Plasmonics and Photonics, Ultracold Atoms, NMR and Quantum Information, Nanoscience and Nanomaterials, High Energy Physics, Gravitation and String Theory, and Astronomy and Astrophysics. These are broad headings but not boundaries, and there is considerable collaboration across them through the exchange of ideas and facilities as well as through joint publications. Several faculty members associated to the Physics programme are jointly associated with other programmes at IISER, particularly Chemistry and Biology. An outline of the research of each faculty member associated to the Physics

Programme can be found in the appropriate section of this brochure.

While IISER does its best to support new faculty in setting up their research programmes, all faculty members are encouraged to apply for competitive, peer-reviewed grants to fund their research in the longer term. Many faculty members have entered into formal collaborations both nationally and internationally with the support of granting agencies and/or joint agreements between science academies. Some of the grants active or recently active at IISER Pune include DST-SERB projects, DST-DAAD projects, DST Nano-mission grants, Wellcome Trust-DBT Fellowships, CEFIPRA grants, ISRO projects, INSPIRE, Ramanujan and J.C. Bose Fellowships. Special mention may be made of the Centre for Research in Energy and Sustainable Materials being set up at IISER (across different disciplines) under a DST grant, and the recent entry of IISER Pune into the CMS Collaboration at CERN, for which India's participation is supported by a special DAE-DST Consortium.

Ph.D. students are a key component of our programme. Endowed with fellowships and housed on campus, they play a major role in our research activity and provide a lively audience for seminar speakers. We have held special lecture series to sensitise our students to exciting opportunities in areas ranging from soft matter systems to neutrinos to topological insulators, and these have always been widely appreciated.

We are also appreciative of the excellent scientific staff who manage our research and teaching laboratories. We pride ourselves on our instrumentation, both purchased and home-built, and on the fact that it is kept in excellent working condition, for which their dedicated service (through very long days and sometimes nights) has proved essential. This provides an efficient research and teaching environment and goes a long way towards inspiring students in the direction of experimental research.

Faculty Members



G. Ambika

Professor and Dean, Graduate Studies

<http://www.iiserpune.ac.in/~g.ambika/>
Joined IISER Pune: August 2006



Research:

My research interests are in theoretical studies on nonlinear dynamics as applied to complex systems and understanding complex systems using complex networks and time series analysis. The focus of our research is on applying theory of dynamical systems to understand and control emergent dynamics and pattern formation in complex systems.

We study dynamics on networks with slow and fast dynamics, relevant mechanisms underlying the growth of complex networks, connectivity decay in directed networks specifically in the context of Alzheimer's disease, and complexity measures from time series and complex networks especially for astrophysical and physiological data. In the next few years I plan to focus on specific issues like characterisation of cross topology in interacting networks, connectivity measures in directed networks, stability of power grids and spreading of epidemics on dynamic networks of social interactions.

Academic Background:

My PhD is from Cochin University of Science and Technology (1988) in nonlinear dynamics. After this I carried out postdoctoral research in the same university for 5 years on the characterisation of chaos and nonlinear time series analysis. Thereafter I was a faculty member at Maharajas College, Cochin until 2006.

Selected Publications / Last Five Years:

- "Dynamical behaviours in time-delay systems with delayed feedback and digitized coupling", Chiranjit Mitra, G. Ambika and Soumitro Banerjee. Chaos, Solitons and Fractals, 69, 188-200 (2014).
- "On interrelations between recurrences and connectivity trends between stock indices", B. Goswami, G. Ambika, N. Marwan and J. Kurths. Physica A, 391, 4364 (2012).
- "Amplitude death in complex networks induced by environment", V. Resmi, G. Ambika, R.E. Amritkar and G. Rangarajan, Phys. Rev. E 85, 046211 (2012).
- "General mechanism for amplitude death in coupled systems", V. Resmi, G. Ambika and R.E. Amritkar, Phys. Rev. E 84, 046212 (2011).
- "Nonlinear time series analysis of the light curves from the black hole system GRS 1915+105", K.P. Harikrishnan, R. Mishra, G. Ambika. Res. Astr. Astrophys. 11, 71-90 (2011).

Grants and Awards:

- DST-SERB project: "Complexity measures from multifractal analysis to

- characterize ECG data for diagnosis and therapy" (2014).
- DST-SERB project: "Emergent dynamics on growing networks with comparable time scales" (2010-13).
- DST-DAAD project: "Interacting networks to model and control dynamics of complex systems" (2012-14).
- Outstanding Faculty Award, IISER Pune (2008-09).
- Visiting Associate, Physical Research Lab, Ahmedabad (2008-09) and IUCAA, Pune since 1995.

Teaching Activities:

- Mechanics, Fall 2006, Fall 2007.
- Electromagnetism and Optics, Spring 2007
- Classical Mechanics, Fall 2009, Fall 2010, Fall 2011, Fall 2012
- Classical Mechanics, Fall 2008, Fall 2009, Fall 2010, Fall 2011, Fall 2012.
- Nonlinear Dynamics, Spring 2009, Spring 2010, Spring 2014.
- Dynamical Systems, Spring 2011.
- Electrodynamics, Fall 2013.
- Classical Electrodynamics, Fall 2013.

Organisational Activities:

- Dean, Graduate Studies, since 2006.
- Member, Senate, IISER, Pune.
- Presiding Officer, Internal Complaints Committee.
- Chair, Academic Committee.
- Chair, Committee on Graduate Courses.
- Chair, Physics Curriculum Committee.
- Chair, Women's Cell, IISER, Pune, 2009-13.
- Library in charge, 2006-2009.
- Warden, 2006-10.

In addition, I take initiative and offer assistance in several general activities: Organisation of the annual convocation of the institute, selection and interview committees, institutional brochures, organisation of academic events etc.

Outreach Activities:

My outreach activities include giving talks in INSPIRE science camps and KVPY summer programmes for school students, refresher courses at academic staff colleges, Science Day lectures in colleges, SERC schools and fostering undergraduate research through summer projects for students from colleges and universities.

Sudarshan Ananth

Associate Professor

www.aei.mpg.de/~ananth
Joined IISER Pune: January 2008



Research:

Quantum Yang-Mills theory provides a remarkably accurate description of three of the four fundamental forces in Nature (the weak, strong and electromagnetic forces). The fourth force, gravity, is classically well understood thanks to the general theory of relativity but lacks a consistent quantum description. My research is aimed at understanding this apparent incompatibility between general relativity and quantum mechanics. Current themes of investigation include the physics of higher spin fields, perturbative ties between Yang-Mills theory and gravity, and continuous-spin representations.

Academic background:

I received a Ph.D. in Theoretical Physics from the University of Florida in 2005. Subsequently I was a Junior Scientist at the Max Planck Institute for Gravitational Physics (Albert Einstein Institute) for two years before moving to IISER Pune in 2008.

Grants and Awards:

- Member, National Academy of Sciences India, 2013.
- N. S. Satya Murthy Memorial Award, Indian Physics Association, 2012.
- Young Scientist Medal, Indian National Science Academy, 2011.
- Young Scientist Platinum Jubilee Award, National Academy of Sciences India, 2011.
- Young Associate, Indian Academy of Sciences, 2009 – 2013.
- Max Planck Partner Group, Max Planck Society, 2009 – 2014.
- Ramanujan Fellowship, DST, Govt. of India, 2008 – 2012.

Teaching Activities:

- World of Physics I (Mechanics): Fall 2008, Fall 2009, Fall 2010, Fall 1011, Fall 2012, Fall 2014.
- Mathematical Methods in Physics: Spring 2014.
- World of Physics III (Electromagnetism): Spring 2008.
- Group Theory: Spring 2009, Spring 2010.
- Nuclear and Particle Physics: Spring 2011.
- Quantum Field Theory: Spring 2013.

Organisational Activities:

I have served on many committees over the past 6 years. Some of these include the Women's cell, Physics faculty recruitment committee, Physics curriculum committee, Physics PhD student selection committee, IT committee, IISER website in-charge, Awards committee, New campus committee, Student welfare committee, New physics building committee.

Outreach Activities:

I regularly give talks aimed at student audiences at various colleges/institutions. Most recently: on the "Forces of Nature" at NIT Suratkal, the University of Hyderabad and CMI, Chennai.

Ramana Athreya

Associate Professor

www.iiserpune.ac.in/~rathreya
Joined IISER Pune: August 2009



Research:

I am a radio astronomer with research interests spanning a range of phenomena best studied at low radio frequencies, viz. galaxy cluster radio halos, high redshift Universe, active galactic nuclei and pulsars. To this end we have invested considerable effort into developing high sensitivity imaging algorithms. I also devote half my time to research in biological diversity and evolutionary biology.

Academic Background:

Following a PhD from the National Centre for Radio Astrophysics (TIFR) in 1996, I worked at the Institute of Astrophysics, Paris (postdoc, 1998-99), European Southern Observatory (postdoc, 1999-2002), and NCRA-TIFR (faculty, 2003-2009), before joining IISER.

Arjun Bagchi

INSPIRE Faculty Fellow

www.iiserpune.ac.in/~a.bagchi
Joined IISER Pune: June 2013



Research:

I am a theoretical high energy physicist working on aspects of string theory. String theory is the most successful attempt at a theory of quantum gravity. One of its most intriguing ideas is the Holographic Principle which states that in a quantum gravity theory all physics within some volume can be described in terms of some theory on the boundary. This revolutionary proposal was put on firm footing by the AdS/CFT correspondence, a conjectured equivalence or duality between a theory of gravity in a negatively curved Anti de-Sitter (AdS) spacetime and the a conformal field theory (CFT) on its boundary.

The primary goal of my research is to understand the Holographic Principle by trying to generalise it to different situations which go beyond standard AdS/CFT. My current main research programme aims to understand aspects of holography in flat spacetimes. I am also interesting in the recent formulations of a holographic connection for higher spin theories and its potential link to the tensionless limit of string theory.

Academic Background:

I did my PhD in 2010 at the Harish Chandra Research Institute, India under Ashoke Sen. Thereafter I was a Post-Doctoral Fellow at the University of Edinburgh, UK (2010-2013) and a Visiting Post-Doctoral Fellow at MIT (2013).

Selected Publications / Last Five Years:

- "A survey for H I in the distant Universe: the detection of associated 21-cm absorption at $z = 1.28$ ", S.J. Curran, M.T. Whiting, A. Tanna, E.M. Sadler, M.B. Pracy, R. Athreya, MNRAS, 429, 3402 (2013).
- "Low-frequency radio observations of Seyfert galaxies: A test of the unification scheme", V. Singh, P. Shastri, C.H. Ishwara-Chandra, R. Athreya, A & A, 554, 85 (2013).
- "Recurrent radio outbursts at the center of the NGC 1407 galaxy group", Simona Giacintucci, Ewan O'Sullivan, Tracy E. Clarke, Matteo Murgia, Jan M. Vrtilek, Tiziana Venturi, Laurence P. David, Somak Raychaudhury, Ramana M. Athreya, ApJ, 755, 172 (2012).
- "A combined low-radio frequency/X-ray study of galaxy groups. I. Giant Metrewave Radio Telescope Observations at 235 MHz and 610 MHz", Simona Giacintucci, Ewan O'Sullivan, Jan M. Vrtilek, Laurence P. David, Somak Raychaudhury, Tiziana Venturi, Ramana M. Athreya, Tracy E. Clarke, Matteo Murgia, Pasquale Mazzotta and 5 coauthors, ApJ, 732, 95 (2011).
- "Detection of off-pulse emission from PSR

B0525+21 and PSR B2045-16", Rahul Basu, Ramana Athreya, Dipanjan Mitra, ApJ, 728, 157 (2011).

Teaching Activities:

- Introduction to Astronomy & Astrophysics; Fall 2009, Spring 2010, Spring 2011, Spring 2012, Fall 2013.
- Physics Lab I, Fall 2010, Fall 2011, Fall 2012.
- Introduction to Mathematical Methods, Spring 2013.
- Biostatistics, Fall 2013, Fall 2014.
- Scientific Enquiry, Spring 2011.

Organisational Activities:

I have been managing the Summer Student programme at IISER for the last 4 years.

Selected Publications / Last Five Years:

1. "Higher spin theory in 3-dimensional flat space", Hamid Afshar, Arjun Bagchi, Reza Fareghbal, Daniel Grumiller, Jan Rosseel. Phys. Rev. Lett. 111 (2013) 121603, e-Print: arXiv:1307.4768 [hep-th].
2. * "Cosmic Evolution from Phase Transitions in 3d Flat Space", Arjun Bagchi, Stephane Detournay, Daniel Grumiller, Joan Simon. Phys. Rev. Lett. 111, 181301 (2013), e-Print: arXiv:1305.2919 [hep-th].
3. * "Holography of 3d Flat Cosmological Horizons", Arjun Bagchi, Stephane Detournay, Reza Fareghbal, Joan Simon. Phys. Rev. Lett. 110, 141302 (2013), e-Print: arXiv:1208.4372 [hep-th].
4. * "Flatspace Chiral Gravity", Arjun Bagchi, Stephane Detournay, Daniel Grumiller. Phys.Rev.Lett. 109, 151301 (2012), e-Print: arXiv:1208.1658 [hep-th].
5. * "Correspondence between Asymptotically Flat Spacetimes and Nonrelativistic Conformal Field Theories", Arjun Bagchi. Phys.Rev.Lett. 105 (2010) 171601.

* Before joining IISER Pune

Grants and Awards:

- PEIN Excellence Grant 2014: Visiting Professorship, University of Santiago de Compostela, Spain.
- "Holography for Flat Spacetimes" Fulbright Nehru Research Award 2014: Awarded by Department of State, USA (Fulbright foundation): Research Fellowship for a stay of 18 months at Massachusetts Institute of Technology, USA (2014-2016). Total amount: 70,000 USD (approx).
- Gravitational Research Foundation: Gravitational Essay Competition 2013. Honourable Mention (with Daniel Grumiller).
- Lise Meitner Award 2013: Awarded by FWF Austrian Science Fund.
- "Probing Quantum Gravity through Holography" - Lise Meitner Award 2013. Awarded by FWF Austrian Science Fund. Total amount: 150,000 Euros (approx).

Teaching Activities:

Classical Mechanics, Fall 2014.
Quantum Field Theory, Spring 2014.

Organisational Activities:

Physics Seminar Coordinator (Aug 2013 – Aug 2014).
Organiser, "Stringy Days" -- a 2-day workshop on string theory and related physics.
Curriculum development: I proposed, developed and taught a course on Quantum Field Theory in Spring 2014.
Member, post-doctoral programme committee, Physics.

Ashna Bajpai

Ramanujan Fellow

Joined IISER Pune: December 2011



Research:

I am an experimental condensed matter physicist and my broad area of research is electronic correlations and magnetism. My current interests centre around synthesis and physical properties of magnetic materials for spintronic applications. One of the key research areas in spintronics has been to identify materials with large spin polarization (normal ferromagnets / half metallic ferromagnets) as well as materials that can change their magnetic state by not only the applied magnetic field but also through electric field (magnetoelectricity) or mechanical stress (piezomagnetism). I am particularly interested in exploring interface effects in magnetically functional core-shell materials relevant to above mentioned spintronic applications.

Academic Background:

I received my PhD in Physics from UGC-DAE Consortium for Scientific Research in Indore, India. My post doctoral research spanned different institutes: Tata Institute of Fundamental Research, Mumbai (2000-2002 and 2004-2005); Center for Advanced Technology, Indore (2003); Leibniz Institute for Solid State and Material Research, Dresden, (2005-2009) and the Department of Materials at Oxford University (2010-2011).

Selected Publications / Last Five Years:

- *"The filling of carbon nanotubes with magnetoelectric Cr₂O₃", A. Bajpai, S. Gorantla, M. Löffler, S. Hampel, M.H. Rummeli, J. Thomas, M. Ritschel, T. Gemming, B. Büchner, R. Klingeler. Carbon, 50, 1706 (2012).
- *"Tuning the magnetic properties of iron filled carbon nanotubes", F.C. Dillon, A. Bajpai, A. Koós, S. Downes, Z. Aslam, N. Grobert. Carbon, 50, 3674 (2012).
- *"On the influence of nano meter thick antiferromagnetic surface layer on ferromagnetic CrO₂ grain", P. Das, A. Bajpai, Y. Ohno, H. Ohno and J Mueller. Journal of Applied Physics, 112, 053921 (2012).
- *"Interface driven magnetoelectric effects in granular CrO₂", A. Bajpai, P. Borisov, S. Gorantala, R. Klingeler, J. Thomas, T. Gemming, W. Kleemann and B. Buechner. Europhys. Lett. 91, 17006 (2010).
- *"Unusual field dependence of remanent magnetization in granular CrO₂: possible role of piezomagnetism", A. Bajpai, R. Klingeler, N. Winzent, A. K. Nigam, S-W Cheong, and B. Buechner. J. Phys: Cond. Mat. 22, 096005 (2010).

- Chromium dioxide and composites of chromium dioxide and other oxides of chromium such as CrO₂/Cr₂O₃ and CrO₂/Cr₂O₃, A. Bajpai and A. K. Nigam. US Patent No. 7276226 / Indian Patent No. 204533 / EU Patent Pending.

Grants and Awards:

Marie Curie International Incoming Fellowship (IIF)
Ramanujan Fellowship (2012)

Teaching Activities:

- Physics Lab IV: Fall 2012
- Physics Lab III: Spring 2013
- Physics Lab VI: Fall 2013
- Physics Lab VII: Spring 2014
- Physics Lab I: Fall 2014

Outreach Activities:

Organised the Science Academies Refresher Course in Experimental Physics in IISER Pune in December 2013.

* Before joining IISER Pune

Nabamita Banerjee

Assistant Professor

Joined IISER Pune: July 2014



Research:

I am a theoretical high energy physicist. I mainly work on black holes. We explore the fundamental issues related to black hole entropy and apply various black hole solutions to understand properties of interacting quantum field theories in the context of AdS/CFT correspondence. I am also interested in fluid dynamics. By applying the second law of thermodynamics, we constrain the number of transport coefficients for both relativistic and non-relativistic fluids. We also build models to compute the transport coefficients of Quark-Gluon Plasma that has been produced at the Relativistic Heavy Ion Collider (RHIC).

Academic Background:

I did my Ph.D at the Harish Chandra Research Institute in 2010. Thereafter I had several postdoctoral positions including a FOM Fellowship, ITF Utrecht, under Prof. Gerard 't Hooft (2009-2010), a Veni Grant at Utrecht University (2010-2012) and at NIKHEF, The Netherlands (2012-2013). I then took up an Assistant Professorship at IACS, Kolkata during 2013-2014.

Selected Publications / Last Five Years:

- *"Entropy current for non-relativistic fluid", Nabamita Banerjee, Suvankar Dutta, Akash Jain and Dibakar Roychowdhury, JHEP 1408, 037 (2014).
- *"Constraints on fluid dynamics from equilibrium partition functions", N. Banerjee, J. Bhattacharya, S. Bhattacharyya, S. Jain, S. Minwalla and T. Sharma, JHEP 1209, 046 (2012).
- *"Hydrodynamics from charged black branes", Nabamita Banerjee, Jyotirmoy Bhattacharya, Sayantani Bhattacharyya, Suvankar Dutta, R.Loganayagam and P. Surowka, JHEP 1101:094 (2011).
- *"Moduli and electromagnetic black brane holography", Dumitru Astefanesei, Nabamita Banerjee and Suvankar Dutta, JHEP 1102:021 (2011).
- *"Black hole hair removal", Nabamita Banerjee, Ipsita Mandal and Ashoke Sen, JHEP 0907:091 (2009).

Grants and Awards:

- NWO Veni grant, The Netherlands
- Ramanujan Fellowship, 2013, DST India.

Teaching activities:

Will teach Quantum Field Theory I in Spring 2015.

* Before joining IISER Pune.

Bhas Bapat

Associate Professor

www.iiserpune.ac.in/~bhasbapat
Joined IISER Pune: July 2014



Research:

I work in experimental atomic and molecular physics. A major area of research has been kinematically complete dissociative ionisation studies on molecules, with a view to understand the formation, properties and stability of highly charged molecular ions. We combine ion momentum spectrometry and electron energy spectroscopy along with multiparticle coincidence techniques to obtain phase-space maps of the dissociative ionisation products. To create highly charged molecules we use fast electrons and ions from an accelerator (IUAC, Delhi) as well as soft x-rays from a synchrotron (Indus-1, Indore). Some highlights of our work include identification of bent states of CO_2^{3+} and determination of the lifetimes of metastable states of CO_2^{2+} .

Academic Background:

I got my PhD from TIFR, Mumbai (1997). Thereafter I was a Postdoctoral Fellow at University of Freiburg, Germany (1998-2000), a Visiting Fellow at Centre for Advanced Technology, Indore (2000-2001) and a Faculty Member at PRL, Ahmedabad (2001-2014).

Selected Publications / Last Five Years:

- “Charge symmetric dissociation of doubly-ionized N_2 and CO molecules”, Amrendra Pandey, B. Bapat, K. R. Shamasundar, Journal of Chemical Physics 140, 034319 (2014).
- “Three body dissociation of CS_2^{2+} subsequent to various S(2p) Auger transitions”, K Saha, S B Banerjee and B Bapat, Journal of Chemical Physics 139, 164309 (2013).
- “A combined electron-ion spectrometer for studying the complete kinematics of molecular dissociation upon shell selective ionization”, K. Saha, S. B. Banerjee, B. Bapat, Review of Scientific Instruments 84, 073101 (2013).
- “Ion-induced triple fragmentation of CO_2^{3+} into $\text{C}^+ + \text{O}^+ + \text{O}^+$ ”, M. R. Jana, P. N. Ghosh, B. Bapat, R. K. Kushawaha, K. Saha, I. A. Prajapati, and C. P. Safvan, Physical Review A 84, 062715 (2011).
- “Triple F^+ ejection from SF_6 bombarded by swift ions”, R K Kushawaha, S Sunil Kumar, M R Jana, I A Prajapati, C P Safvan and B Bapat, Journal of Physics B 43, 205204 (2010).

Grants and Awards:

At PRL we have a sanction for developing the ion spectrometer for the Aditya-L1 mission of ISRO.

Teaching activities:

In the first semester after joining IISER Pune I coordinated the first year Physics Laboratory course. In Ahmedabad I taught regularly in an extra-curricular programme for B.Sc. students from colleges all over Gujarat for 7 years.

Organisational Activities:

I am coordinating the creation of online courses from IISER Pune under the ‘Swayam’ initiative of the Ministry of Human Resource Development. I have proposed a project for re-building of classic experiments that form the bedrock of 20th and 21st century physics, with the participation of students, thereby facilitating experimental pedagogy in physics. Eventually this activity could enable the formation of a nodal centre for experimental activities in undergraduate physics courses throughout the country.

* Before joining IISER Pune

Outreach Activities:

I work with Eklavya, an organisation based at Bhopal working on improving science curricula and teaching methods in schools. I have conducted teachers' workshops, and have been involved in the writing of learning-by-doing modules for high school science teachers and students being developed by that organisation. I am the primary author of the module on Heat and Temperature (published), and a contributor to modules on Motion (motion), Nature of Matter (in press), Light (in press), and Electricity (being developed).

In Ahmedabad I have worked for several years coordinating science competitions, conducting quizzes and screening school and college students for scholarships under the outreach programmes of PRL.

Arijit Bhattacharyay

Associate Professor

www.iiserpune.ac.in/~a.bhattacharyay
Joined IISER Pune: June 2008



Research:

I am a theoretical physicist. I am presently working on some basic issues related to equilibrium of a mesoscopic system over an inhomogeneous conformation space. The other areas of my interest on which I am presently working are analogue gravity in Bose-Einstein condensates, effects of non-local interactions on density modulated states, and vortices in a Bose-Einstein condensate. I am also working on the resistive regime of a one-dimensional superconductor where the superconducting and normal phases coexist.

Academic Background:

I did my Ph.D. work on pattern formation at IACS (Kolkata) and got a degree from Jadavpur University, Kolkata. I carried out postdoctoral work at TU Darmstadt, Germany (2003-2004), Padova University, Italy (2004-2007) and University of Warwick, UK (2007-2008).

Selected Publications / Last Five Years:

- “Nonlocal interactions in a BEC: an analogue gravity perspective”, Supratik Sarkar and A. Bhattacharyay. J. Phys. A: Math. Theor. 47, 092002 (2014) (FTC).
- “Equilibrium of a mesoscopic system with conformation dependent damping: An alternative approach”, A. Bhattacharyay. Physica A 392, 4265 (2013).
- “Directed transport in equilibrium: a model study”, A. Bhattacharyay. Physica A 391, 1111 (2012).
- “Revisiting the Langer-Ambegaokar-McCumber-Halperin theory of resistive transitions in one-dimensional superconductors with exact solutions”, Darshan G. Joshi and A. Bhattacharyay. J. Phys. Cond. Mat. (FTC), 23, 342203 (2011).
- “Equilibrium of a Brownian particle in a damping induced inhomogeneous space: an alternative approach”, Avik Biswas and A. Bhattachayay, J. Phys. A: Math. Theor. 48, 015003 (2015).

Grants and Awards:

Co-PI on the DST Project “Emergent dynamics on growing networks with comparable time scales” with Dr. M.S. Santhanam and Dr. G. Ambika.

Teaching Activities:

- Linear Algebra (2008)
- Statistical Physics I (Spring 2009)
- Condensed matter physics I (2009)
- Condensed matter physics II (2010)
- Physics Lab 2 (Spring 2011)
- Biophysics (2011)
- Condensed matter physics I (2011)
- Quantum Mechanics and Statistical Physics (2012)
- Condensed matter physics I (2012)
- Thermodynamics (2013)
- Quantum Mechanics I (2014)
- Physics Lab I (Fall 2014)

Organisational Activities:

Member, Curriculum Committee, selection committees for PhD and undergraduates in physics and interdisciplinary areas. I have been a regular member of various departmental committees. I helped in developing the academic time-table at an early stage of IISER Pune. I organized several seminars and special lectures by experts in the respective fields.



Apratim Chatterji

Assistant Professor

www.iiserpune.ac.in/~apratim/
Joined IISER Pune: January 2009



Research:

I am a soft matter physicist using methods of statistical physics and multiscale simulations to investigate emergent properties of coarse-grained models of many interacting macromolecules (a) in equilibrium, and (b) in flow. I have been working at identifying the principles leading to self-assembly of nano-rods with an axial pore seen in some experiments performed in IISER-Pune. In a different project, we observe the hierarchical self assembly of model (Lennard-Jones) nano-particles in a background nematically ordered self-assembled micellar matrix. We are currently investigating the effect of shear on these systems. I have also been working to develop a computational scheme to obtain steady state extensional flow with PBC incorporated so that one can systematically investigate soft matter systems in extensional flow. I have started projects looking at active matter incorporating 3-D hydrodynamic interactions and its effect on the coil globule transition of a polymer. Two other running projects are: the dynamics of a single polymer diffusing in a hydrodynamic medium confined between two fluctuating membranes, and equilibrium structure and aggregation of star polymers with dipoles at the tips of star-arms.

Academic Background:

I did my PhD from IISc, Bangalore in 2003 under the supervision of Rahul Pandit. Thereafter I held postdoctoral positions at University of Mainz (2002-2005), University of Toronto (2005-2007) and Research Center Juelich (2007-2009).

Selected Publications / Last Five Years:

- "Self-assembly of monodisperse CdS nanocylinders with an axial pore", J. Kiruthiga and Apratim Chatterji. Phys. Rev. E 89, 022304, (2014).
- "Dynamical and rheological behaviour of ultrasoft colloids under shear flow", Sunil P. Singh, Apratim Chatterji, Gerhard Gompper and Roland G. Winkler. Macromolecules 46, 8026 (2013).
- "Steady state dynamics of colloids/polymers in uniaxial extensional flow", Dhairyashil Ghatage and Apratim Chatterji. Phys. Rev. E 88, 043303 (2013).
- "Nanochannel induced advection combined with reaction diffusion dynamics of reacting ions leads to self assembly of ordered cylindrical nanostructures", J. Kiruthiga and Apratim Chatterji. J. Chem. Phys. 138, 024905, (2013).
- "The role of effective charges in the electrophoresis of highly charged colloids", Apratim Chatterji and Juergen Horbach. J. Phys. Cond. Mat. 22, 494102 (2010).

Teaching Activities:

- Electrodynamics, Fall 2009.
- Statistical Physics, Spring 2010.
- Electrodynamics I, Fall 2010.
- Statistical Physics, Spring 2011.
- Mathematical Methods, Fall 2011.
- Statistical Physics, Spring 2012.
- Mathematical Methods, Fall 2012.
- Modern Physics Lab, Spring 2013.
- Modern Physics Lab, Spring 2014.
- Computational Methods in Physics, Fall 2014.

Organisational Activities:

- Coordinator for Integrated PhD programme in Physics since its inception.
- Carried out committee work to purchase IISER's first compute cluster.
- Warden for 6 months.
- Contributed to various question paper committees for IISER-admissions and other all-India competitive exams.
- Hosted the Mumbai-Pune Soft Matter meetings twice at IISER-Pune.
- Kickstarted the Soft-Matter-YIM (Pondicherry) programme along with other soft matter physicists in India.

Outreach Activities:

- Gave popular lectures on soft matter and/or computational techniques at the University of Pune, Presidency College Kolkata, Maharastra Institute of Technology, Pune.
- Organized the Soft Matter@ IISER event in 2013 as part of departmental activities, where the speakers were Rama Govindarajan, Roop Mallik, K. Guruswamy and myself.
- Gave academic talks at many institutes, conferences held in India and out of India.
- Thesis examiner for PhD theses of two students from IIT Madras and IIT Kanpur, respectively.

Harsh Chaturvedi

Ramanujan Fellow

www.iiserpune.ac.in/people/fellows-details/65
Joined IISER Pune: June 2010



Research:

Our research can broadly be classified as: (1) solution phase studies, (2) condensed phase studies and (3) application driven research and development. We aim to functionalize nanoparticles such as single walled carbon nanotube (SWNT) and graphene with optically active and biologically sensitive molecules and use these functionalized SWNT/graphene for fabricating novel electro-optical sensors and bio-nano hybrid devices. In these years, we have specifically functionalized SWNT with optically active, organic polymer OPV and also biologically synthesized, optically active bacterio-rhodopsin. We have built required research labs and a clean room facility at IISER Pune for functionalisation, fabrication and electro-optical characterization of fabricated thin film and molecular transistors based on these functionalised SWNT for diverse electro-optical applications. Along with devices we are deeply interested in understanding electro-optical effects in colloidal solutions of nanoparticles.

Academic Background:

Completed doctoral research on optical effects in functionalized single walled carbon nanotubes at the University of North Carolina, Charlotte, under the supervision of Dr. Jordan C Poler in 2008. Joined as an IISER Fellow in 2009 and was subsequently awarded Ramanujan Fellowship by Dept. of Science and Technology (DST, India) in 2010.

Selected Publications / Last Five Years:

- "Optical effects in carbon nanotubes", H.Chaturvedi, Book, Scholar's Press, Germany (2013).
- Technology for "Separation of semiconducting and metallic single walled carbon nanotubes" Patent (2013) (applied for).
- * "Mechanically docked metaliodendrimers about single walled carbon nanotubes", H.Chaturvedi and J.C.Poler; J.Phys. Chem C (2009).
- * "Dispersions and aggregation of carbon nanotubes", H.Chaturvedi, J.C.Poler. In the "Handbook of Nanophysics; a seven volume project, published by Taylor & Francis (2010).

Grants / Awards:

"Optical gate based on Bacteriorhodopsin functionalized carbon nanotubes", Dept. of Science and Technology (2013-16). Rs 85 Lakhs.
"Optical effect in functionalized single-walled carbon nanotubes", Nanomission (2013-15), Rs 65 Lakhs).
"Infrared sensors based on nanotubes", DRDO (Reviewed), Rs 85 Lakhs.
SPIE (International society for Optics and Photonics) Research Scholarship Award, 2007.
SPIE Graduate Award, 2007.
Best Graduate Research Award, UNC Charlotte, 2007, 2008.
Ramanujan Fellowship, DST, 2010.

Teaching Activities:

Electrodynamics: Spring 2009, Spring 2010
Optics: Fall 2009, Spring 2011
UG Lab: Spring 2009, Fall 2009, Fall 2010, Fall 2012, Fall 2013, Spring 2014
Nanoscience: Spring 2012
Waves & Matter: Spring 2013

Outreach Activities:

Actively contributed for outreach activities giving talks, donating books and encouraging students at Rawatbhata (Rajasthan), Jain Institutes (Bangalore), Bhartiya Vidyapeeth (Pune), Indus Valley School (Pune) among other places.

* Before joining IISER Pune.

Shouvik Datta

Assistant Professor

www.iiserpune.ac.in/~shouvik
Joined IISER Pune: July 2008



Research:

I am an experimental condensed matter physicist studying the quantum opto-electronics of semiconductor nano-structures and devices. Some of the questions I focus on are: how to understand electronic processes within a semiconductor laser diode under very high charge injection, what happens to the dielectric response of a material medium or a laser diode, when it starts to emit light and finally starts lasing, what are the electrical signatures of excitonic electroluminescence, Mott transition as well as excitonic BEC and excitonic lasing, what is the precise roles of fluid dynamics in nanofabrication. In my laboratory we also carry out studies on how to fabricate efficient quantum dot solar cells and how bulk electronic defects behave at the nano-scale.

Academic Background:

I got my Ph.D. from the Tata Institute of Fundamental Research (University of Mumbai) in 2001. Thereafter I was a Postdoctoral Fellow at the University of Nebraska-Lincoln, USA (2001-2004) and University of Oregon, USA (2004-2008).

Selected Publications / Last Five Years:

- "Dynamics of electronic transitions and frequency dependence of negative capacitance in semiconductor diodes under high forward bias", Kanika Bansal, M. Henini, M. Alshammari, and Shouvik Datta, Applied Physics Letters 105, 123503 (2014).
- "Cadmium vacancy minority defects as luminescence centers in size and strain dependent photoluminescence shifts in CdS nanotubes", Arthur Varghese, Prasenjit Ghosh and Shouvik Datta, Journal of Physical Chemistry C 118, 21604 (2014).
- "Temperature dependent reversal of voltage modulated light emission and negative capacitance in AlGaNP based multi quantum well light emitting devices", Kanika Bansal and Shouvik Datta, Appl. Phys. Lett. 102, 053508, (2013).
- "Directionally asymmetric self-assembly of cadmium sulfide nanotubes using porous alumina nanoreactors: Need for chemohydrodynamic instability at the nanoscale", Arthur Varghese and Shouvik Datta, Physical Review E 85, 056104 (2012).

- "Voltage modulated electro-luminescence spectroscopy to understand negative capacitance and the role of sub-bandgap states in light emitting devices", Kanika Bansal and Shouvik Datta, J. Appl. Phys. 110, 114509 (2011).

Grants and Awards:

- Co-PI in DST Nano-Science Unit at IISER-Pune, Rs 5.6 Crore (2009-2014).
- Co-PI on Indo-Israel Grant from DST-OCS, Rs 19.44 Lakhs, 2011-2013.
- PI of a DST project, Rs 54.4 Lakhs, July, 2013-June, 2016.
- Co-PI of the Centre for Research in Energy and Sustainable Materials (CORESUM) at IISER-Pune, Rs 4.5 Crore.

Teaching Activities:

- Physics Laboratory: Fall 2008, Fall 2010, Fall 2014.
- Electronics Laboratory: Spring 2009.
- Fall Thermodynamics: 2009.
- Experimental Methods: Spring 2010.
- Advanced Physics Laboratory: Spring 2011, Fall 2011.
- Atomic & Molecular Physics: Spring 2012.
- Introductory Classical Mechanics and Electricity Magnetism: Fall 2012.
- Quantum Mechanics: Spring 2013.
- Classical Mechanics: Fall 2013.
- Waves and Matter: Spring 2014.

Organisational Activities:

Was a Hostel Warden in the initial phase of IISER.

Outreach Activities:

Have tried to forge a strong research collaboration between industrial R&D labs and IISER-Pune.

Aparna Deshpande

Assistant Professor

www.iiserpune.ac.in/~aparna.d
Joined IISER Pune: August 2011



Research:

I am a condensed matter experimentalist specializing in Scanning Tunnelling Microscopy (STM), Scanning Tunnelling Spectroscopy (STS), and single atom and molecule manipulation to visualize, probe and manipulate matter at the atomic scale. My research interests span the investigation of local electronic properties of novel materials like graphene, topological insulators and strongly correlated electronic systems. Presently, in my lab, my students and I are working on the topological insulator material Bi₂Se₃. I am also interested in the manipulation of single molecules and molecular self assembly on conducting surfaces to test their functionality for device applications.

Academic Background:

I did a B.Sc in Physics from D. G. Ruparel College, Mumbai followed by an M.Sc in Physics from Mumbai University. I completed my PhD in Physics at Ohio University, Athens, Ohio, USA in 2007. I did my postdoctoral research work at the University of Arizona, Tucson (2007-2010) and at Northwestern University, Evanston (2010-2011).

Selected Publications / Last Five Years:

- * "Templating sub-10 nm atomic layer deposited oxide nanostructures on graphene via one-dimensional organic self-assembled monolayers", Justice M. P. Alaboson, Chun-Hong Sham, Sumit Kewalramani, Jonathan D. Emery, James E. Johns, Aparna Deshpande, TeYu Chien, Michael J. Bedzyk, Jeffrey, W. Elam, Michael J. Pellin, and Mark C. Hersam, Nano. Lett. 13, 5763 (2013).
- * "Self-assembly and photopolymerization of sub.2 nm one-dimensional organic nanostructures on graphene", Aparna Deshpande, Chun-Hong Sham, Justice M. P. Alaboson, Jonathan M. Mullin, George C. Schatz, and Mark C. Hersam, J. Am. Chem. Soc, 134, 16759 (2012).
- * "Scanning probe microscopy of graphene", Aparna Deshpande and Brian LeRoy, Physica E, 44, 743 (2012) (invited review article).
- * "Determination of chemical specific atomic interaction with scanning tunneling microscope", Aparna Deshpande, Kai-Felix Braun and Saw-Wai Hla, Appl. Phys. Lett., 99, 221902 (2011).
- * "Scanning tunnelling microscopy and

spectroscopy of ultra-flat graphene on hexagonal boron nitride", Jiamin Xue, Javier Sanchez-Yamagishi, Danny Bulmash, Philippe Jacquod, Aparna Deshpande, K. Watanabe, T. Taniguchi, Pablo Jarillo-Herrero and Brian LeRoy, Nature Materials, 10, 282 (2011).

Teaching Activities:

- Introductory physics lab, Fall 2011
- Physics lab III, Spring 2012
- Physics lab VI (Coordinator), Fall 2012
- Physics lab VII, Spring 2013
- Introductory physics lab (Coordinator), Fall 2013
- Physics lab II, Fall 2014.

Outreach Activities:

Gave a talk titled "Scanning Tunneling Microscopy, Atomic Force Microscopy" at the DST sponsored Consolidation of University Research for Innovation and Excellence (CURIE) Workshop at Banasthali University, Rajasthan during 5-7 October 2012.

* Before joining IISER Pune

C.V. Dharmadhikari

Visiting Faculty

Joined IISER Pune: December 2011



Research:

My work involves development of a whole range of Scanning Probe Microscopes and their applications to the investigation of a host of problems at the frontiers of surface science, thin films and nanoscience. My current interests are in:

- photon emitting STM (PESTM, low current STM operating in field emission mode for imaging nanostructures/nanobiostructures)
- contact mode/non-contact mode current imaging using AFM
- force spectroscopy of colloidal systems
- AFM imaging using piezoelectric/piezoresistive cantilevers
- noise analysis of tunneling and field emission current fluctuations
- electron transport across nanostructures
- synthesis of nanostructures using SPM

Academic Background:

I did my Ph.D from the University of Pune in 1979. After this I was a Postdoctoral Fellow at the James Franck Institute, University of Chicago (1980-84) and a faculty member at the University of Pune (1984-2011).

Selected Publications / Last Five Years:

- "Charge storage and electron transport properties of gold nanoparticles decorating urethane - methacrylate comb polymer network", S. Patil, S. Datar, R. Narayan, Asha S.K and C. V. Dharmadhikari, Nanoscale, 5,4404 (2013).
- "Force on a conducting tip near a metallic surface coated with a polarizable dielectric layer: theory and experiment", K. S. Date, A.V. Kulkarni, C. V. Dharmadhikari, e-J. Surf. Sci. Nanotech. 9, 206 (2011).
- "A comparative study of thermionic emission from vertically grown carbon nanotubes and tungsten cathodes", S. K. Kolekar, S. P. Patole, P. S. Alegaonkar, J. B. Yoo and C. V. Dharmadhikari, Appl. Surf. Sci. 257, 10306 (2011).
- "Electrical characterization of zinc oxide/ aluminum nitride thin film precursor field effect transistor structures: A conducting atomic force microscopy and density functional theoretical study", S. Dey, S. Jejurikar, S. K. Bhattacharya, A. Banerji, K. P. Adhi and C. V. Dharmadhikari, J. Appl. Phys. 108, 094510 (2010).
- "Observation of electron tunneling induced photon emission in gallium (Ga)

doped (1%) zinc oxide (ZnO) sample using scanning tunneling microscopy", S. Dey, S. D. Shinde, K. P. Adhi and C. V. Dharmadhikari, Appl. Phys. Lett. 95, 063503 (2009).

Grants and Awards:

- Prin. V. K. Joag Award for excellence in Teaching & Research 2003-04 by University of Pune.
- Homi J Bhabha Award: Applied Sciences 2002 by University Grants Commission, New Delhi.
- BRNS Eminent Visiting Professor, Indira Gandhi Center for Atomic Research (IGCAR), Kalpakkam, 2002-03.
- Welch Foundation Award by International Union for Vacuum Science Techniques & Application (IUVSTA), USA, 1980

Teaching activities:

- Physics Lab III: Spring 2012
- Physics Lab V: Spring 2013
- Physics Lab VI: Fall 2012, Fall 2013, Fall 2014
- Physics Lab VII: Spring 2014

Restructuring of laboratory courses with emphasis on hands-on approach / relevance to the corresponding theory courses. Setting up of classic experiments with modern methods of data analysis and instrumentation.

Outreach Activities:

- Workshop on Innovation: Brokering Nanotechnology, Creating Capacity, March 27-28, 2014
- Science academies refresher course in experimental physics, December 9-24, 2013
- Symposium on collaboration between industries and academia, Oct 28-29, 2013
- Experimental physics workshop for post-graduate teachers, May 13-14, 2013

Sourabh Dube

Assistant Professor

www.iiserpune.ac.in/~sdube

Joined IISER Pune: September 2013



Research:

I am an experimental particle physicist. I work at the CMS experiment and try to discover new particles in the high energy collisions at the LHC. The LHC is gearing up to start collisions at 13 TeV in 2015, which is the highest energy collisions achieved ever. I will primarily focus on sifting through the data to find hints that the Standard Model of particle physics is insufficient. I also have an interest in finding supersymmetric particles. I hope and expect the next two years of data at the LHC will help us to address a lot of unanswered questions about our universe.

Academic Background:

I got my PhD at Rutgers University (2008). Subsequently I was Chamberlain Fellow at Lawrence Berkeley National Laboratory, Berkeley, US (2009-2013).

Selected Publications / Last Five Years:

- * "Search for New Phenomena in Events with Three Charged Leptons at a Center-of-Mass Energy of 8 TeV with the ATLAS detector". ATLAS Collaboration, Tech. Report ATLAS-CONF-2013-070 (2013).
- * "Search for microscopic black holes in a like-sign dimuon final state using large track multiplicity with the ATLAS detector", ATLAS Collaboration, Phys. Rev. D 88, 072001 (2013).
- * "Search for new phenomena in events with three charged leptons at $\sqrt{s} = 7$ TeV with the ATLAS Detector". ATLAS Collaboration, Phys. Rev. D 87 052002 (2013).
- * "Search for strong gravity signatures in same-sign dimuon final states using the ATLAS detector at the LHC", ATLAS Collaboration, Phys. Lett. B 709, 322 (2012).
- * "The FE-14 pixel readout integrated circuit", M. Garcia Sciveres et al., Nucl. Inst. and Meth. A 636, S155 (2011).

* Before joining IISER Pune.

Teaching Activities:

- World of Physics - Quantum Mechanics: Spring 2014
- Physics Laboratory II: Fall 2014

Organisational Activities:

I am a member of the IISER Curriculum Committee and the IISER Library Committee. I was also the Faculty Coordinator for Karavaan 2014, the science-and-cultural student festival of IISER, Pune. I am also the member of the Physics Department Screening Committee for new faculty hires.

Outreach Activities:

I am the co-administrator of the Physics Programme's Facebook page, with the stated aim of bringing the science and the scientists of the physics department to the outside world. I served as judge for BrainCafe Budding Scientist Contest 2013 at City Pride School, Nigdi, Pune where school children from all over Maharashtra presented their science projects. I gave an invited outreach talk at the Frontiers in Physics VII Conference held at Fergusson College, Pune. Recently I served as an expert for interacting with students participating in the National Children Science Congress (NCSC) held at SJBIT, Bengaluru.



Anil Gangal

Visiting Faculty

Joined IISER Pune: May 2010



Research:

I am a theoretical physicist. I work in the area of nonlinear dynamics with a particular focus on calculus on fractals. My main research program currently consists of developing calculus on highly irregular structures and fractals with a view to applications in statistical physics and space-time physics. A systematic development of calculus on two classes of fractals was carried so far. These are (1) fractal subsets of real line and (2) fractal paths or continuous fractal curves. Sobolev spaces on fractals of these classes were constructed. The calculus developed retains much of the simplicity of ordinary calculus. A conjugacy of this calculus with ordinary calculus is established, which allows one to construct solutions of a wide class differential equations on fractals with ease.

Academic Background:

I obtained a PhD in Physics in 1981 from the University of Bombay working at theTata Institute of Fundamental Research. I then worked at the University of Kaiserslautern, Germany as a Wissenschaftlicher Mitarbeiter till July 1983. Subsequently I was on the faculty of University of Pune until 2010.

Selected Publications / Last Five Years:

- Chapter 9: "Outline of Calculus on Fractals and Applications", Abhay Parvate, Seema Satin, A.D.Gangal, and Chapter 10: "Random Walk and Broad Distributions on Fractal Curves", Seema Satin and A.D. Gangal, "Fractional Calculus: Theory and Applications", Narosa Publishing House (2014).
- "Fokker–Planck equation on fractal curves", Seema E. Satin, Abhay Parvate and A.D. Gangal, Chaos, Solitons & Fractals 52, 30 (2013).
- "Calculus on fractal subsets of real line II: conjugacy with ordinary calculus", A. Parvate and A.D. Gangal, Fractals 19:271 (2011).
- "Calculus on fractal curves", A. Parvate, S. Satin and A.D. Gangal, Rn. Fractals 19:15 (2011).
- * "Calculus on fractal subsets of real line I", A. Parvate and A.D. Gangal, Fractals 17:53 (2009).

Teaching activities

- Thermodynamics: Fall 2010
- Particle and Nuclear Physics: Spring 2010, Spring 2011
- Electrodynamics: Fall 2011
- World of Physics II: Spring 2012
- Statistical Mechanics I: Spring 2013, Spring 2014
- Statistical Mechanics II: Fall 2012, Fall 2013, Fall 2014

* Before joining IISER Pune

Prasenjit Ghosh

Assistant Professor

www.iiserpune.ac.in/~pghosh

Joined IISER Pune: September 2010



Research:

My research involves exploring novel physics and chemistry at the nanoscale using theoretical tools. In particular we are interested in how properties (e.g. structural, electronic, vibrational, magnetic and chemical) change upon reducing size or lowering dimensionality (particularly in the nano-scale) and how the changes in these properties affect the phenomena associated with these low dimensional (e.g. nanowires, nanotubes, surfaces and clusters) materials. To address such issues we perform first principles calculations using quantum mechanical density functional theory (for ground state properties), density functional perturbation theory (for vibrational properties) and time dependent density functional theory (for excited state properties). Although, we are primarily a computational group, we collaborate with experimental groups. Our goals are to understand aspects of chemical bonding and microscopic couplings, to obtain information about the atomistic structure and electronic states and to design new materials with desired properties.

Academic Background:

I did my PhD in 2007 from JNCASR, Bangalore. Thereafter I held a postdoctoral position at the Abdus Salam International Centre for Theoretical Physics, Trieste (2007-2010).

Selected Publications / Last Five Years:

- "Cadmium vacancy minority defects as luminescence centers in size and strain dependent photoluminescence shifts in CdS nanotubes", A. Varghese, P. Ghosh and S. Datta, J. Phys. Chem. C, 118, 21604 (2014).
- "Fluxionality of Au clusters at ceria surfaces during CO oxidation: relationships among reactivity, size, cohesion, and surface defects from DFT simulations", P. Ghosh, M. F. Camellone and S. Fabris, J. Phys. Chem. Lett., 4, 2256 (2013).
- "Substrate induced changes in the magnetic and electronic properties of hexagonal boron nitride", N. Joshi and P. Ghosh, Phys. Rev. B, 87, 235440 (2013).
- "Hydrogen-induced reversal of spin alignment in graphene supported on Ni(111) surface", N. Joshi, N. Ballav and P. Ghosh, Phys. Rev. B, 86, 121411(R) (2012).
- "Hydrogenation of ferrimagnetic graphene on a Co surface: significant enhancement of spin moments by C-H functionality", I. Kaul, N. Joshi, N. Ballav and P. Ghosh, J. Phys. Chem. Lett., 3, 2852 (2012).

Grants and Awards:

Co-PI, DST-Nano Mission, Jointly with Pune University and CDAC Pune. Grant amount Rs 8 Crore INR.

Teaching Activities:

- Numerical Methods (IDC): Spring 2011, Spring 2012
- Mathematical Methods (IDC): Spring 2013
- Computational Physics: Fall 2011, Fall 2012, Fall 2014
- Physics Undergraduate Lab (second year): Fall 2013
- Solid State Chemistry: Fall 2011, Fall 2012
- Modelling and Simulations in Chemistry: Fall 2011

Organisational Activities:

- PhD Coordinator for Chemistry from 2011-2013
- Currently member of IT Committee
- Currently member of Physics Infrastructure Committee

Mukul Kabir

Assistant Professor

www.iiserpune.ac.in/~mukul
Joined IISER Pune: August 2012



Research:

I work on understanding material phenomena at different length and time scales, where we combine density functional theory, transition state theory and kinetic Monte Carlo. I apply these techniques to understand edge magnetism in graphene nanoflakes, band-gap engineering in 2D materials under external perturbations, and defect kinetics in graphene, and carbon nanotubes.

Apart from these projects, a significant effort is devoted toward the problems in sustainable energy research. Here, we focus on designing Fe-based (low-cost) catalysts for molecular hydrogen splitting, which is useful toward green energy production (chemical energy to electricity), understanding oxygen reduction reaction, and oxygen diffusion at perovskite oxide surface (used as cathode for solid-oxide fuel cell) for renewable energy technologies, and understanding the phase segregation in FeCr-alloys relevant to nuclear reactors

Academic Background:

I did my Ph.D. at the S. N. Bose National Center for Basic Sciences, Kolkata in 2006, and was then a Postdoctoral Associate at the Massachusetts Institute of Technology from 2006-2011.

Selected Publications / Last Five Years:

- "Manipulation of edge magnetism in hexagonal graphene nanoflakes", Mukul Kabir and Tanusri Saha-Dasgupta, Physical Review B 90, 035403 (2014).
- "Role of oxometallic complex on OH dissociation during water oxidation: A microscopic insight from DFT", Soumyajit Sarkar, Mukul Kabir, Martha Greenblatt and Tanusri Saha-Dasgupta, Journal of Materials Chemistry A 1, 10422 (2013).
- "Reversible mechanism for spin crossover in transtion-metal cyanides", Mukul Kabir, and Krystyn J. Van Vliet, Physical Review B 85, 054431 (2012).
- "Predicting dislocation climb and creep from explicit atomistic details", Mukul Kabir, Timothy T. Lau, David Rodney, Sidney Yip, and Krystyn J. Van Vliet, Physical Review Letters 105, 095501 (2010).
- "Effects of vacancy-solute clusters on diffusivity in metastable Fe-C alloys", Mukul Kabir, Timothy T. Lau, Xi Lin, Sidney Yip, and Krystyn J. Van Vliet, Physical Review B 82, 134112 (2010).

Grants and Awards:

- Ramanujam Fellowship (2013-2018), Department of Science and Technology, India

Teaching Activities:

- Advanced Condensed Matter Physics II: Spring 2013, Spring 2014.
- Condensed Matter Physics I: Fall 2013
- Physics Lab IV: Fall 2014

Organisational Activities:

- Member of the question paper setting committee for BS-MS entrance, 2013, 2014.
- Member of Physics Outreach Committee.
- Member of Physics Screening Committee.
- Member of Institutional Dining Committee.

* Before joining IISER Pune.

Avinash Khare

Raja Ramanna Fellow

Joined IISER Pune: January 2011



Research:

While my initial work is in the area of quantum field theory and elementary particle physics, in recent years I have been interested in broader area of theoretical physics. One of my interests for the last 30 years is in the area of supersymmetry in quantum mechanics. Even today it is giving new insight into the area of conventional quantum mechanics. My other interest is in the area of nonlinear dynamics with special interest in coherent structures and their relevance to optical communication, BEC-BCS transition etc.

Academic Background:

I got my Ph.D. from SINP, Kolkata in 1971. I have been a faculty member at the Institute of Physics, Bhubaneswar for 36 years.

Selected Publications / Last Five Years:

- "Stability of solitary waves in the nonlinear Dirac equation with arbitrary nonlinearity", S. Shao, N.R. Quintero, F. Mertens, F. Cooper, A. Khare and A. Saxena, Phys. Rev. E90 032915 (2014).
- "The scattering amplitude for newly found shape invariant potential", R.K. Yadav, A. Khare and B.P. Mandal, Annals of Phys. 331, 313 (2013).
- "Statistical mechanics of a discrete Schrodinger equation with saturable nonlinearity", M.R. Samuelsen, A. Khare, A Saxena and K.O. Rasmussen, Phys. Rev. E87, 044901 (2013).
- "Linear superposition for a class of nonlinear equations", Phys. Lett. A 377, 2761 (2013). A. Khare and A. Saxena.
- "Soliton in a PT-symmetric potential with competing nonlinearity", A. Khare, S.M. Al-Marzoug and H. Bahlouli, Phys. Lett. A376, 2880 (2012).

Teaching Activities:

- Advanced Quantum Mechanics: Fall 2011, Fall 2012, Fall 2013, Fall 2014.
- Nuclear and Particle Physics: Spring 2012, Spring 2014
- During the fall of 2011, I gave a set of lectures on Basic Quantum Mechanics to second year students and on Advanced Quantum Mechanics to Ph.D. students.

Grants and Awards:

- Fellow, Indian National Science Academy, New Delhi.
- Fellow, Indian Academy of Sciences, Bangalore.
- Raja Ramanna Fellowship, DAE.

Outreach Activities:

I have been acting as mentor at over 40 INSPIRE camps all over India for meritorious students. I have visited schools and colleges in the villages of Maharashtra and given over 16 popular science talks (in Marathi).

Organisational Activities:

I was a member of the Academic Committee of IISER for 2 years.

Sulabha Kulkarni

Visiting Professor

sites.google.com/site/drsulabhakkulkarni/home

Joined IISER Pune: March 2009



Research:

I work in the area of experimental condensed matter physics. My research is focussed in surface science, nanotechnology and materials science. In recent years I have worked on some problems related to localized surface plasmon resonance and multiferroics. I often make use of synchrotron radiation to analyse the materials properties.

Academic Background:

I got my Ph. D. from University of Pune in 1976. After a postdoctoral position at the Technical University, Munich (1977-1978), I have been a faculty member at the University of Pune until 2009.

Selected Publications / Last Five Years:

- "Self assembled vertically aligned gold nanorod superlattices for ultra-high sensitive detection of molecules", Amey Apate, Prashant Bhaskar, Raja Das, Smita Chaturvedi, Pankaj Poddar and Sulabha Kulkarni. Nano Research (2014) Doi:10.1007/s12274-014-0572-2.
- "Probing bismuth ferrite nanoparticles by hard X-ray photoemission: Anomalous occurrence of metallic bismuth", Smita Chaturvedi, Indranil Sarkar, Mandar M. Shirolkar, U-Ser Jeng, Yi-Qi Yeh, Ranguwar Rajendra, Nirmalya Ballav and Sulabha Kulkarni, Appl. Phys. Lett. 105, 102910 (2014).
- "Ethylenediamine-mediated Wurtzite phase formation in ZnS", S. A. Acharya, Neeraj Maheshwari, Laxman Tatikondewar, Anjali Kshirsagar and S. K. Kulkarni, Cryst. Growth & Design 13, 1369 (2013) 1369-1376.
- "Observation of enhanced dielectric coupling and room temperature ferromagnetism in chemically synthesized BiFeO₃@SiO₂ core-shell particles", Shirolkar Mandar, Das Raja, Maity Tuhin, Poddar Pankaj, Kulkarni

Sulabha. J. Phys. Chem. C 116, 19503 (2012).

- 'Nanotechnology : Principles and Practices' by Sulabha K. Kulkarni, Co-Published by Capital Co., N. Delhi & Springer (3rd Ed. 2014).

Grants and Awards:

- DST Nanoscience Unit (2009).
- Fellow, Asia Pacific Materials Society (2013).
- Fellow, Indian National Science Academy (2011).
- Maharashtra State Award for Book Writing (2009).

Teaching activities:

- Physics Lab (1st Year): Spring 2009, Fall 2009, Fall 2013.
- Physics Lab (2nd Year): Fall 2014.
- Nanotechnology : Fall 2010, Fall 2011
- Physics At Nanoscale : Fall 2012, Spring 2014
- Materials Science: Spring 2010, Spring 2012,
- Advanced Materials Science: Spring 2013

Organisational Activities:

- Organised the workshop: "Powder X-ray Diffraction and Small Angle Scattering" May 15-16, 2012 for Ph. D. Students (43) in IISER, NCL and UOP, Pune.
- Organised the workshop: "Nanotechnology for Energy and Health" Oct. 10-11, 2014 in Fergusson College, Pune.
- Reviewed DST, CSIR projects and an NPTEL Course on Semiconductor Nanodevices (2014).
- Served as Member of the Selection/ Awards committees in different Institutes/Universities.
- Associate Editor of J. Nanophotonics (IEEE) and reviewer for several journals
- DST WOS-A chairperson since 2007.
- Member 'Task Force Committee Nanomedicine', Indian Council of Medical Research, New Delhi.

Outreach Activities:

- Every year minimum 6 talks in colleges/ schools/ teacher's training programs, plus talks in (mostly) remote schools/colleges in Maharashtra.

T.S. Mahesh

Associate Professor

www.iiserpune.ac.in/~mahesh.ts/homepage.htm

Joined IISER Pune: May 2007



Research:

I am an NMR (nuclear magnetic resonance) spectroscopist working in the experimental aspects of quantum information, quantum computation, and quantum control. Using ensembles of nuclear spin networks in organic compounds as quantum testbeds, we investigate a variety of concepts involving quantum coherence. The nuclear spin-networks can retain quantum coherences for long durations, from seconds to minutes, and also permit precise and complex controls on their dynamics via carefully designed radio frequency pulses. We have experimentally simulated various concepts such as quantum phase transitions, Schrodinger dynamics of a particle in various potentials, Franck-Condon transitions, quantum mirror inversion, etc. Recently we have developed certain ultra-fast protocols for quantum state tomography and quantum process tomography.

Academic Background:

I did my PhD under the guidance of Prof. Anil Kumar (Physics Department, IISc, Bangalore) during 1997 to 2003. I was a postdoctoral fellow at MIT, Cambridge, USA (2003-2004), and a Humboldt fellow at the University of Dortmund, Germany (2005-2007).

Grants and Awards:

- "Quantum Information Processing by Nuclear Magnetic Resonance: Oriented Spin Systems as Large Quantum Registers", DST (2011-2014) Rs. 27 lakh.
- "Quantum Memory based on Nitrogen Vacancy Centers in Diamond", DST Swarnajayanti Fellowship (2014-2019), Rs. 2.14 crores.

Teaching activities:

- Physics Laboratory: Fall 2007, Spring 2008, Spring 2009, Fall 2009, Fall 2011, Fall 2013, Fall 2014.
- Mathematical Methods: Fall 2008, Fall 2010
- Quantum Information: Fall 2009, Fall 2011, Spring 2013, Fall 2014
- Quantum Physics - I: Spring 2011, Spring 2012
- Electronics - I: Spring 2008, Fall 2012
- Nuclear Magnetic Resonance: Spring 2010
- Experimental Methods: Spring 2009
- Atomic and Molecular Physics: Spring 2014

Organisational Activities:

I have been supervising the NMR Research Center, a central facility which has recorded tens of thousands of NMR spectra over last five years. The center is currently being expanded and is aimed at becoming one of the best NMR facilities in India. Over the past several years, I have been a member of various committees including the Purchase Committee, Curriculum Committee, Faculty Screening Committee, etc.

Outreach Activities:

Talks in schools and colleges:

- "Laboratory Simulation of Craters: Error Analysis for Undergraduates", Olympiad Training Camp, HBCSC, Mumbai, 2007.
- "Quantum Computers – Sooner or Later", Fergusson College, Pune, 2008.
- "Miracles in Quantum World", DST Inspire Workshop, Sagar, Karnataka, April 2010.
- "Miracles in Quantum World", DST Inspire Workshop, Moodbidri, Karnataka, May 2011.



Sunil Mukhi

Professor and Chair, Physics Programme

www.sunilmukhi.in

Joined IISER Pune: November 2012



Research:

I am a particle theorist with a strong interest in the formalism of gauge theory, supersymmetry, gravity and unification. My research has been primarily in the area of string theory, with a focus on theoretical mechanisms and mathematical properties of the theory in different phases. Some of the areas in which I have previously made contributions are: conformal invariance of the field theory on the superstring worldsheet, mass corrections for supersymmetric solitons and monopoles, dualities in string and M-theory, properties of black holes, and multiple membranes in M-theory. I am currently carrying out research on black hole entropy and its relation to entanglement entropy, and writing a textbook for Cambridge University Press on the Standard Model of Particle Physics.

Academic Background:

I did my Ph.D at the State University of New York, Stony Brook (1981). Thereafter I was a Postdoctoral Fellow at the International Centre for Theoretical Physics, Trieste (1981-84), and at the Tata Institute of Fundamental Research (1984-85). From 1985 to the present I have been a faculty member at the Tata Institute of Fundamental Research.

Selected Publications / Last Five Years:

- "Multiple Membranes in M-theory", Jonathan Bagger, Neil Lambert, Sunil Mukhi, Constantinos Papageorgakis, Physics Reports 527, 1-100 (2013).
- "Unravelling the novel Higgs mechanism in (2+1)d Chern-Simons theories", Sunil Mukhi, JHEP 1112, 083 (2011).
- "String theory: a perspective over the last 25 years", Sunil Mukhi, Class. Quant. Grav. 28 153001 (2011).

Grants and Awards:

- Shanti Swarup Bhatnagar Prize in Physical Sciences (1999).
- J.C. Bose Fellowship (2009-present).
- Fellow of Indian Academy of Sciences.
- Fellow, Indian National Science Academy.
- Fellow, The World Academy of Science.

Teaching Activities:

- Nuclear and Particle Physics, Spring 2013
- World of Physics IV: Quantum Mechanics, Spring 2014
- World of Physics II: Electromagnetism, Fall 2014
- Mathematical Methods, Spring 2015.

Organisational Activities:

- Chair, Physics Programme, IISER.
- Dean, Student Activities, IISER.
- Member, IISER Senate.
- Chair, IISER Ethics Committee.
- Editor, Journal of High Energy Physics (since 1997).
- Member of DST Committee on INSPIRE fellowships.
- Former member, DST Programme Advisory Committee.

Outreach Activities:

Numerous public lectures and articles aimed at school/college students, mainly on particle physics, string theory, unification and the Large Hadron Collider.

Sunil Nair

Assistant Professor

www.iiserpune.ac.in/~sunil

Joined IISER Pune: July 2011



Research area:

I am an experimental condensed matter physicist with interests in the synthesis and investigations of strongly correlated electron systems. The problems being investigated by me at IISER Pune span from multiferroics and geometrically frustrated systems to unconventional superconductors. We specialise in synthesizing novel materials with an eye on their potentially useful properties, and investigate them using a host of characterisation tools. This includes measurement of the magnetic, electronic and thermodynamic properties, as well as scattering using X-rays and neutrons. For the next few years, my research is likely to concentrate on the discovery of new multiferroics, investigation of anomalous magnetism in 4d/5d transition metal oxides, and on the normal state magnetotransport of unconventional superconductors.

Academic Background:

I did my PhD at the Inter University Consortium for DAE Facilities, Indore (2005). I held postdoctoral positions at Tata Institute of Fundamental Research, Mumbai (2004-2005), Max Planck Institute for Chemical Physics of Solids at Dresden, Germany as a Humboldt Fellow (2005-2009) and Clarendon Laboratory at the University of Oxford as a Marie Curie Fellow (2009-2011).

Selected Publications / Last Five Years:

- "Hall effect in heavy fermion metals", Sunil Nair, S. Wirth, S. Friedemann, F. Seglich, Q. Si and A. Schofield, Advances in Physics 61, 583 (2012).
- "Cu3Nb2O8: A Multiferroic with Chiral Coupling to the Crystal Structure", R. D. Johnson, Sunil Nair, L. C. Chapon, A. Bombardi, C. Vecchini, D. Prabhakaran, A. T. Boothroyd, and P. G. Radaelli, Phys. Rev. Lett. 107, 137205 (2011)
- "Magnetism and superconductivity driven by identical 4f states in a heavy-fermion metal", Sunil Nair, O. Stockert, U. Witte, M. Nicklas, R. Schedler, K. Kiefer, J. D. Thompson, A. D. Bianchi, Z. Fisk, S. Wirth and F. Steglich, P.N.A.S. (USA) 107, 9537 (2010).
- "Precursor state to superconductivity in CeIrIn₅: Unusual scaling of magnetotransport", Sunil Nair, M. Nicklas, F. Steglich, J. L. Sarrao, J. D. Thompson, A. J. Schofield and S. Wirth, Physical Review B 79, 094501 (2009).
- "Precursor state to unconventional superconductivity in CeIrIn₅", Sunil Nair, S. Wirth, M. Nicklas, J. L. Sarrao, J. D. Thompson, Z. Fisk, and F. Steglich,

Physical Review Letters 100, 137003 (2008).

Grants and Awards:

- DST-DAAD Personnel exchange programme (2014)
- SERB-DST research project on new multiferroics (2014)
- CSIR research project on 4d/5d transition metal oxides (2014)
- Equipment Subsidy grant from the Alexander von Humboldt Foundation (2014)
- Marie Curie International Incoming Fellowship (2009)
- Indian National Science Academy medal for Young Scientists (2007)
- Alexander von Humboldt Post-doctoral fellowship (2006)
- Best Thesis Award in Solid State Physics by the Indian Physics Association (2005)

Teaching Activities:

- Physics Lab 2: Fall 2011
- Physics Lab 7: Spring 2012
- Physics Lab 2: Fall 2012
- Physics lab 7: Spring 2013
- Methods in Experimental Physics: Fall 2013
- Physics Lab 5 : Spring 2014
- Physics Lab 2 : Fall 2014

Organisational Activities:

Served on the iPhD admissions committee. Currently serving on the Research Lab committee, Physics, Safety Committee, JEST Co-ordination Committee, Physics Curriculum Committee, Industry-Academia Collaboration Committee, Ishan Vikas. Organised BRNS Conference on Neutron Scattering, Feb 2014 at IISER Pune.

* Before joining IISER Pune.

Rejish Nath

Assistant Professor

www.iiserpune.ac.in/~rejish
Joined IISER Pune: October 2013



Research Area:

The field of ultra-cold atomic systems, including trapped ions and polar molecules, has developed as an interdisciplinary area, studying diverse problems across many areas of physics. The key in all these studies is the ability to manipulate and design inter-particle interactions using external fields. My research focuses on some of these problems, including the study of (non-local) non-linear phenomena such as solitons, vortices and pattern formation in weakly interacting Bose-Einstein condensates with long-range interactions. On the strongly correlated side, we address condensed matter problems using atoms in optical lattices or trapped ions. Our studies also intensively involve pure atomic physics, where the current focus is on the high-angular momentum, Rydberg-state properties of alkali atoms.

Academic Background:

I got my PhD at Leibniz University of Hannover, Germany in June 2009, in the group of Luis Santos. My post-doctoral positions were at MPIPKS, Dresden, Germany (2009 – 2011), group of Dr. Thomas Pohl, and IQOQI, University of Innsbruck, (Oct. 2011 – 2013), group of Prof. Peter Zoller.

Selected Publications / Last Five Years:

- "Quantum spin ice and dimer models with Rydberg atoms", W. Glaetzle, M. Dalmonte, R. Nath, I. Rousochatzakis, R. Moessner and P. Zoller, *Phy. Rev. X* in press (2014).
- "Dissipative many body quantum optics in Rydberg media", V. Gorshkov, R. Nath and T. Pohl, *Phys. Rev. Lett.*, 110, 153601 (2013).
- "Trapped two-dimensional condensates with synthetic spin-orbit coupling", S. Sinha, R. Nath and L. Santos, *Phys. Rev. Lett.*, 107,270401 (2011).
- "Three-dimensional roton-excitations and supersolid formation in Rydberg-excited BECs", N. Henkel, R. Nath and T. Pohl, *Phys. Rev. Lett.*, 104,195302 (2010).
- "Phonon instability against soliton formation in 2D dipolar BEC", R. Nath, P. Pedri and L. Santos, *Phys. Rev. Lett.*, 102, 050401 (2009).

Teaching Activities:

- Quantum Mechanics 1, Fall 2014.
- Part of Quantum Optics, jointly with Dr. Pavan Kumar, Spring 2013.

Organisational Activities:

- Committee for Ph.D. Student Admissions, Physics.
- Outreach Committee, Physics.

* Before joining IISER Pune.

Shivprasad V. Patil

Associate Professor

www.iiserpune.ac.in/~s.patil
Joined IISER Pune: January 2008



Research:

I am an experimental physicist working in nano-mechanics, biophysics and instrumentation. The main focus of my laboratory is to understand how molecules respond to external mechanical perturbations at the boundary where the continuum picture of matter breaks down. We develop novel experimental tools to understand mechanics at the nano-scale. So far we have probed normal and shear response of water under nano-scale spatial confinement. Other systems of our current as well as future interest are lipid bilayers and single protein molecules. To measure the response of few molecules to external mechanical perturbations is a difficult experimental proposition. Our group possesses a somewhat unique talent for building instruments for this purpose.

Academic Background:

I did my Ph.D. at the University of Pune in 2003. This was followed by postdoctoral positions at Wayne State University (2003-2005) and Institute of Microelectronics, CSIC Madrid (2005-2008).

Selected Publications / Last Five Years:

- "Viscoelasticity and shear thinning of nano-confined water", Karan Kapoor, Amandeep, and Shivprasad Patil, *Phys. Rev. E*, 89, 013004, (2014).
- "Photoinduced dark fraction due to blinking and photodarkening probability in aqueous CdTe quantum dots", A.V.R.Murthy, Padmashri Patil, Shouvik Datta and Shivprasad Patil, *J.Phys.Chem.C*, 117, 13268 (2013).
- "A new tuning fork-based instrument for oscillatory shear rheology of nano-confined liquids", Karan Kapoor, Vinod Kanawade, Vibham Shukla, Shivprasad Patil, *Rev. Sci. Instrum.*,84, 025101 (2013).
- "Probing the role of chain length on diffusion dynamics of pi-conjugated polymers by Fluorescence Correlation Spectroscopy", A.V.R. Murthy, Mahima Goel, Shivprasad Patil, M. Jayakannan, *J. Phys. Chem. B* 115, 10779 (2011).
- "Dynamic solidification of nano-confined water films", S. H. Khan, G. Matei, S. Patil and P. Hoffmann, *Phys. Rev. Lett.* 105, 106101 (2010).

Grants and Awards:

- DST Nano-mission grant.
- Wellcome-Trust DBT India alliance intermediate fellowship and grant.

Teaching Activities:

- Microprocessors: Fall 2008
- Materials Science and Methods of Experimental Physics: Fall 2009
- Physics Lab I: Spring 2010
- Physics Lab II: Fall 2010
- Physics Lab III: Spring 2009, Spring 2011, Spring 2014
- Quantum Mechanics: Fall 2011
- Advanced Physics Lab: Spring 2012
- Advanced Physics Lab V: Fall 2012, Spring 2013
- Advanced Physics Lab VI: Fall 2013
- Electronics I: Fall 2014.

Organisational Activities:

- Served on Purchase Committee (2009-2011).
- Served on Academic Committee (2011-2013).
- Part of Committee on Students Activities (COSA) for last two years.
- Handling all sports activities and purchase at IISER Pune.

Outreach Activities:

- A talk in Fergusson college Nov. 2013 "Atomic Force Microscopy : Beyond imaging".
- A talk in Bharati Vidyappeth's lavale campus, Nov. 2014" Atomic Force Microscopy: AFM and its applications in Engineering".
- DST Inspire camp lectures in Jaysinghpur College , Dist. Kolhapur.
- DST Inspire camp lectures in Willingdon college, Dist. Sangli.

G.V. Pavan Kumar

Assistant Professor

www.iiserpune.ac.in/~pavan

Joined IISER Pune: May 2010



Research:

I am interested in optical physics and applications of plasmons and excitons in nanostructures and molecular systems. Specifically, I am interested in questions pertaining to propagation and localization of light at sub-wavelength scale. To answer such questions, we (1) fabricate and synthesize a variety of nano-architectures; (2) probe them using home-built optical microscopy and nanoscopy methods; (3) theorize and model the nano-optical interaction. Over the past 4.5 years at IISER-Pune, we have fabricated a novel plasmonic nano-element called end-to-end coupled nanowires. We have developed a new method – plasmofluidic surface enhanced Raman scattering - to detect and probe single molecules using dynamic evanescent traps of plasmonic nanoparticles. We have developed Fourier-space optical microscopy method that can be used to determine k-vector distribution of photons emerging from nanostructures.

Academic Background:

I did my Ph.D at the Jawaharlal Nehru Centre for Advanced Scientific Research (JNCASR), Bangalore in 2008. Thereafter I was an ICFO post-doc fellow at the Institute of Photonic Sciences, Barcelona (2008) and a Postdoctoral Associate at Discovery Park, Purdue University (2008-2010).

Selected Publications / Last Five Years:

- "Plasmofluidic single-molecule surface enhanced Raman scattering from dynamic assembly of plasmonic nanoparticles", Partha P. Patra, Rohit Chikkaraddy, Ravi P.N. Tripathi, Arindam Dasgupta, G.V. Pavan Kumar; Nature Communications, 5, 4357 (2014).
- "Remote-excitation surface enhanced Raman scattering with counter-propagating plasmons: silver nanowire-nanoparticle system", Arindam Dasgupta, Danveer Singh, Shreyash Tandon, Ravi P.N. Tripathi, G. V. Pavan Kumar; Journal of Nanophotonics, 8(1), 083899 (2014).
- "Dual-path remote-excitation surface enhanced Raman microscopy with plasmonic nanowire dimer", Arindam Dasgupta, Danveer Singh, G. V. Pavan Kumar; Applied Physics Letters, 103, 151114 (2013).
- "Microsphere-coupled organic waveguide: preparation, remote excitation of whispering gallery modes and waveguiding property", Rohit Chikkaraddy, Arindam Dasgupta, S. Dutta Gupta, G. V. Pavan Kumar, Applied Physics Letters, 103, 031112 (2013).

- "Highly tapered pentagonal bipyramidal Au microcrystals with high index faceted corrugation: Synthesis and optical properties", Gangaiah Mettela, B. Radha, Danveer Singh, G. V. Pavan Kumar, G. U. Kulkarni; Scientific Reports, 3, 1793, DOI: 10.1038/srep01793 (2013).

Grants and Awards:

- 2014, DST Nanomission grant on Nonlinear Plasmonics, Rs 1.2 crore (as PI).
- 2014, DST-SERB grant on organic materials and photonics, Rs 50 lakhs (as co-PI).
- 2014, Young Scientist Award, JNCASR conference on materials, Trivandrum, Kerala.
- 2013, INSA Medal for Young Scientist (Physics), Indian National Science Academy (INSA).
- 2012, DST-SERB grant On Raman microscopy, Rs 50 lakhs.
- 2011, Associate, Indian Academy of Sciences.
- 2010, DST Ramanujan Fellowship in Physical Sciences.

Teaching activities:

- Classical and Quantum Optics: Spring 2015, Spring 2014
- Atomic and Molecular Physics: Spring 2013
- Advanced Physics laboratory: Fall 2010, Fall 2011, Fall 2012
- General Physics laboratory: Spring 2012, Fall 2010
- Electronics: Spring 2011
- Some experiments in Advanced Physical Chemistry: Fall 2014, Fall 2013, Fall 2012, Fall 2011

Organisational Activities:

- Hostel Warden (since Oct 2010).
- Member, Committee on Students Activity (COSA) – since 2013.

Outreach Activities:

- Organizer, KVPY camp (2011).
- Speaker, DST Inspire camps (since 2010).

Umakant D. Rapol

Assistant Professor

www.iiserpune.ac.in/~umakant.rapol

Joined IISER Pune: August 2009



Research:

I am an experimental physicist working in the area of atomic physics and quantum optics with particular emphasis in the area of physics with ultra-cold atoms/ions. Current research interests are in exploring novel phases of matter using Bose-Einstein condensates (BECs). The atomic physics and quantum optics laboratory setup at IISER Pune is the only Laboratory in the country where a Bose-Einstein condensation can be routinely produced. Current experiments are focused on looking for novel phases in Bose-Einstein condensates by engineering the inter-atomic interactions. Parallel efforts are being undertaken to create vortices in Rb BEC using synthetically generated magnetic fields and to reach the quantum Hall regime.

Academic Background:

I got my Ph.D at the Indian Institute of Science, Bangalore (2003). Thereafter I was a Visiting Researcher at Ecole Normale Supérieure, Paris, group of Claude Cohen-Tannoudji and Michelle Leduc (2003-2004) and at University of Innsbruck, group of Rainer Blatt (2004-2005). I then took up a position in Industrial R&D as Lead Scientist, Micro and Nano Structures Technology Division, General Electric Global Research, Bangalore (2005-2009).

Selected Publications / Last Five Years:

- "Bose-Einstein condensation in an electro-pneumatically transformed quadrupole-Ioffe magnetic trap", Sunil Kumar, Sumit Sarkar, Gunjan Verma, Chetan Vishwakarma, Md. Noaman and Umakant Rapol, <http://arxiv.org/abs/1408.4640>, New Journal of Physics, in press.
- "Fringe locking subsystem and methods of making and using the same", S. Maity, S. Vartak, and U. Rapol. US Patent 8,363,224 B2 (2013).
- "Systems and methods for detection and imaging of two-dimensional sample arrays", S. Maity, U. Rapol et al. WO Patent 2,012,057,681 (2012), and "Systems and methods for detection and imaging of two-dimensional sample arrays", A. Patil, S. Maity, V. Langoju, A. Rammohan, S. Vartak, and U. Rapol. US Patent 2012/0,105,852 (2012).
- "Welding control system", E. Calla, S. Maity, U. Rapol and A. Silvia. US Patent App. 12/491,158. and "Schweißsteuerungssystem", DE Patent (German Patent) 102,010,017,316 (2010).

Grants and Awards:

- British Council grant under Knowledge Economy Partnership programme with the University of Birmingham (2013).
- Prof. Anil Kumar memorial award for best Ph. D. thesis, Department of Physics, IISc Bangalore.

Teaching Activities:

- Physics Lab: Fall 2009, Fall 2014.
- Physics Lab III: Spring 2012, Spring 2014.
- Physics Lab IV: Fall 2013.
- Advanced Physics Lab: Fall 2010, Spring 2011, Fall 2011.
- Atomic, Molecular and Optical Physics: Spring 2010, Spring 2011.
- Electronics: Fall 2011, Spring 2013.

Organisational Activities:

I have been actively involved in the development of design of undergraduate physics laboratories, curriculum and contents. I have been instrumental in the introduction of physics laboratories courses for the third and fourth year labs and in extending the curriculum of courses on electronics.

Past committee work: Member of the Purchase Committee, Member of various Ph D and Int. Ph D selection committees, member of research and undergraduate laboratory space design committee, Member of Joint Admissions Committee for undergraduate admissions, Representative/Member of the Joint Entrance Screening test (JEST) Consortium. Present committee work: Member of Academic committee, Member of Faculty applications screening committee, Co-organizer of the Joint Entrance Screening test 2015, Representative of the Ligo-India consortium (INDIGO).



M.S. Santhanam

Associate Professor

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Joined IISER Pune: May 2008



Research:

My primary research interests are in the broad areas of nonlinear dynamics and chaos and statistical physics. Most of my work is concentrated in the area of quantum chaos in which we study quantum mechanical manifestations of classical chaos, directed transport in quantum chaotic systems and more recently quantum chaos in microcavity resonators. In the last few years, I have extensively worked on random walks and extreme events on complex networks. We focus on the occurrence of extreme events in network settings with flux defined through random walk model. This has applications in many areas ranging from transport properties in physical systems to search engine algorithms. In the next few years, much of my work would be focussed on understanding transport properties in non-KAM chaotic systems in both classical and quantum regimes.

Academic Background:

I got my Ph.D at the Physical Research Laboratory, Ahmedabad in 1999. Subsequently I was a Research Staff Member at IBM India Research Laboratory (1998-2002) and a Guest Scientist at the Max Planck Institute for the Physics of Complex Systems, Dresden, Germany (2002-2004). After this I took up a faculty position at PRL, Ahmedabad (2004-2008).

Selected Publications / Last Five Years:

- "Record statistics of financial time series and geometric random walks", Behloul Sabir and M. S. Santhanam, Phys. Rev. E. 90, 032126 (2014).
- "Manipulation of extreme events on scale-free networks", Vimal Kishore, Abhijeet R. Sonawane and M. S. Santhanam, Phys. Rev. E. 88, 014801 (2013).
- "Extreme events and event size fluctuations in biased random walks on networks", Vimal Kishore, M. S. Santhanam and R. E. Amritkar, Phys. Rev. E. 85, 056120 (2012).
- "Extreme events on complex networks", Vimal Kishore, M. S. Santhanam and R. E. Amritkar, Phys. Rev. Lett. 106 , 188701 (2011).
- "Dynamics of kicked particles in a double-barrier structure", Harinder Pal and M. S. Santhanam, Phys. Rev. E 82 , 056212 (2010).

Grants and Awards:

Research project sanctioned by DST, Govt of India on "Emergent dynamics on growing networks with comparable time scales" (jointly with Dr. Arijit Bhattacharyay and G. Ambika) for the years 2010-2013.

Teaching Activities:

- Introduction to computation, Fall 2008.
- Relativity and quantum physics, Spring 2009.
- Mathematical methods, Fall 2009.
- Quantum mechanics I, Spring 2010.
- Quantum mechanics II, Fall 2010.
- Computational Physics, Spring 2011, Fall 2011.
- Nonlinear Dynamics, Spring 2012.
- Physics Laboratory I, Fall 2012.
- Quantum Mechanics I, Spring 2013.
- Computational Physics, Fall 2013.
- World of Physics II (Waves and Matter), Spring 2014.

Organisational Activities:

- Active member of IT Committee since 2008.
- Chairperson of IT Committee since 2012.

Outreach Activities:

I have given talks at schools and colleges, at KVPY camps and groups of children hosted by other organisations on science related topics.

Seema Sharma

Assistant Professor

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Joined IISER Pune: April 2014



Research:

My research interests mainly revolve around understanding the elementary particles which constitute the universe and their interactions. The Large Hadron Collider is scheduled to operate at a centre-of-mass energy of 13 TeV starting in 2015, and will open an unprecedented phase space for the production of heavy particles. The goal of my current research is to identify signatures of new physics beyond the standard model. I am searching for supersymmetric particles, which provide a solution to the hierarchy problem and in some cases are also a potential candidate for the dark matter. Once any new particles are observed, I will work on characterizing the new phenomena. At present, I am also leading the subgroup of the CMS SUSY physics program which focusses on the generic searches for gluinos and squarks in a variety of all hadronic and single lepton final states. I plan to work on the detector upgrade efforts and contribute to the hardware improvements that will help in better particle identification and reconstruction in the more powerful phase of the LHC in 2022-23.

Academic Background:

I did my PhD in experimental particle physics at Tata Institute of Fundamental Research (TIFR), Mumbai (2008). Thereafter I was a Postdoctoral Research Associate at Fermilab, USA (2008-2014).

Selected Publications / Last Five Years:

- * "Search for new physics in the multijet and missing transverse momentum final state in proton-proton collisions at $\sqrt{s} = 8$ TeV", CMS Collaboration, JHEP 06 (2014) 055, arXiv:1402.4770.
- * "Search for new physics in the multijets and missing transverse energy in 7 TeV proton-proton collisions", CMS Collaboration, Phys. Rev. Lett. 109 (2012) 171803, arXiv:1207.1898.
- * "Determination of jet energy calibration and transverse momentum resolution in CMS", CMS Collaboration, JINST 6 (2011) 11002
- * "Search for new physics with jets and missing transverse momentum in pp collisions at $\sqrt{s} = 7$ TeV", CMS Collaboration, JHEP 1108 (2011) 155
- * "The CMS barrel calorimeter response to particle beams from 2 to 350 GeV/c", S. Abdullin et al. Eur. Phys. J. C 60 (2009), 359-373

Grants and Awards:

I am one of two faculty members to join the CMS collaboration at CERN as part of IISER Pune. This project is funded by a DAE-DST consortium under the umbrella of India-CMS.

Teaching Activities:

- World of Physics - Electricity and Magnetism, Fall 2014.

Organisational Activities:

Member of the institute IT committee.

* Before joining IISER Pune.

Surjeet Singh

Assistant Professor

www.iiserpune.ac.in/~surjeet.singh/
Joined IISER Pune: December 2009



Research:

I am an experimentalist working in the area of condensed matter physics. In my research group we use the optical floating zone and the high-temperature solution or flux methods to grow single-crystals of strongly correlated oxides and intermetallics. Materials that are currently being pursued include spin $S = \frac{1}{2}$ chains and ladders where the quantum effects are particularly strong; iron-based superconductors which provide the first example of high-temperature superconductivity outside the cuprate family; the pyrochlore structure based iridates where a combination of geometrical frustration and substantial spin-orbit and electronic correlations result in many interesting phases including topological insulators; and some perovskite based oxides as potential thermoelectrics.

Academic Background:

I got my PhD from TIFR Mumbai in 2003. Subsequently I held postdoctoral positions at the Max Planck Institute for Chemical Physics of Solids, Dresden (2003-2005), University of Paris, Orsay (2005-2009) and Leibnitz institute (IFW), Dresden (March-April 2009).

Prasad Subramanian

Associate Professor

www.iiserpune.ac.in/~p.subramanian
Joined IISER Pune: May 2008



Research:

My research interests range from solar and solar-terrestrial physics to black hole accretion, within the overall framework of plasma astrophysics. I use a combination of semi-analytical theory and analysis of data from ground and space-based instruments such as the SOHO and STEREO satellites, the Giant Metrewave Radio Telescope (GMRT), the GRAPES-3 cosmic ray telescope and the upcoming Aditya solar observing satellite to be launched by the Indian Space Research Organisation. We study the dynamics of mass ejections from the Sun's corona and in the manner in which they impact the near-Earth space environment. We are also interested in aspects of high energy astrophysics such as physical prescriptions for viscosity in hot accretion disks around black holes and the manner in which relativistic jets are launched.

Academic Background:

I got my PhD in 1997 from George Mason University, Fairfax, VA, following which I was a postdoc at the Naval Research Lab, Washington, DC. I followed that with a postdoctoral position at IUCAA, Pune and a faculty position at the Indian Institute of Astrophysics, Bangalore, prior to joining IISER Pune in 2008.

Selected Publications / Last Five Years:

- "Crystal growth of the non-magnetic Zn²⁺ and magnetic Co²⁺ doped quasi one-dimensional spin chain compound SrCuO₂ using the travelling solvent floating zone method", K. Karmakar, A. Singh, S. Singh, A. Poole, C. Ruegg, ACS Cryst. Growth Des., 14(3) 1184 (2014).
- "Spin Pseudogap in Ni-Doped SrCuO₂", G. Simutis, S. Gvasaliy, M. Mansson, A.L. Chernyshev, A. Mohan, S. Singh, C. Hess, A.T. Savici, A.I. Kolesnikov, A. Piovano, T. Perring, I. Zaliznyak, B. Buchner and A. Zheludev, Phys. Rev. Lett., 111 067204 (2013).
- "Spin-orbital separation in the quasi 1D Mott-insulator Sr₂CuO₃", J. Schlappa, K. Wohlfeld, K.J. Zhou, M. Mourigal, M.W. Haverkort, V.N. Strocov, L. Hozoi, C. Monney, S. Nishimoto, S. Singh, A. Revcolevschi, J.S. Caux, L. Patthey, H.M. Ronnow, J. Van Den Brink and T. Schmitt, Nature 458, 82 (2012).
- "Spinon heat transport and spin-phonon interaction in the spin-1/2 Heisenberg chain cuprates Sr₂CuO₃ and SrCuO₂", N. Hlubek, X. Zotos, S. Singh, R. Saint-Martin, A. Revcolevschi, B. Buechner and C. Hess,

J. Stat. Mech.: Theory and Experiment (2012).

- "Phase diagram of the iron arsenide superconductors Ca(Fe_{1-x}Co_x)₂As₂", L. Harnagea, S. Singh, G. Friemel, N. Leps, D. Bombor, M. Abdel-Hafiez, A.U.B. Wolter, C. Hess, R. Klingeler, G. Behr, S. Wurmehl and B. Buechner, Phys. Rev. B 83 094523 (2011).

Grants and Awards:

- Crystal growth of the newly discovered high-temperature Iron-arsenide superconductors AFe₂As₂ (A = Ba, Ca, Sr and Eu), DST, India, Rs 27 Lakhs.
- Personnel Exchange Program, Indo-Switzerland: "Electronic, Magnetic and Non-magnetic Doping of Quantum Spin Chains", DST, India

Teaching activities:

- Physics Lab IV Optics and Quantum Physics: Spring 2010, 2011, 2013, 2014
- Physics Lab III Thermodynamics and Optics: Fall 2010
- Classical Mechanics: Fall 2011
- Advanced Physics Lab: Spring 2012
- Electrodynamics: Fall 2012
- Electricity and Magnetism: Fall 2013
- Condensed Matter Physics: Fall 2014

Organisational Activities:

I have been handling PhD admissions in Physics since 2012. I am a member of the Institute's Purchase Committee and was previously a member of the Examination Committee. I also served on the Brochure Committee of the institute and iPhD admissions committee.

Outreach Activities:

Supervised laboratory visits by school children.

Selected Publications / Last Five Years:

- "Coronal turbulence and the angular broadening of radio sources - the role of the structure function", M. Ingale, P. Subramanian and I. Cairns, 2014, to appear in the Monthly Notices of the Royal Astronomical Society.
- "Self-similar expansion of solar coronal mass ejections: implications for Lorentz self-force driving", P. Subramanian, K. P. Arunbabu, A. Vourlidas and A. Mauriyya, Astrophysical Journal, 790, 125 (2014).
- "Can solar wind viscous drag account for CME deceleration?", P. Subramanian, A. Lara and A. Borgazzi, Geophysical Research Letters, 39, L19107 (2012).
- "TeV blazar variability: the firehose instability?", P. Subramanian, A. Shukla and P. Becker, Monthly Notices of the Royal Astronomical Society 423, 1707 (2012).
- "Forbush decreases and turbulence levels at CME fronts", P. Subramanian, H. M. Antia, S. Dugad, U. Goswami, S. K. Gupta et al, Astronomy and Astrophysics 494, 1107 (2009).

Grants and Awards:

- Initiation and propagation of Earth-directed Coronal Mass Ejections (CMEs), PI: Prasad Subramanian, Co-PI: Dibyendu Nandi (IISER-Kolkata), Oct 2013 – Jan 2015, Asian Office of Aerospace Research and Development, Tokyo, USD 66,000.
- Modelling and observations of CME propagation, associated radio bursts and cosmic ray Forbush decreases at the earth, PI: Prasad Subramanian, 2012-2015, ISRO/CAWSES program, Rs 7.69 lakh.
- Propagation and near-earth manifestations of solar coronal mass ejections, PI: Prasad Subramanian, 2009-2012, ISRO/Respond program, Rs 12.58 lakh.
- Buti Foundation Award for excellence in Plasma Science and Technology, 2013.

Teaching Activities:

- Classical Electrodynamics, Fall 2008, Fall 2009, Fall 2010, 2014
- Plasma Physics, Spring 2014
- Introductory Physics Lab, Fall 2013
- Fluid Dynamics, Spring 2013 (also coordinated Earth System Science)
- Special Relativity and Electrodynamics, Spring 2012 (also lectures of astrophysics for World of Physics II)
- Mathematical Methods in Physics, Fall 2011
- Fluid Dynamics, Fall 2009 (one module), Spring 2011
- Electricity and Magnetism, Spring 2009, Spring 2010

Suneeta Vardarajan

Associate Professor

www.iiserpune.ac.in/~suneeta

Joined IISER Pune: July 2010



Research:

I am a theoretical physicist and work in two inter-connected fields: gravitation and mathematical physics. In gravitation, I am mainly interested in black hole physics, and work on problems ranging from classical perturbation theory (which is important for providing astrophysical signatures of black holes) to quantum features of black holes. I also study the dynamics of matter propagating in non-black hole spacetimes such as asymptotically anti-de Sitter spacetimes, which interface with related areas like string theory.

In mathematical physics, I am mainly interested in Ricci flow, a flow of geometries which was used to prove the Poincare conjecture in mathematics. New geometric techniques were introduced in the proof. This flow equation appears naturally in physics as a renormalization group (RG) flow for a class of quantum field theories. My work in the last few years in this area has been to exploit this connection, and the geometric techniques from Ricci flow, to yield insights both in two dimensional quantum field theories and mathematics.

Academic Background:

I got my Ph.D at the Institute of Mathematical Sciences, Chennai, India (2002). Thereafter I was an Alexander von Humboldt Fellow, University of Munich (2002-2003), a Pacific Institute for Math. Sciences Fellow, University of Alberta, Canada (2003-2005) and a Research Fellow, University of New Brunswick, Canada (2005-2007). After this I took on a position as Assistant Professor, University of Alberta, Canada (2007-2010).

Selected Publications / Last Five Years:

- "Stability analysis of anisotropic spacetimes", Bhavesh Khamesra, V. Suneeta, Phys. Rev. D 90, 024044 (2014).
- "A naked singularity stable under scalar field perturbations", Amruta Sadhu, V. Suneeta, Int. J. Mod. Phys. D 22 (2013) 1350015.
- "Stability analysis of the Witten black hole under world-sheet RG flow", Carolyn Lambert, V. Suneeta, Phys. Rev. D 86, 084041 (2012).
- "Investigating stability of a class of spacetimes under Ricci flow", Suvankar Dutta, V Suneeta, Class. Quant. Grav. 27:075012 (2010).

Grants and Awards:

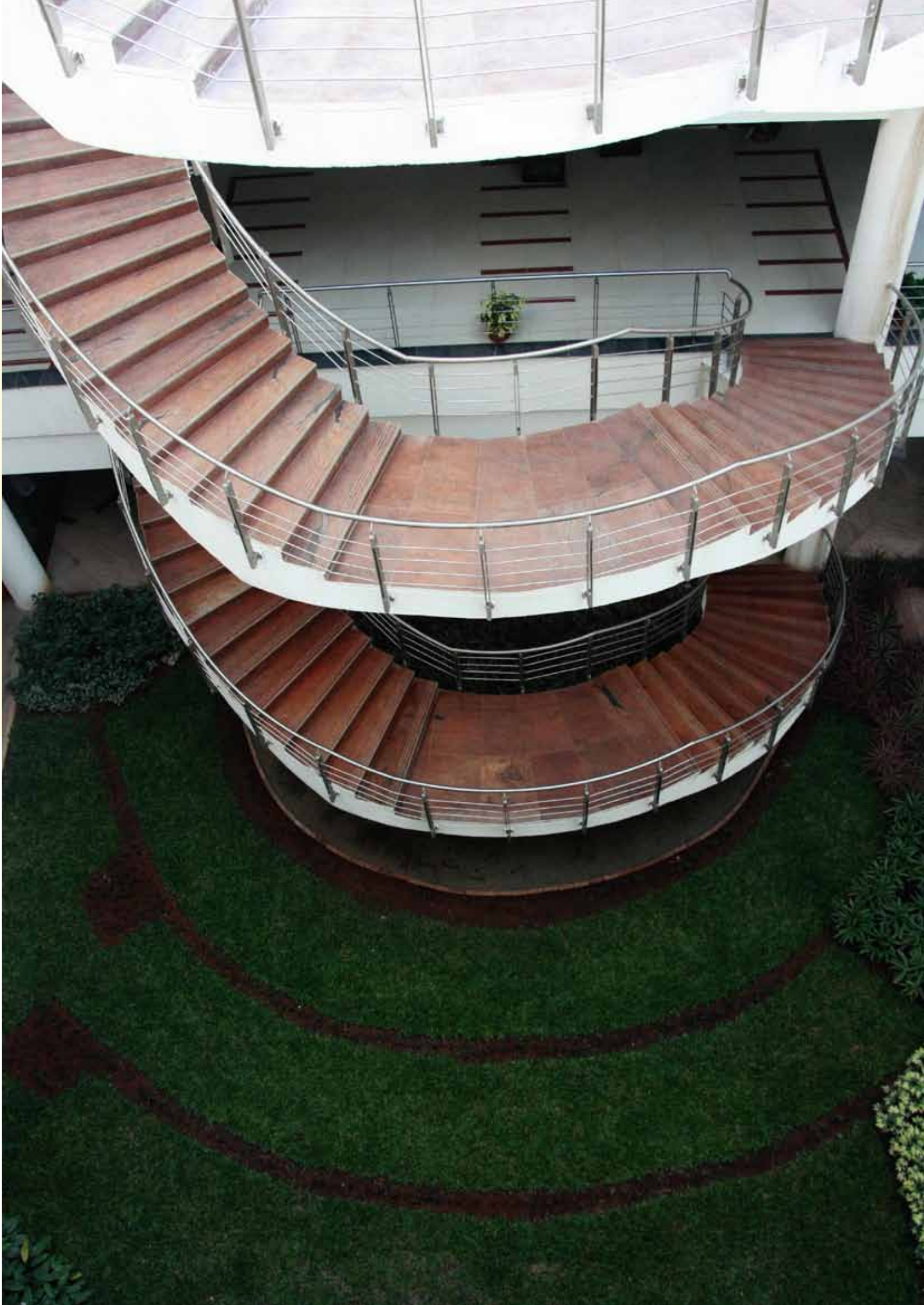
Canadian \$90,000 from Natural Sciences and Engg. Research Council of Canada and Canadian \$40,000 from the University of Alberta for the period 2007-2010.

Teaching Activities:

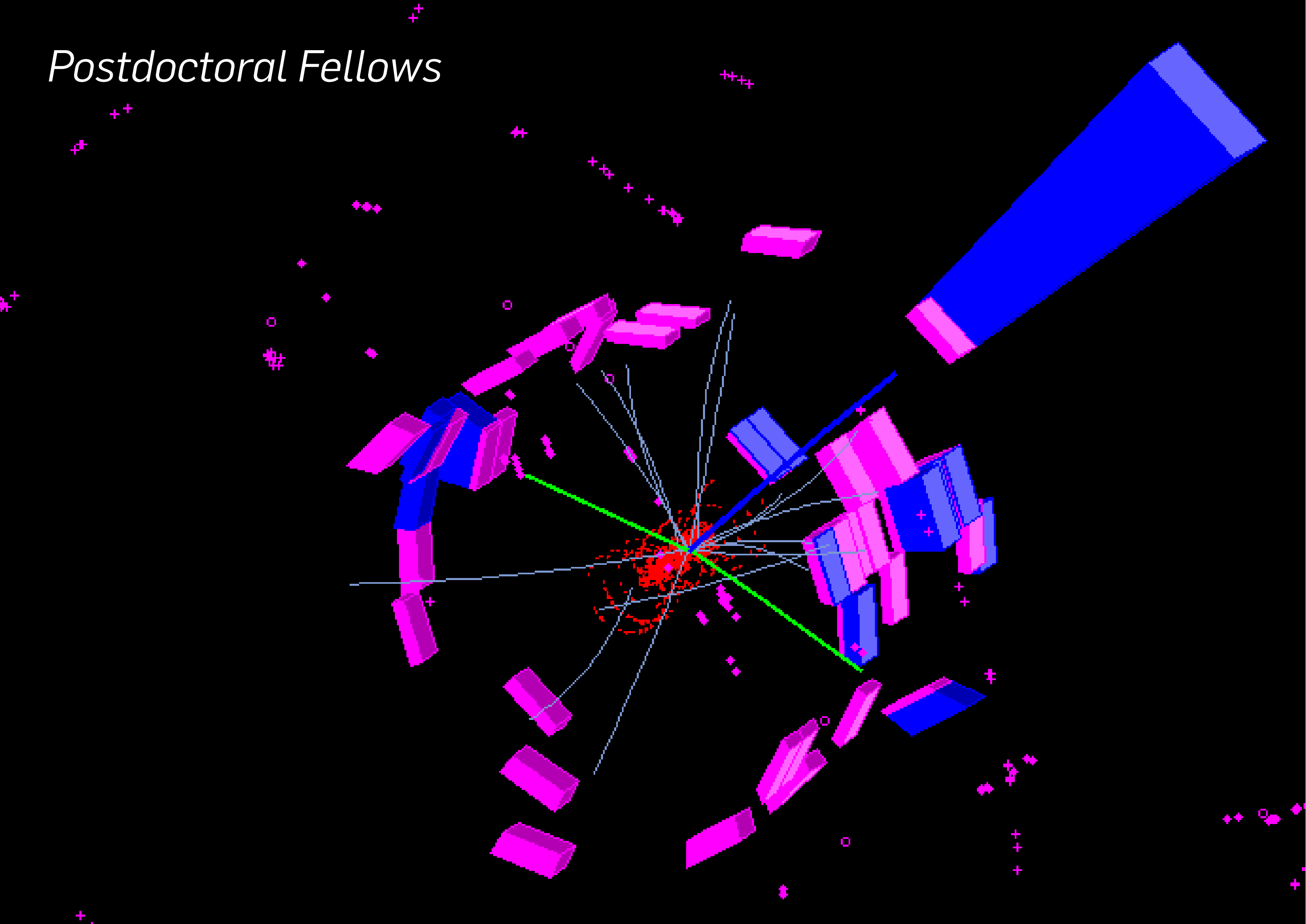
- Mathematical methods in physics: Fall 2012, Fall 2013, Fall 2014.
- Gravitation and Cosmology: Fall 2011, Spring 2013, Spring 2014.
- Calculus: Spring 2012.
- World of Physics: Spring 2011.
- Mathematical methods (for the sciences): Fall 2010.

Organisational Activities:

- Chair, Library committee (2010 to present).
- Member, Senate Council of IISER Pune (until 2014).
- Chair, Infrastructure Committee, Physics (2013 to present).
- Maths Ph.D committee (2010-2012).
- Editorial Board, Geometric flows (de Gruyter).
- Organizer, 27th IAGRG (Indian Association of General relativity and Gravitation) meeting, HNBSU, Srinagar, Uttarakhand, March 2013.
- Organiser, Workshop on Numerical Ricci flow in Computer Science, Geometry and Physics, (official satellite workshop of the International Congress of Industrial and Applied Mathematics, ICIAM 2011), University of British Columbia, Vancouver, July 2011.
- Member, Women in Mathematics committee, the Canadian Mathematical Society 2010-2011.



Postdoctoral Fellows





Smita Chaturvedi

Project Scientist under DST Women Scientists Scheme (working with Dr Sulabha Kulkarni)

Joined IISER Pune: October 2013

Research: Currently I am involved in nanoscale synthesis of multiferroic materials (Bismuth Ferrite) and rare earth orthoferrite materials (summarium orthoferrite, dysprosium orthoferrite); their structural, magnetic and optical characterization; effect of doping and temperature on their structure and properties and applications in the area of spintronics and nano device applications.

Academic background: I obtained a Ph.D. in condensed matter physics from Rani Durgavati University, Jabalpur in 2002. Later I worked as Research Associate at IIT Mumbai (2002-2004) and as Postdoctoral Fellow from 2010 to 2011 at Oakland University, Rochester, Michigan (2010-2011).

Selected Publications / Last Five Years:

- "Coercivity and exchange bias of bismuth ferrite nanoparticles isolated by polymer coating", S. Chaturvedi, M. M. Shirolkar, R. Rajendra, S. Singh, N. Ballav and S. Kulkarni, J. Appl. Phys., 115, 123906 (2014).
- "Probing bismuth ferrite nanoparticles by hard x-ray photoemission: Anomalous occurrence of metallic bismuth", S. Chaturvedi, I. Sarkar, M. M. Shirolkar, U.-S.

Jeng, Y.-Q. Yeh, R. Rajendra, N. Ballav and S. Kulkarni, Appl. Phys. Lett., 105, 102910 (2014).

- A. Apte, P. Bhaskar, R. Das, S. Chaturvedi, P. Poddar and S. Kulkarni, Nano Res., to appear (DOI: 10.1007/s12274-014-0572-2).



Nitin S. Wadnerkar

IISER Postdoctoral Research Associate (working with Dr Mukul Kabir)

Joined IISER Pune: April 2014

Research: Most research based on ab-initio methods use ideal structures to determine material properties. However, first-principles methods often fail to accurately predict the materials' properties for renewable-energy applications. Particularly, I am studying materials (like perovskites) which have significant features of the presence of orbital-ordering and Jahn-Teller distortions. Improving oxygen-reduction processes and understanding Jahn-Teller distortions in perovskites is a key component in this effort. I will also be focusing on DFT-study of optical properties of graphene-inspired 2D materials.

Academic Background: I did my Ph.D. in Physics at SRTM University, Nanded, in 2012 and was a postdoctoral fellow at the School of Chemical and Bioprocess Engineering, University College Dublin from 2012-2013.

Selected Publications / Last Five Years:

- * "Photo-active and optical properties of Hematite (Fe2O3)-water interfaces: An experimental and theoretical study", N.J. English, M. Rahman, N. Wadnerkar et al, Phys. Chem., Chem. Phys. 16, 14445 (2014).
- * "The influence of Ti- and Si-doping on the structure, morphology and photo-response properties of α -Fe2O3 for efficient water splitting...", M. Rahman, N.

Wadnerkar, N.J. English et al, Chem. Phys. Lett. 592, 242 (2014).

- * "Photo-active and optical properties of Bismuth Ferrite (BiFeO3): An experimental and theoretical study", K.A. McDonnell, N. Wadnerkar, N.J. English et al, Chem. Phys. Lett., 572, 78 (2013).
- * "Density functional theory investigations of bismuth vanadate: effect of hybrid functionals", N. Wadnerkar and N.J. English, Comp. Mat. Sci. 74, 33 (2013).



Shankhadeep Chakraborty

Postdoctoral Fellow (with Arjun Bagchi)

Joined IISER Pune: September 2014

Research: I am a theoretical high energy physicist. I work on string theory and the AdS/CFT correspondence. Presently I am working on the tension limit of string theory which has been considered a long-standing problem. We are trying to probe this from the underlying symmetry structure. I am also working on holographic entanglement entropy in collaboration with Dr. Nabamita Banerjee. We aim to study the entanglement entropy structure for a strongly coupled dissipative fluid, which is related to black hole dynamics via the fluid/gravity correspondence.

Academic Background: I did my PhD at the Institute of Physics Bhubaneswar (2013) and was a postdoctoral fellow at the Institute of Mathematical Sciences, Chennai (2012-2014).

Selected Publications / Last Five Years:

- "Schwinger effect and negative differential conductivity in holographic models", S. Chakraborty and B. Sathiapalan, Nucl. Phys. B890 (2014) 241 (2014).
- * "Brownian motion in strongly coupled, anisotropic Yang-Mills plasma: A holographic approach", Shankhadeep Chakraborty, Somdeb Chakraborty and Najmul Haque, Phys.Rev. D89,

066013 (2014).

- * "Some aspects of QGP phase in a hQCD model", Rong-Gen Cai, S. Chakraborty, Song He, Li Li, JHEP 1302 (2013) 068.
- * "Correlators of giant gravitons from dual ABJ(M) theory", S. Chakraborty and Tanay K. Dey, JHEP 1203 (2012) 062.
- * "w ∞ 3-algebra", Shankhadeep Chakraborty, Alok Kumar and Sachin Jain, JHEP 0809 (2008) 091.

* Before joining IISER



Rudranil Basu

IISER Postdoctoral Research Associate (working with Arjun Bagchi)

Joined IISER Pune: September 2014

Research: I am a theoretical high energy physicist. I work on string theory and the AdS/CFT correspondence. Presently I am working on the tension limit of string theory which has been considered a long-standing problem. We are trying to probe this from the underlying symmetry structure. I am also working on holographic entanglement entropy in collaboration with Dr. Nabamita Banerjee. We aim to study the entanglement entropy structure for a strongly coupled dissipative fluid, which is related to black hole dynamics via the fluid/gravity correspondence.

Academic Background: I did my PhD at the Institute of Physics Bhubaneswar (2013) and was a postdoctoral fellow at the Institute of Mathematical Sciences, Chennai (2012-2014).

Selected Publications / Last Five Years:

- "Galilean conformal electrodynamics", Arjun Bagchi, Rudranil Basu and Aditya Mehra. JHEP 1411, 061 (2014).
- * "3D flat holography: entropy and logarithmic corrections", Arjun Bagchi and Rudranil Basu. JHEP 1403, 020 (2014).
- * "Consistent 3d quantum gravity on lens spaces", Rudranil Basu and Samir K Paul, Phys. Rev. D 85, 023520 (2012).

- * "Horizon mechanics and asymptotic symmetries with an Immirzi-like parameter in 2+1 dimensions", Rudranil Basu and Ayan Chatterjee, Class. Quant. Grav. 28 (2011) 225013.
- * "Local symmetries of non-expanding horizons", Rudranil Basu, Ayan Chatterjee and Amit Ghosh, Class. Quant. Grav. 29, 235010 (2012).

* Before joining IISER.



Arpita Roychoudhury

IISER Postdoctoral Research Associate (working with Dr Shivprasad Patil)

Joined IISER Pune: April 2014
www.iiserpune.ac.in/~s.patil/people.html

Research: I am an experimental biophysicist. My work involves studying nano-mechanics of bio-membranes and lipid bilayers as well as understanding mechanical properties of single proteins and the effects of external stresses on these properties. Currently I am working on investigating the mechanical strength of tethers formed in supported lipid bilayers by pulling them using atomic force microscopy based force spectroscopy. The experimental results and findings recorded in next two years are expected to provide useful insight in understanding the membrane-water interaction and eventually the process of endocytosis in cells.

Academic Background: I have a PhD in Biophysics from Heinrich Heine University, Dusseldorf, Germany.

Selected Publications / Last Five Years:

- * "Studying bacterial membrane proteins with single-molecule atomic force spectroscopy", A. Roychoudhury, and F. Oesterhelt, Microscopy and Analysis, Bd. 25, S. 15 (2011).
- * "Effect of the compatible solute ectoine on the stability of the membrane

proteins", A. Roychoudhury, D. Häussinger and F. Oesterhelt, Protein & Peptide Letters, Bd. 19, BSP/PPL/E-Pub/00460 (2012).

- * "Membrane protein stability depends on the concentration of compatible solutes – a single molecule force spectroscopic study", A. Roychoudhury, A. Bieker,

D. Häussinger and F. Oesterhelt, , Biol. Chem. doi: 10.1515/hsz-2013-0173 (2013).

- * "Mechanical stabilization of membrane proteins using compatible solutes", A. Roychoudhury, R. Reinehr, D. Häussinger and F. Oesterhelt, Biophysical Journal, 100(3): 479a (2011).
- * S. Roychoudhury, A.

Roychoudhury, A. Talukdar, G.D. Sharma: "Antifreeze proteins – plant comfort in cold world". BIOTECH, Annual journal of Dept. of Biotechnology, G C College, Silchar, India, pp. 16-20; ISSN – 2230 – 9098 (2010-2011).

*Before joining IISER.

Ph.D. Students

Response of Nanomaterials using Circuital approach: A Novel Concept
Adarsh B Vasista, G V Pavan Kumar*
Photonics and Optical Nanoscopy Laboratory, IISER Pune
Indian Institute of Science Education and Research, Pune
Pune - 411008, Maharashtra
*E-mail: pavan@iiserpune.ac.in

Lumped Elements
Electric circuits' considers the properties of matter like Resistance, Inductance, and Capacitance as lumped elements. That is, the spatial extent of the elements is negligible in the approach to problem. This approach is very promising for troubleshooting.

Nano-Pass circuits
Nanomaterials like a thin coated wire (Nanowire) is considered as a lumped element. The circuit is simulated using a circuit simulator. The simulation is carried out by setting frequency of a AC, by using the circuit simulator. The circuit simulator has been shown by theory. The circuit simulator has been shown by theory. The circuit simulator has been shown by theory.

Low pass characteristics
Transfer Function
Frequency in log scale

Tuned-Pass Characteristics
Transfer Function
Frequency in log scale

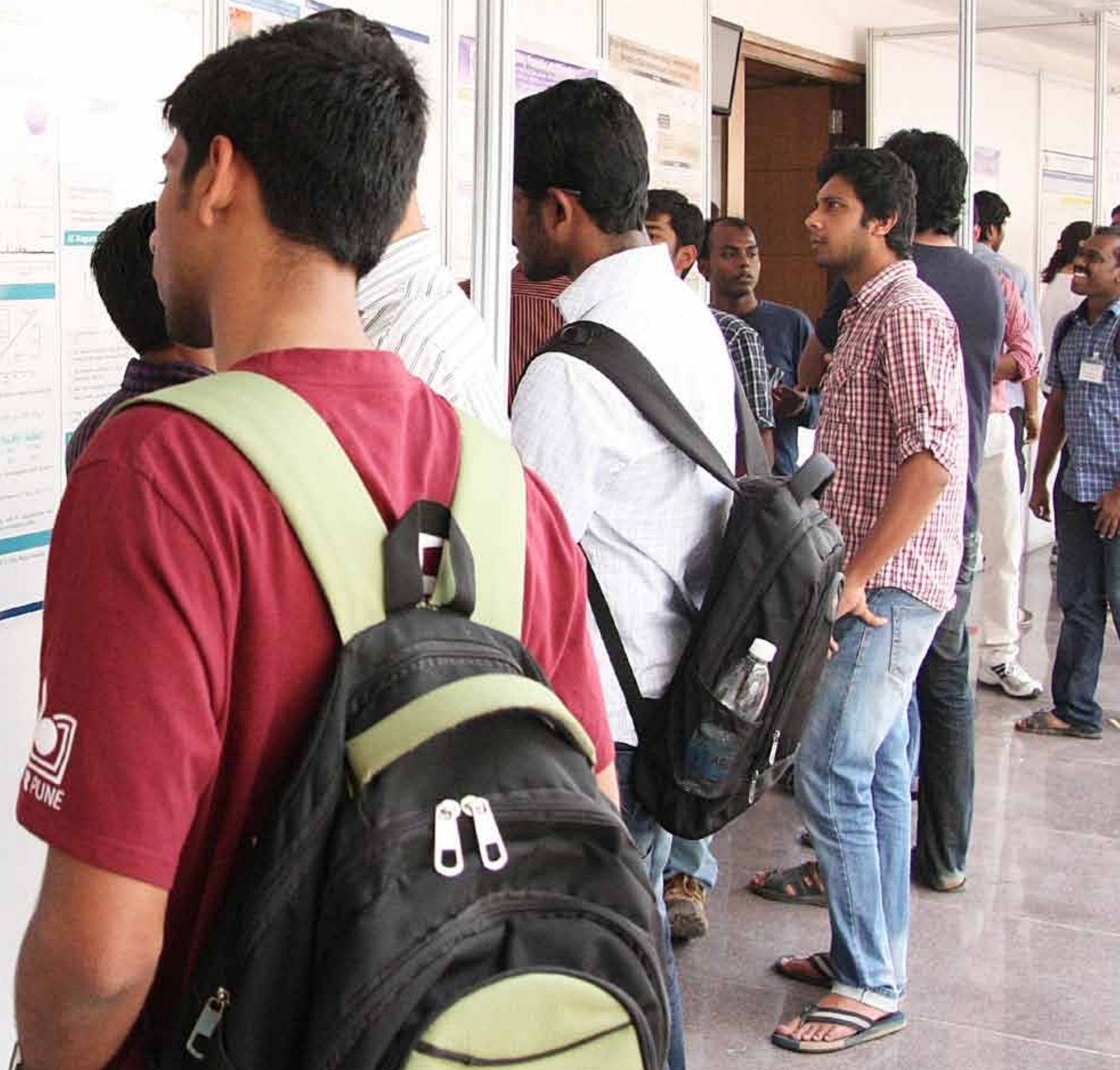
Plasmonic materials from our Lab
Equivalent of end-end coupled nanowire
TEM image and circuital equivalent of Ag@Au core-shell Nanowire

Tuning of magnetic frustration in $S = \frac{1}{2}$ Kagome metal-organic complexes
A. D. Sahoo, J. Kim, A. K. Sahoo
Indian Institute of Science Education and Research, Pune

Introduction
The Kagome lattice is a unique geometric structure that has been the subject of intense research in condensed matter physics. In this work, we study the magnetic properties of a Kagome metal-organic complex, which exhibits magnetic frustration. The complex is a 1D chain of Kagome units, which are interconnected by metal-organic linkers. The resulting structure is a 3D lattice with a Kagome-like topology. The magnetic properties of the complex are studied using neutron scattering and magnetization measurements. The results show that the complex exhibits a magnetic phase transition at a low temperature, which is attributed to the magnetic frustration in the Kagome lattice.

DC Magnetization
The DC magnetization of the complex is measured as a function of temperature and magnetic field. The results show that the magnetization increases with increasing temperature and magnetic field. The increase in magnetization is attributed to the magnetic frustration in the Kagome lattice.

References
1. S. K. Ghosh, J. Kim, A. K. Sahoo, *Phys. Rev. B*, **85**, 040408 (2012).
2. A. D. Sahoo, J. Kim, A. K. Sahoo, *Phys. Rev. B*, **85**, 040408 (2012).
3. A. D. Sahoo, J. Kim, A. K. Sahoo, *Phys. Rev. B*, **85**, 040408 (2012).





Madhusudan Ingale (August 2008)

I work in solar astrophysics under the guidance of **Dr. Prasad Subramanian**. Heating of the solar corona and solar wind has been the subject of intense research in heliophysics. Turbulent dissipation is often invoked as a major candidate for this heating. In my research I study the constraints imposed on the amplitude of density turbulence in solar corona and solar wind using observations of angular broadening of radio source.



Abhishek Shukla (August 2009)

I am working in quantum information and quantum computation under the guidance of **Dr. T.S. Mahesh**. My research is focused on quantum measurements, foundations of quantum mechanics, study and suppression of decoherence, and applications of quantum information processing (QIP) techniques in spectroscopy.



Koushik Karmakar (August 2010)

I work in experimental condensed mater physics under the guidance of **Dr. Surjeet Singh**. I study the magnetic ground state and magnetic excitation spectrum of spin $S = \frac{1}{2}$ chains related to high TC superconductors. These chains are grown as large crystals suitable for inelastic neutron Scattering using the flux method adapted to an optical floating zone furnace.



Snehal Shekatkar (August 2010)

I work in the theory of control of chaos and theory of complex networks under the supervision of **Prof. G. Ambika**. In our research, we have introduced a modification of the external augmentation scheme for chaos control to make it more effective and flexible. In complex networks, we have proposed a new evolutionary mechanism for the growth of complex networks.



Shaikh Mubeena (August 2010)

I work under the supervision of **Dr. Apratim Chatterji**. In my research, I worked on developing a coarse grained model potential to study the isotropic nematic transition for self assembling polymeric systems (micelles) using MC simulations. I am also investigating self assembly of model nanoparticles in a background matrix of nematically ordered polymeric chains. My expertise is soft-matter physics and multiscale simulation techniques.



Sunil Kumar (August 2010)

I work in quantum optics and atomic physics under the supervision of **Dr. Umakant Rapol**. My research work includes the demonstration of trapping of ultra cold atoms (87Rb) in the vicinity of optical near field potentials created by plasmonic nanostructures and study of atom-plasmon interactions. This system can be used as new possible candidate for distributed quantum information processing.



Swathi Hegde (August 2010)

I work in NMR quantum information processing under the guidance of **Dr. T.S. Mahesh**. I have been involved in the problems concerned with quantum simulations of unitary and non-unitary dynamics. Specifically, we have experimentally investigated decoherence, its suppression, and exotic freezing in many-body quantum system.



Arindam Dasgupta (August 2010)

I work in photonics and optical nanoscopy with **Dr. G.V. Pavan Kumar**. My research focuses on optical antennae, remote excitation surface enhanced Raman scattering (SERS) and directivity measurements. An optical antenna work as a transducer between near-field and far-field radiation. while SERS studies characterize near-field gain, directivity measurements give insights on far-field radiation properties.



Kajari Gupta (August 2011)

I work in nonlinear dynamics and complex systems under supervision of **Prof. G. Ambika**. In my research I study the theoretical and numerical investigations on how the time scale properties of dynamics can play a role in coupled systems and in complex networks. These studies can help us to understand complex systems with varying time scale properties such as climate system, social interaction.



A. Shweta (August 2011)

I work in radio astronomy under **Dr. Ramana Athreya**. I study diffuse and extended (Mpc scale) emission, known as ‘radio halos’ associated with intra-cluster medium of some clusters of galaxies. My work primarily deals with GMRT data analysis, as the emission is more prominent at low frequencies (below 500 MHz).



Sumit Sarkar (August 2011, IPhD)

I work under the supervision of **Dr. Umakant D. Rapol**. I am interested in experimentally engineering novel Hamiltonians using light-matter interaction induced gauge fields. My work will be helpful in studying the dynamics of many interesting condensed matter and high energy physics systems that are difficult to probe or manipulate otherwise.



Amruta Sadhu (August 2011, IPhD)

I work in the area of general relativity under **Dr. Suneeta Vardarajan**. My work includes stability analysis of different spacetimes using perturbation techniques.



Supratik Sarkar (August 2011, IPhD)

I work in Gravity: BlackHole-Hawking radiation under the guidance of **Dr. Arijit Bhattacharyay** and in collaboration with my co-guide Prof. Soumitra Sengupta, IACS-Kolkata. My PhD work focuses on the emergence of a massive scalar modulating field in the analogue gravity model of a BEC as a result of Lorentz symmetry breaking.



Mahendra Mali (August 2011, IPhD)

I work on theoretical particle physics under the supervision of **Dr. Sudarshan Ananth**. My research involves understanding of one of the four forces of nature, gravity, using quantum field theory.



Srikrishna Sekhar (August 2011, IPhD)

I work on observational radio astronomy under the guidance of **Dr. Ramana Athreya**. Our group is interested in radio halos, which is diffuse emission present in galaxy clusters. My work deals with the physics of the emission as well as developing techniques for high sensitivity imaging at low radio frequencies.



Nishtha Sachdeva (August 2012)

I work in solar astrophysics under the guidance of **Dr. Prasad Subramanian**. My research topic includes data analysis and study of Coronal Mass Ejection (CME) kinematics and propagation. Earth-directed CMEs can cause destruction to space borne missions and technologies on the Earth. I also look at GRAPES-3 data for Forbush decrease precursors for the study of turbulence levels near Earth.



Kunal Kothekar (August 2012)

I work in the experimental particle physics group under the supervision of **Dr. Sourabh Dube**. Our group is a part of the CMS Collaboration at LHC-CERN. We are preparing for the 2015 LHC run, where we will smash protons at energy of 13 TeV and will look forward to understand the current problems of Standard Model. My current work focuses on the calibration of the CMS hadron calorimeter for the 2015 run.



Amandeep (August 2012)

I study nanomechanical properties of confined liquid with the research group led by **Dr. Shivprasad Patil**. My PhD work focuses on measuring rheological properties of confined water with home built instrument. My research is expected to shed light on the complex visco-elastic behavior of the water under nano-confinement.



Harshini Tekur (August 2012)

I am working under **Dr. M.S. Santhanam** in the field of quantum chaos, which seeks to understand quantum mechanical analogues of classically chaotic systems. In particular, we are interested in studying quantum chaos in optical microcavities. In our work we use both theoretical and computational strategies to focus on several fundamental and applied aspects of physics.



Gunjan Verma (August 2012)

I work in the field of ultra cold atomic gases under the guidance of **Dr. Umakant Rapol**. I am building an experimental setup to achieve strong coupling between a single Strontium atom and surface plasmon modes. My work will have direct implications in demonstrating distributed quantum information processing. I am also interested in short and long range interaction in Rb-87 BEC.



Rohit Kumar (August 2012)

I work with **Drs. Sunil Nair** and **Surjeet Singh** in recently discovered iron based High TC Superconductors. My concern is to address the relation of electronic nematic order and unconventional superconductivity using magnetotransport as a primary tool on high-quality crystals which we grow using the flux method.



Ravi Prakash Nath Tripathi (August 2012)

I am working in nano photonics under the supervision of **Dr. G. V. Pavan Kumar**. My research focuses on the investigation how light interacts with plasmonic metamaterials and organic nano/meso structures. These investigations utilize knowledge from both material science and optics.



Somendranath Panja (August 2012)

I work under the supervision of **Dr. Sunil Nair**. In our research we explore novel oxide multiferroics by studying their physical properties by linear & nonlinear dielectric, magnetic susceptibility measurements, neutron diffraction, and pyroelectric measurement. We also study the mechanisms that give rise to the coupling between charge & spin degrees of freedom.



Shishir Sankhyayan (August 2012)

I work in observational cosmology under the supervision of **Dr. Ramana Athreya** (IISER) and Dr. Joydeep Bagchi (IUCAA). I study the large scale structure (LSS) using galaxy redshift surveys. The properties of LSS (super-clusters, walls, filaments and voids) from these surveys give the cosmological parameters apart from the cosmic microwave background radiation, thus putting further constraint on them.



Rohit Babar (August 2012)

I work in materials modeling under the guidance of **Dr. Mukul Kabir**. In my research, I study defects in graphene and carbon nanotubes, and how the physical, electronic and magnetic properties can be tailored through control of the defects.



Sanku Paul (August 2012)

I work in quantum chaos under the supervision of **Dr. M.S. Santhanam**. My work is to study novel phenomena like interplay between disorder and localisation, coherent quantum control and quantum transport .



Aditya Mehra (August 2012)

I work in different aspects of string theory under the guidance of **Dr. Arjun Bagchi**. In my research, I explore various aspects of Galilean electrodynamics and also study the corresponding holographic picture.



Sk Rejaul (August 2012)

I work under the supervision of **Dr. Aparna Deshpande**. My research work involves investigation of local electronic properties of Dirac materials using scanning tunneling microscopy (STM) at low temperature. These properties help to define and design these materials for applications in spintronics. Presently, I am focusing on topological insulator material Bi₂Se₃ and its Fe doped variants.



Rabindranath Bag (August 2012)

I work under the supervision of **Dr. Surjeet Singh**. I focus on the single crystal growth using the Traveling Solvent Floating Zone technique associated with an image furnace. My work aims to clarify subtle issues related to the crystal growth of strongly correlated oxides. I am also interested in the magnetic and thermal transport properties of these materials.



Chetan Kumar Vishwakarma (August 2012, IPhD)

I work in the field of ultra cold atoms under the guidance of **Dr. Umakant Rapol**. My PhD work focuses on laser cooling and trapping of single Strontium atoms in near field optical potential for experiments towards distributed quantum information processing. My work is expected to open up new avenues in studying atom-plasmon and atom-atom interactions in the nanometer regime.





Prachi Telang (August 2012, IPhD)

I work in the experimental condensed matter physics group under the supervision of **Dr. Surjeet Singh**. My research focuses on the synthesis and investigation of oxide based thermoelectric materials. This class of materials holds great potential for harnessing waste energy along with being non-toxic and stable at high temperatures.



Srilatha Arra (January 2013)

I am working in computational materials under the supervision of **Dr. Mukul Kabir**. I am currently working on catalysis, which generates hydrogen. Hydrogen is an excellent energy carrier and can be used in fuel cells.



Dhanya. S. Menon (August 2012, IPhD)

I work under the supervision of **Dr. Suneeta Vardarajan** in the area of general relativity. My research focuses on the (in)stability of Ads and related space-times.



Vinayak Mallikarjuna Kulkarni (August 2013)

I work in experimental condensed matter physics under the supervision of **Dr. Surjeet Singh**. Currently, I am setting up experiments for measuring thermoelectric properties of materials with higher precision, ease of operation and a wider temperature range than is available commercially. We can use this system to investigate materials with strong spin-orbit coupling.



Anjusha V.S. (August 2012, IPhD)

I work in experimental quantum information under the guidance of **Dr. T.S. Mahesh**. My research involves NMR-Quantum information processing and quantum simulations. Quantum information deals with the identification and exploitation of quantum resources for information processing.



Debnath Talukdar (August 2013)

I work in computational material science under the guidance of **Dr. Prasenjit Ghosh**. Presently I am working on studying the structure, stability and electronic properties of Germanium bilayer, and the effect of Stone-Wales defect on the electronic properties of germanene.



Mainak Ghosh (August 2012, IPhD)

I work in soft matter physics under **Dr. Apratim Chatterji's** guidance. My current research topic includes complex fluids as well as active matter. I also study complex biological systems including polymers and membranes.



Abhijit Pendse (August 2013)

I work on the theory of Bose Einstein Condensates (BEC) under the guidance of **Dr. Arijit Bhattacharyay**. A BEC is a state of matter of a dilute gas of bosons in which a large fraction of bosons occupy the lowest quantum state. In such a state many quantum phenomenon show up on a macroscopic scale. In my research I study the effect of non-local interactions on the amplitude modulated states and vortices in BEC.



Tomin K James (August 2012, IPhD)

I work under **Dr. Prasad Subramanian** in solar astrophysics. My topic of research is Coronal Heating, wherein I search for energy sources responsible for heating up of solar corona and estimate the energy budget involved in such heating events. I use the NASA\ESA\JAXA spacecraft data dedicated for the study of Sun and heliosphere.



Avirup De (August 2013)

I work in spin caloritronics under the guidance of **Dr. Sunil Nair**. Spin caloritronics focuses on the interaction of spins with heat currents. Spin Seebeck effect and Inverse Spin Seebeck effect are the two key mechanisms that play an important role in this field of spin caloritronics. I am interested in understanding the coupling of spin, charge and heat currents in magnetic thin-films.



Sarath Kumar Thadeti (August 2013)

I work in experimental condensed matter physics under the supervision of **Dr. Sunil Nair**. In my research I synthesize and investigate different 4d and 5d transition metal oxide materials to expound structural relationships in these systems.



Shubhanshu Chauhan (August 2013)

I work in the experimental particle physics group with **Dr. Sourabh Dube**. My research focuses on using data collected by CMS detector to find any new physics beyond Standard Model. I am also studying the simulation of the CMS detector for the upcoming LHC run of data taking at CERN.



Pulastya Parekh (August 2013)

I am working in theoretical high energy physics under the supervision of **Dr. Arjun Bagchi**. I am looking into the tensionless limit of string theory, exploring the connections to Galilean Conformal Symmetry. We would attempt to quantize the theory in this limit using this this symmetry. The goal is to obtain a connection between string theory and higher spin theories.



Namrata Patnaik (August 2013)

I work in the condensed matter physics group under the supervision of **Dr. Ashna Bajpai**. My work focuses on the synthesis and characterization of antiferromagnetic materials which show the phenomenon of piezomagnetism. I intend to study size effects in these systems through dc magnetization and non linear ac susceptibility.



Turmoli Neogi (August 2013)

I work in theoretical high energy physics under the guidance of **Prof. Sunil Mukhi**. I am presently studying various aspects of asymptotic limits of space-time, and the BMS-CFT correspondence in different dimensions.



C.S. Sudheer Kumar (August 2013)

I work in the group of **Dr. T.S. Mahesh** on experimental quantum information processing (QIP). My research work is focused towards quantum measurements and includes standard projective measurement, generalised measurement (POVM), weak measurement, protective measurement, and so on. I am trying to understand these and implement them in QIP tasks.



Anshul Kapoor (August 2013, IPhD)

I work in the experimental particle physics group with **Dr. Sourabh Dube**. My research focuses on the search for new particles produced in the proton-proton collisions at the LHC. Presently I am developing a code framework that will be used to analyse data from the CMS experiment during the 2015 LHC run.



Jay Mangaonkar (August 2013, IPhD)

I'm working in atomic physics and quantum optics under **Dr. Umakant Rapol**. My project is to build an paul type ion trap. These devices trap a single ion or a chain of ions using static and RF oscillating electric fields in a quadrupole arrangement . They are a useful tool to build high precision atomic clocks, quantum computing, quantum information processing and quantum simulation experiments.



Sandip Varkey George (August 2013, IPhD)

I work in the complex systems group under the supervision of **Prof. G. Ambika**. My work is on non linear time series analysis with a focus on technique development to characterize and quantify non-linearity in observational time series. At present I am working on characterization of chaotic time series using Fourier transforms and multi-fractal analysis of irregular variable stars.



Deepak Khurana (August 2013, IPhD)

I work in quantum information processing group under the supervision of **Dr. T.S. Mahesh**. Currently I am looking at the lifetime of long lived nuclear singlet spin states in strongly coupled ordered systems. Potential applications of these special states include studies of slow molecular process, and the improvement of NMR imaging methods.



Adarsh B Vasista (August 2013, IPhD)

I work in photonics and optical nanoscopy group under the guidance of **Dr. G.V. Pavan Kumar**. My work mainly focuses on studying antenna properties of heterogeneous 1D nanostructures with different coupling. Understanding antenna properties of nanostructures will give a deeper insight into light-matter interactions at nanoscale. I also look at circuital modelling of these nanostructures.



Aditee Rane (August 2014)

I work in the experimental particle physics group under the guidance of **Dr. Seema Sharma**. I am learning the basics of experimental collider physics to analyze proton-proton collision data produced at the LHC. I plan to search for supersymmetric particles using the data of the upcoming 2015 LHC run.



Charu Garg (August 2013, IPhD)

I work in condensed matter physics under the supervision of **Dr. Sunil Nair**. I am currently working on 4d- and 5d- transition metal oxides which crystallize in a geometrically frustrated lattice. The frustration imposed by the lattice, magnetic interaction and spin orbit coupling combines to give rise to a number of exotic electronic and magnetic ground states in these materials.



Chandan Kumar Singh (August 2014)

I work in material modeling under the guidance of **Dr. Mukul Kabir**. My research topic includes the study of new materials MAX Phases and MXenes.



G.A.R.S.R.K. Kashyap (August 2013, IPhD)

I work in the area of applied non-linear dynamics under the supervision of **Prof. G. Ambika**. At present, I am studying the effect of random deletion of links in a directed random network. Specifically, I study the effect on the connectivity of the network. A potential application of this study is in treating Alzheimer's disease.



Chinmayee Mishra (August 2014)

I have recently joined the PhD program. I work in theoretical quantum optics under the supervision of **Dr. Rejish Nath**. We study the system of 2D solitons in dipolar Bose-Einstein condensate with tilted dipoles. We show that 2D solitons can be stabilised in a wide range of interaction strengths by simply tilting the dipoles with respect to a 2D plane.



Shreya Krishnamurthy (Project Assistant since 2013)

I work in the field of experimental condensed matter under the guidance of **Dr. Ashna Bajpai**. My current research work includes synthesis of 2-D monolayers by the method of liquid exfoliation. Graphene analogous layered compounds show extremely novel properties, I intend to study the magnetic and transport behaviour in this class of oxide materials.



Shatruhan Singh Rajput (August 2014)

I work under the guidance of **Dr. Apratim Chatterji**. My research will focus on multiscale simulations of jamming of colloids in an extensional flow.



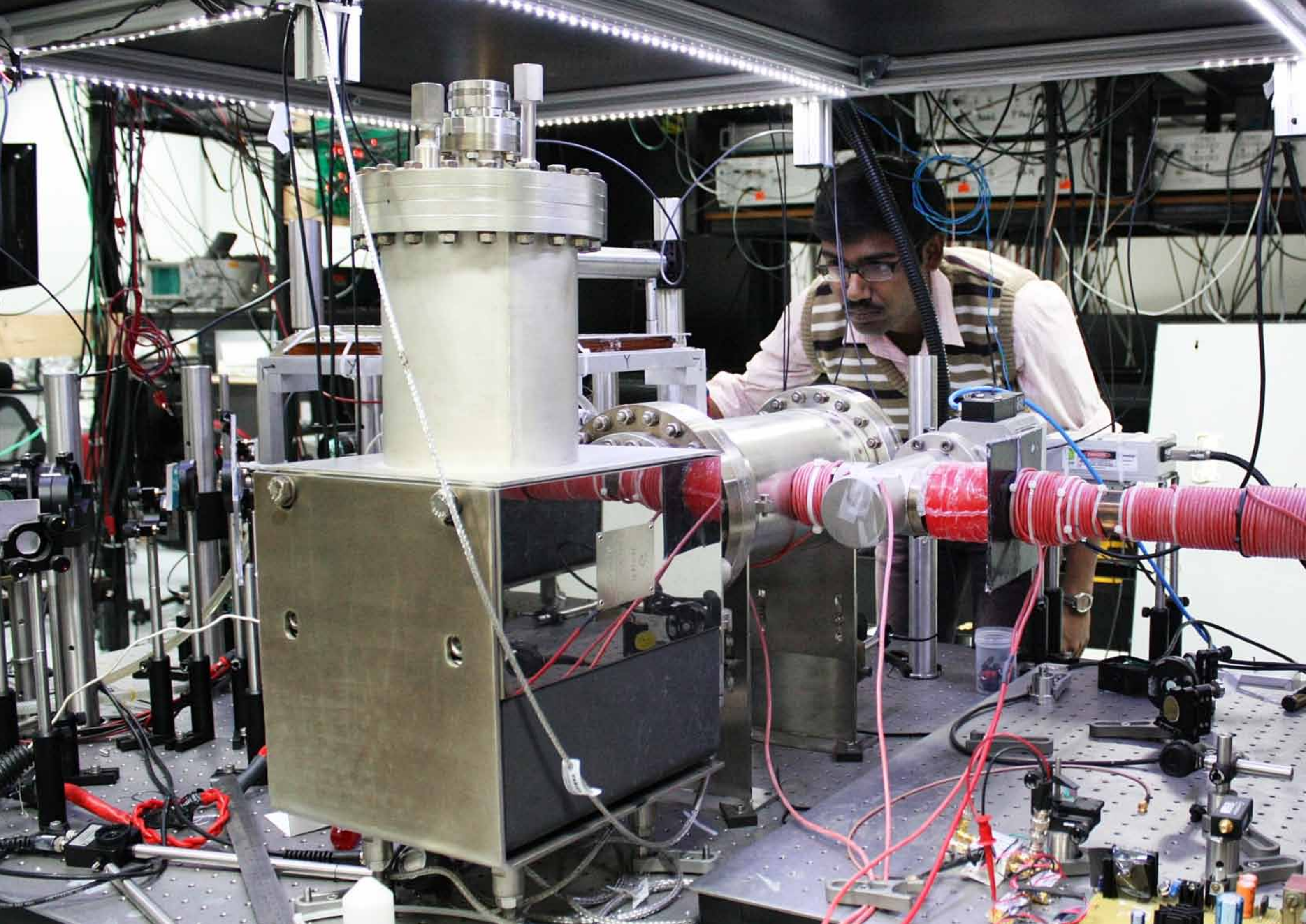
Amit Bhunia (January 2014)

I work in the experimental condensed matter physics group under the supervision of **Dr. Shouvik Datta**. I study the electronic origin of light emission, the onset of lasing and coherence, and the physics of excitons in semiconductor laser diodes using electrical and optical techniques in frequency, time and temperature domains.



Sucheta Majumdar (August 2014)

I work in theoretical high energy physics under the guidance of **Dr. Sudarshan Ananth**. I am currently studying Yang-Mills Theory in light-cone gauge, which focuses on the physical degrees of freedom of the theory. Hence, it is very suitable for the study of real-world processes like scattering amplitudes.





Aakanksha Kapoor (August 2014)

I work in experimental condensed physics under the supervision of **Dr. Ashna Bajpai**. In my research, I focus on the synthesis and characterization of magnetically functionalized carbon nanotubes. I intend to study the potential applications of CNTs in spintronic devices.



Soham Pal (August 2014, IPhD)

I work under the supervision of **Dr. T.S. Mahesh** in the area of quantum information and processing. At present I am studying NMR as a test bed for quantum information and computing, along with quantum simulating simple molecules like HeH+ and H2 molecule.



Projjwal Kanjilal (August 2014, IPhD)

I work under the supervision of **Dr. Nabamita Banerjee**. At present I am learning quantum field theory through active reading projects. It feels great to be a member of the IISER Pune physics department.



Tejal Agarwal (August 2014, IPhD)

I work under the supervision of **Dr. Apratim Chatterji**. Currently I am working on self assembling micro fluids.



Ankita Niranjana (August 2014, IPhD)

I work under the supervision of **Dr. Rejish Nath** in the area of theoretical condensed matter. My current research focuses on the Rydberg states of atoms.



Deepak Kumar Sharma (August 2014, IPhD)

I work under the guidance of **Dr. G.V. Pavan Kumar** in the field of photonics and optical nanoscopy. My research will focus on plasmonic nanoparticle antennas.



Shubham Pandey (August 2014, IPhD)

I work in the experimental particle physics group under the supervision of **Dr. Seema Sharma**. I am currently trying to understand the working of the CMS detector and the software used to analyse the collision events collected by CMS at the LHC in CERN.



Yashwant Chougale (August 2014, IPhD)

I work under the guidance of **Dr. Rejish Nath**, investigating the properties of ultra cold atomic systems realized in various optical lattice geometries, involving the quantum simulation of various phenomena in condensed matter physics.



Sayali Atul Bhatkar (August 2014, IPhD)

I work under **Dr. Nabamita Banerjee**. I am studying construction of entropy current for relativistic fluids.



Kumar Saurabh (August 2014, IPhD)

I work in experimental condensed matter and quantum opto-electronics under the supervision of **Dr. Shouvik Datta**. My research includes the study of photon statistics before and after lasing in semiconductor laser diodes.



Deepak Sharma (August 2014, IPhD)

I work under the guidance of **Dr. Seema Sharma**. Currently I am working with Dr. Bhas Bapat and Dr. Seema Sharma on setting up a magnetic spectrometer to study the momentum distribution of beta particles in the decay of cesium atoms.



Mayur Shende (August 2014, IPhD)

I work in experimental condensed matter physics under the supervision of **Dr. Shouvik Datta**. I work on the network analysis of coherent quantum transport in semiconductor laser diodes.



Dipti D (August 2014, IPhD)

I work under the guidance of **Dr. Aparna Deshpande**. Presently my research involves studying molecular self assembly with scanning tunneling microscopy.



Arnab Sen (August 2014, IPhD)

I work under the guidance of **Dr. Mukul Kabir**. At present I am learning about density-functional theory.



Mohit Kumar Singh (August 2014, IPhD)

I work in the experimental condensed matter group under the supervision of **Dr. Shouvik Datta**. At present, I am studying the shot noise before and after lasing in semiconductor laser diodes.



Rajesh Mandal (August 2014, IPhD)

I work under the guidance of **Dr. Nabamita Banerjee** in theoretical physics. In my research I study the nonrelativistic approximation of Relativistic Fluid Dynamics in 2D flat space.



Seminars and Colloquia



Date	Speaker	Subject
25.08.2010	Shobo Bhattacharya	Tweezing soft matter interfaces and a sticky problem
01.09.2010	Sunil K. Gupta	Astroparticle physics with the GRAPES-3
20.09.2010	Subodh R Shenoy	Is steel the same as glass?
22.09.2010	Rama Govindarajan	Instabilities and interfacial flows
22.09.2010	J.K. Bhattacharjee	The relevance of the theory of large deviations in situations with rare events
29.09.2010	Steffen Wirth	Progress in scanning tunneling microscopy
20.10.2010	S. M. Shivaprasad	Issues of heteroepitaxy and nanostructure in GaN film formation
21.10.2010	Pushan Ayyub	The three paradigms of nanoscience
27.10.2010	K. Subramanian	Magnetizing the universe
12.11.2010	Shankar Ghosh	Desorption to delamination: dynamics of detachment in a colloidal thin film
09.12.2010	Steven Tomsovic	Quantum chaos: origins and developments
26.12.2010	Roger Penrose	Seeing through the big bang into another world
13.01.2011	Anthony Leggett	Bell's theorem, entanglement
18.01.2011	Angelika Sebald and Mathhias Bechmann	NMR and Computation / Computation and NMR
31.01.2011	Biswajit Karmakar	Artificial coupling of spin-resolved topologically protected states of a quantum Hall insulator
01.02.2011	V.P. Nair	On Casimir effect and edges and diffraction
14.02.2011	Alan J. Drew	Local probe investigation of spin transport and dynamics in organic semiconductors
18.02.2011	R.E. Amritkar	Chaotic systems on networks
23.02.2011	Spenta R. Wadia	Space-time structure, black holes and holography
21.03.2011	Frederick Cooper	Nonperturbative predictions for cold atom Bose gases with tunable interactions
25.03.2011	Dilip Angom	Ground state structure and dynamical instabilities in mixtures of quantum gases
25.03.2011	Yihua Yan	New windows on solar flares and CMEs with radio imaging-spectroscopy
09.05.2011	Rajesh Nair	Observing the forbidden zone for light
07.06.2011	V. Ravi Chandra	A memory saving algorithm for computing eigenvalue approximations of quantum systems
30.06.2011	Ashutosh Kotwal	Higgs boson, dark matter and black holes: revolutionizing the laws of the universe with the Large Hadron Collider
29.07.2011	Shashank Shekhar	Solution processed ultra-high density arrays of carbon nanotubes: alignment, transport behaviour and stability to high electric field



Prof. Tony Leggett (Nobel Laureate, 2003) interacting with IISER members



Sir Roger Penrose giving an interview



Prof. David Gross (Nobel Laureate, 2004) in conversation with IISER students.

2011

2012

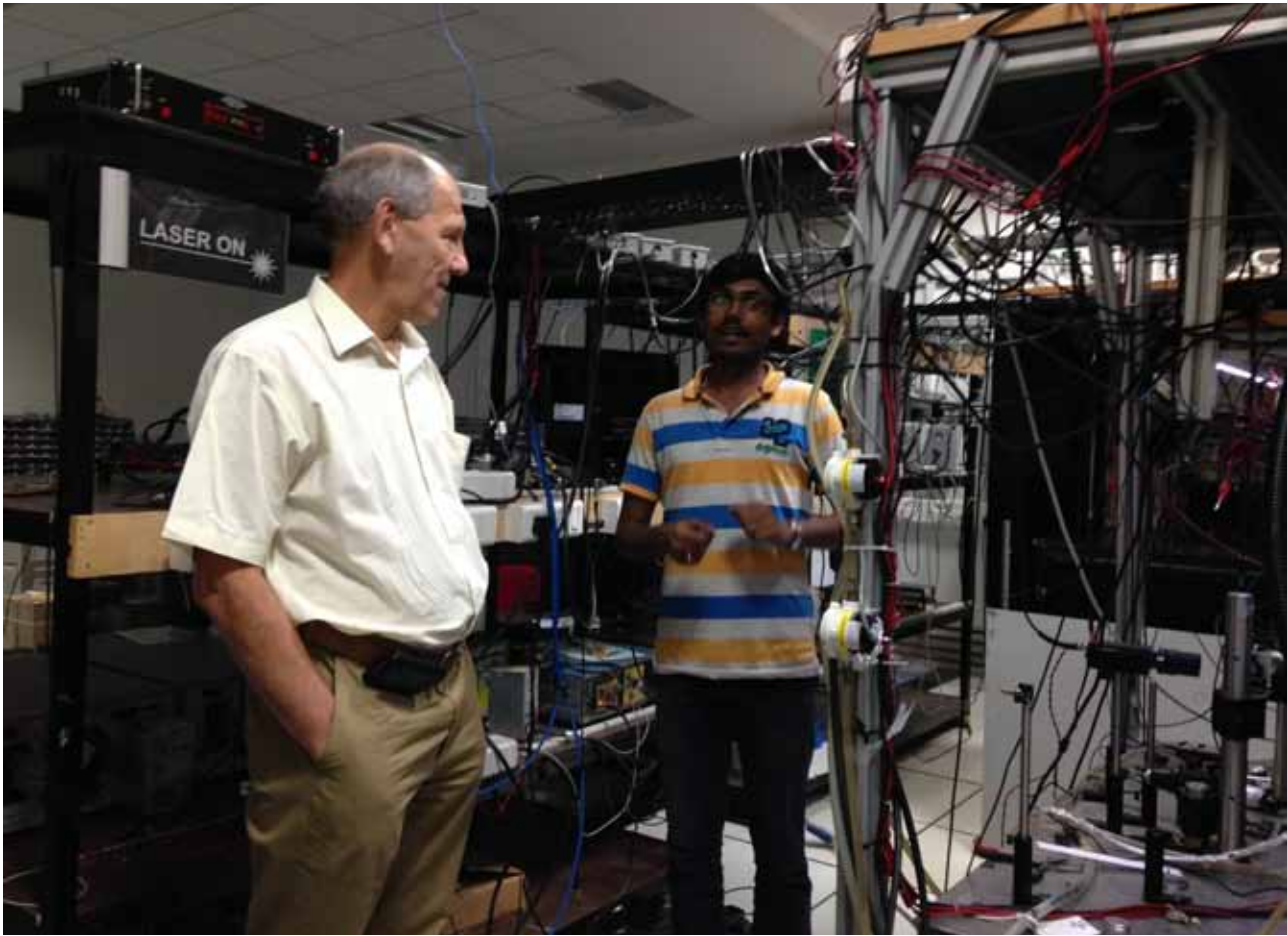
2013

Date	Speaker	Subject
16.08.2011	Miguel Angel	Vortex patches, loops and breathers of the mKdV hierarchy
24.08.2011	Rana Adhikari	Gravitational wave detection with laser interferometry
29.08.2011	Arghya Taraphder	Excitonic liquid states in dichalcogenides and other frustrated systems
14.09.2011	Sanjeev Dhurandhar	Gravitational wave astronomy
16.09.2011	Jogesh C. Pati	Unity in diversity: towards a fulfillment of Einstein's dream
16.11.2011	Anil Kumar	Nuclear Magnetic Resonance: past, present and future.
06.12.2011	Goutam Chattopadhyay	Terahertz science and technology
06.12.2011	Malay Bandopadhyay	Quantum transport at nanoscale: two models for energy and charge transfer
04.01.2012	Rana Biswas	Photonic and plasmonic crystal based enhancement of solar cells - overcoming the Lambertian limit
09.01.2012	Manu Paranjape	Fate of the false monopoles: induced vacuum decay
10.01.2012	Prasad Perlekar	Droplet breakup dynamics in turbulence
16.01.2012	Michael J. Thompson	Solar-terrestrial physics at NCAR's High Altitude Observatory
07.02.2012	Sanjit Das	Geometric flows without and with higher order and higher derivative terms
26.06.2012	Robert Duffin	Type III-L solar radio bursts and their associations with solar energetic proton events
26.07.2012	Guglielmo M. Tino	Cold atom interferometers and optical clocks
25.09.2012	Anand D. Joshi	High-resolution and Doppler observations of filaments in H α
18.12.2012	Milind N. Kunchur	Magnetic flux vortices in superconductors and the vortex explosion transition
01.01.2013	Mohammed Mia	Holographic Thermal QCD
08.01.2013	Chandrabhas Narayana	Elucidating microscopic origin of multiferroicity using Raman spectroscopy
18.01.2013	K.V. Ramanathan	A tale of two techniques - the story of structural and dynamical studies using Solid State NMR
30.01.2013	N. Kumar	Revisiting classical orbital diamagnetism: a surprise
06.02.2013	Kazi Rajibul Islam	Probing many body physics with cold atom quantum simulators
07.02.2013	Christian Rüegg	Luttinger-liquid Physics and quantum critical points in one-dimensional magnets
11.02.2013	Krishnendu Sengupta	Aspects of Dirac materials
12.02.2013	S. Ramakrishnan	Novel superconductivity in non-magnetic d-band superconductors: A tale of two superconductors
14.02.2013	Kedar Damle	Resonating valence-bond wavefunctions for spin liquids, and interacting dimer models

Date	Speaker	Subject
18.02.2013	Sunanda Banerjee	Higgs boson - have we seen it?
19.02.2013	M. Henini	III-V semiconductor nanostructures: fabrications and applications
25.02.2013	Vijay B Shenoy	Fermions in synthetic non-Abelian gauge fields
26.02.2013	V. V. Sreedhar	An exact expression for a flat connection on the complement of a torus knot
25.03.2013	Ananth Ramakrishna	Extra-ordinary transmission of light through plasmonic subwavelength apertures
08.04.2013	Surajit Sengupta	Deformation: from Hooke to quantum metallurgy
15.04.2013	Tarun Sauradeep	Cosmos revealed by Planck: simplicity or duplicity?
16.04.2013	Amit Goyal	Controlled optical similaritons and self-similar rogue waves in nonlinear fiber optics
06.05.2013	Bedangadas Mohanty	Strong interaction phase diagram and high energy heavy-ion collisions
09.08.2013	Utpal Chatterjee	Electronic phase diagram of cuprate high temperature superconductors
26.08.2013	Rajdeep Sensarma	Fun with cold atoms: ferromagnetic response of a "high temperature" quantum antiferromagnet
28.08.2013	Jainendra Jain	From Hofstadter to Chern
02.09.2013	G Rangarajan	Are you connected? Detecting connectivity patterns in networks
12.09.2013	Siddharth Parmeswaran	A typology for quantum Hall liquids
16.09.2013	Amol Dighe, Naba K. Mondal, B. Satyanarayana	Neutrinos@IISER: presentations on neutrino physics and the India Based Neutrino Observatory
07.10.2013	Roop Mallik, Guruswamy Kumaraswamy, Rama Govindarajan, Apratim Chatterji	Soft Matter@IISER
10.10.2013	Rohini Godbole	Higgs and its discovery
21.10.2013	G. Ravindra Kumar	The light intensity frontier
25.10.2013	Priya Mahadevan	Orbital ordering in transition metal oxides - a route to high polarization multiferroics
25.10.2013	Shubhankar Bedanta	Magnetic domains, domain walls and their dynamics
04.11.2013	R. Vijayraghavan	Quantum measurement and feedback with superconducting circuits
06.11.2013	Stefano Kovacs	Membranes from monopole operators in ABJM theory
11.11.2013	Aninda Sinha	HEE-how?: Derivations of entanglement entropy
11.11.2013	Nitin Samarth	Topological Insulators: from exotic particles to spintronics



Prof. Tiziano Camporesi interacting with IISER faculty



Prof. Valery Rubakov visiting a research lab

2014

Date	Speaker	Subject
15.11.2013	Pratap Raychaudhuri	Disordered superconductors: the TIFR story
18.11.2013	Shobo Bhattacharya	Persistence of memory: What do you see and what can you remember or forget?
17.12.2013	Tiziano Camporesi	High energy physics: understanding how our universe works
10.02.2014	Axel Kleinschmidt	Scattering in string theory: Beyond perturbation theory
14.02.2014	Gagan Mohanty	The Higgs discovery and what lies ahead at LHC
03.03.2014	Ashok Singal	Is the Copernican principle violated in the sky?
06.03.2014	Atish Dabholkar	Quantum black holes: A window into the short-distance structure of quantum gravity
07.03.2014	Sandip Trivedi	Gravity and condensed matter physics: the beginning of a dialogue?
26.03.2014	Subhabrata Majumdar	The discovery of primordial gravitational waves
27.03.2014	Stefan Zollner	Precision measurements of optical constants using spectroscopic ellipsometry
07.04.2014	Subrata Pradhan	Steady state superconducting tokamak (SST-1)
08.04.2014	Sahana Roessler	Phase transitions and magnetic precursor state in Fe(1+y)Te
15.04.2014	R. Rajaraman	Indistinguishability in quantum physics
15.04.2014	Daniel Baumann	Newest technologies with superconducting NMR magnets
16.04.2014	Fred Gent	Supernova regulated ISM: the multiphase structure, magnetic field and the dynamo
21.04.2014	T. Saha Dasgupta	Correlation effects in real materials
21.05.2014	Atul Gurtu	Looking beyond the Higgs and the Large Hadron Collider
25.07.2014	Amitabh Lath	Where could the new physics be hiding?
04.08.2014	Tiziana Venturi	Galaxies and galaxy clusters at radio frequencies: An observational overview
05.08.2014	Utpal Chaterjee	Phase incoherence driven melting of CDW order across quantum and thermal phase transitions in intercalated 2H-NbSe2 system
11.09.2014	M. Sivakumar	Higher spin particles: past, present and future
19.09.2014	Nandini Trivedi	Topology and correlations driving new phases and phenomena
12.11.2014	Massimo Taronna	From higher spins to strings: a constructive approach
18.11.2014	Valery Rubakov	The universe before the hot big bang
19.11.2014	N.D. Hari Dass	Varieties of quantum measurements
03.12.2014	Raghavan Rangarajan	Gravitinos, reheating and the matter-antimatter asymmetry of the universe

Academic Events and Special Lectures



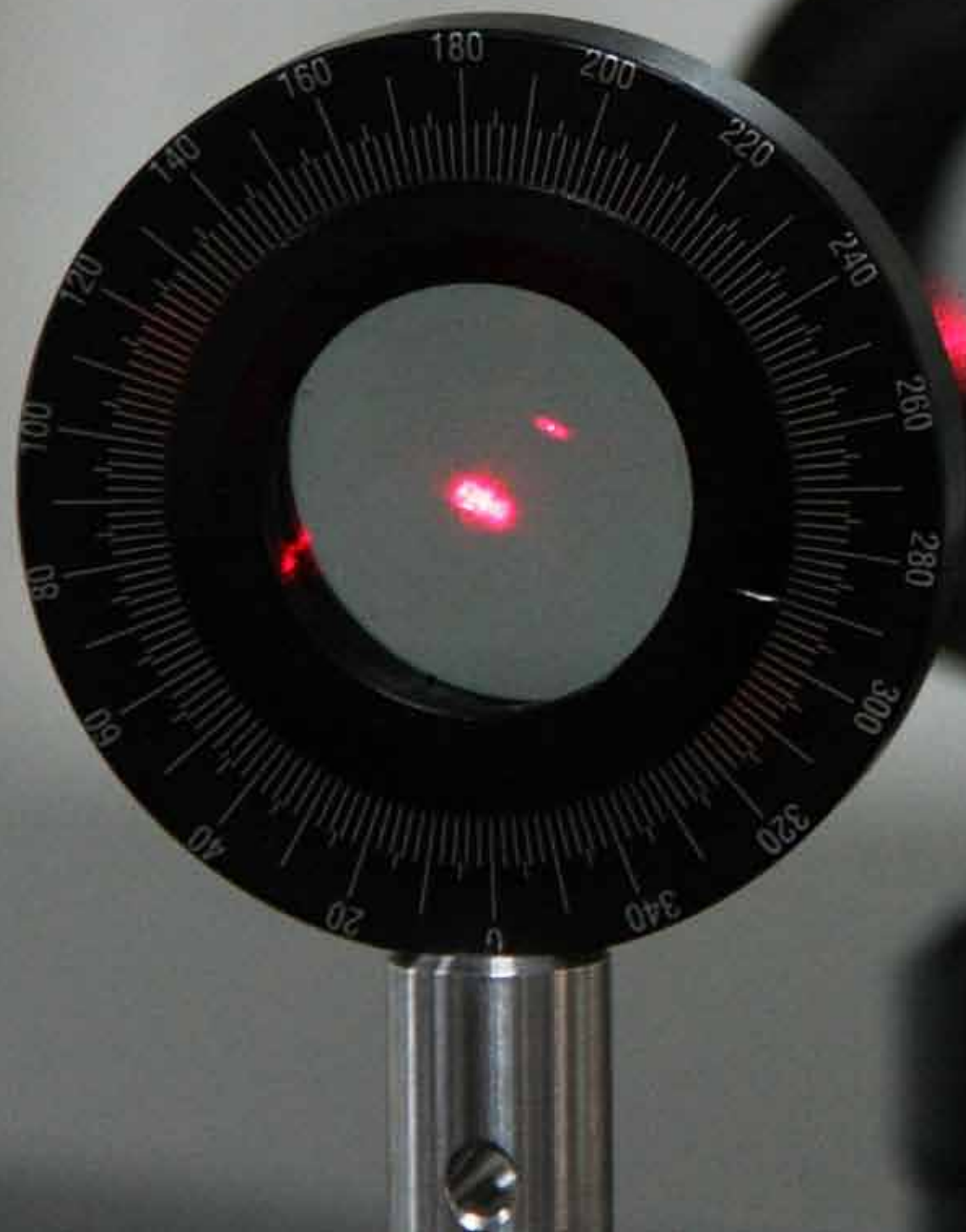
Academic Events:

Session on “Women in Science: Global and Local Scenario” WiSeGaLS 2010 February 20, 2010	International Symposium on Solar-Terrestrial Physics November 05-09, 2012
Emerging Trends in Strongly Correlated Electronic Materials April 17, 2010	Ultracold Atoms for Fundamental Science and Enabling Technologies December 17-21, 2012
Mumbai-Pune Soft Matter Meet January 2011	Mumbai-Pune Soft Matter Meet August 2013
Lecture Series in Physics by Sir Anthony J. Leggett under Erudite Scheme at IISER & IUCAA Pune January 12-13, 2011	Meeting on Neutron Scattering February 10-12, 2014
Quantum Field Theory February 23-27, 2011	Inter-IISER Physics Meet March 15-17, 2014
DST-SERC school in Nonlinear Dynamics December 04-24, 2011	Summer School, MAterials Simulations Theory And Numerlcs (MASTANI) June 30 – July 12, 2014
National Conference on Nonlinear Systems and Dynamics, NCNSD2012 July 12-15, 2012	Stringy Days December 22-23, 2014

Special Lecture Series:

“Critical phenomena and renormalization groups”, J. K. Bhattacharjee February 7-11, 2011
“Strongly correlated systems in condensed matter physics”, Arghya Taraphdar February 13-15, 2012
“Introduction to general relativity and black holes”, Soumitra Sengupta, September 3-7, 2012
“Quantum field theory”, Soumitra Sengupta January 28 - February 2, 2013
“From broken symmetry to topology in condensed matter physics”, Nandini Trivedi February 11-14, 2013

Facilities and Equipment



Magnetic Properties Measurement System (MPMS) from Quantum Design, USA. The magnetometer uses a highly sensitive Superconducting Quantum Interference Device (SQUID) for magnetization measurements over wide temperature and magnetic field ranges.



Powder X-ray Diffractometer from Bruker, USA. The diffractometer is equipped with a powerful LYNXEYE detector. It is used to check the phase purity of samples and for carrying out crystal structure refinements.



Scanning Electron Microscope from Carl Zeiss. The microscope provides high-resolution images of surfaces and nano-structures. It is equipped with an energy dispersive x-ray analysis tool for composition determination. The system also has an integrated state-of-the-art nano-lithography attachment for device fabrication.



Thin-film Deposition system from Excel Instruments, Mumbai using thermal evaporation technique.

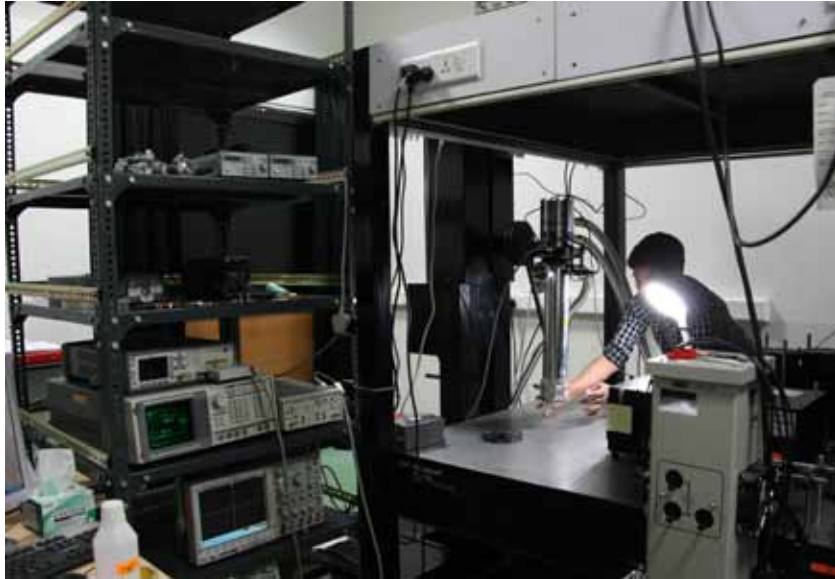


The mirror section of the four-mirror image furnace for single crystal growth. The highly reflecting surfaces are semi-ellipsoidal shaped mirrors. The light flux from halogen lamps is concentrated at their common focal point where temperatures as high as 2500 °C can be reached, sufficient to melt most refractory materials.



Scanning Tunneling Microscope (STM) from Omicron Germany. Operates in ultra high vacuum (UHV) and at low temperatures for dedicated STM, spectroscopy and atom/molecule manipulation experiments at 77 K and 4.2 K

Physical Properties Measurement System (PPMS) from Quantum Design, USA. Several physical properties including resistance, heat capacity, Hall effect, thermal conductivity and magnetic susceptibility of solids can be measured as function of varying temperature and magnetic field. The lowest temperature that can be reached is about 2° K above the absolute zero. Magnetic fields up to 9 Tesla can be applied using a superconducting magnet (not shown).



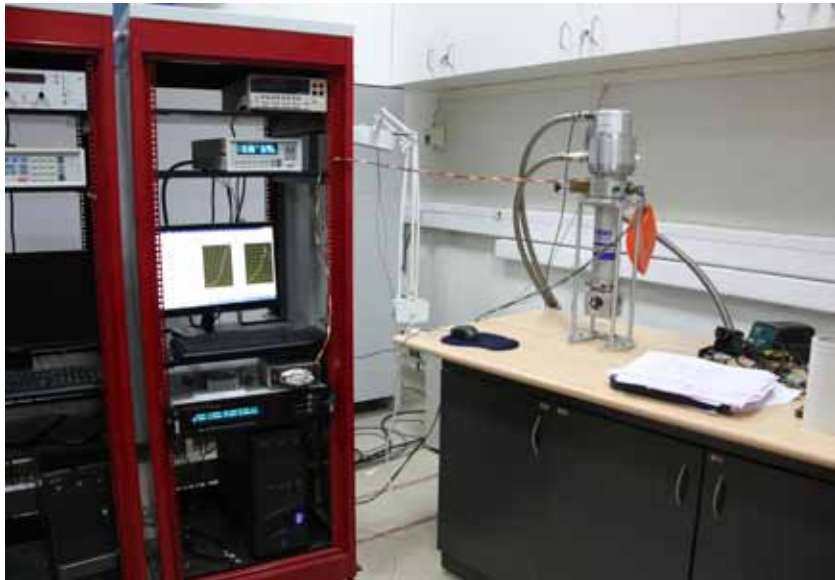
Experimental set-up for studying opto-electronic properties of semiconductor nano-structures and devices.

Glove-box from mBRAUN, Germany. Materials sensitive to moisture and/or oxygen (for example alkali and alkaline earth metals used in the preparation of pnictide superconductors) are processed and stored in this box, which maintains a highly inert, moisture-free atmosphere.

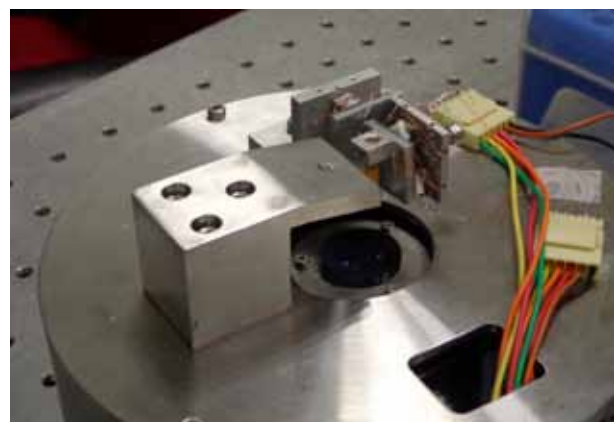


High Performance Computing Facility

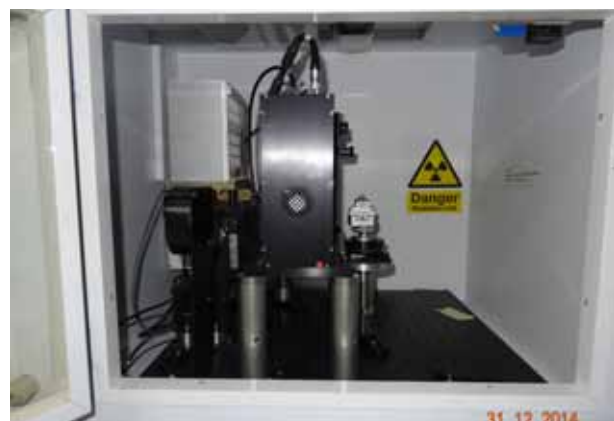
Vacuum sealed High Temperature Tube Furnace from Nabertherm, Germany. This is quintessential equipment used in condensed matter physics labs for materials processing under inert atmospheres of high integrity. There are several such furnaces in the Physics Programme at IISER Pune. The range of operation is from room temperature to about 1600 °C.



Set-up for dielectric spectroscopy in a closed cycle refrigerator for measurements from 4 °K up to room temperature. The real and imaginary parts of the dielectric function are measured using a high precision analyzer.

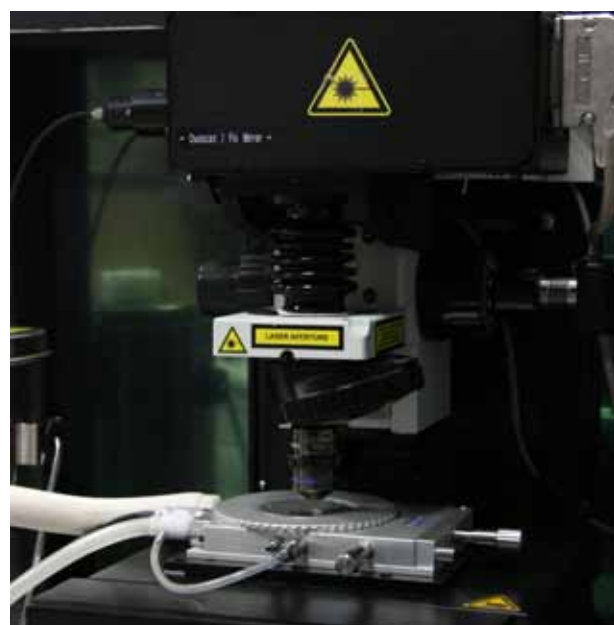


Above: A novel home-built Atomic Force Microscope with fiber based interferometer. The interferometer can measure cantilever displacements with sub-angstrom precision.

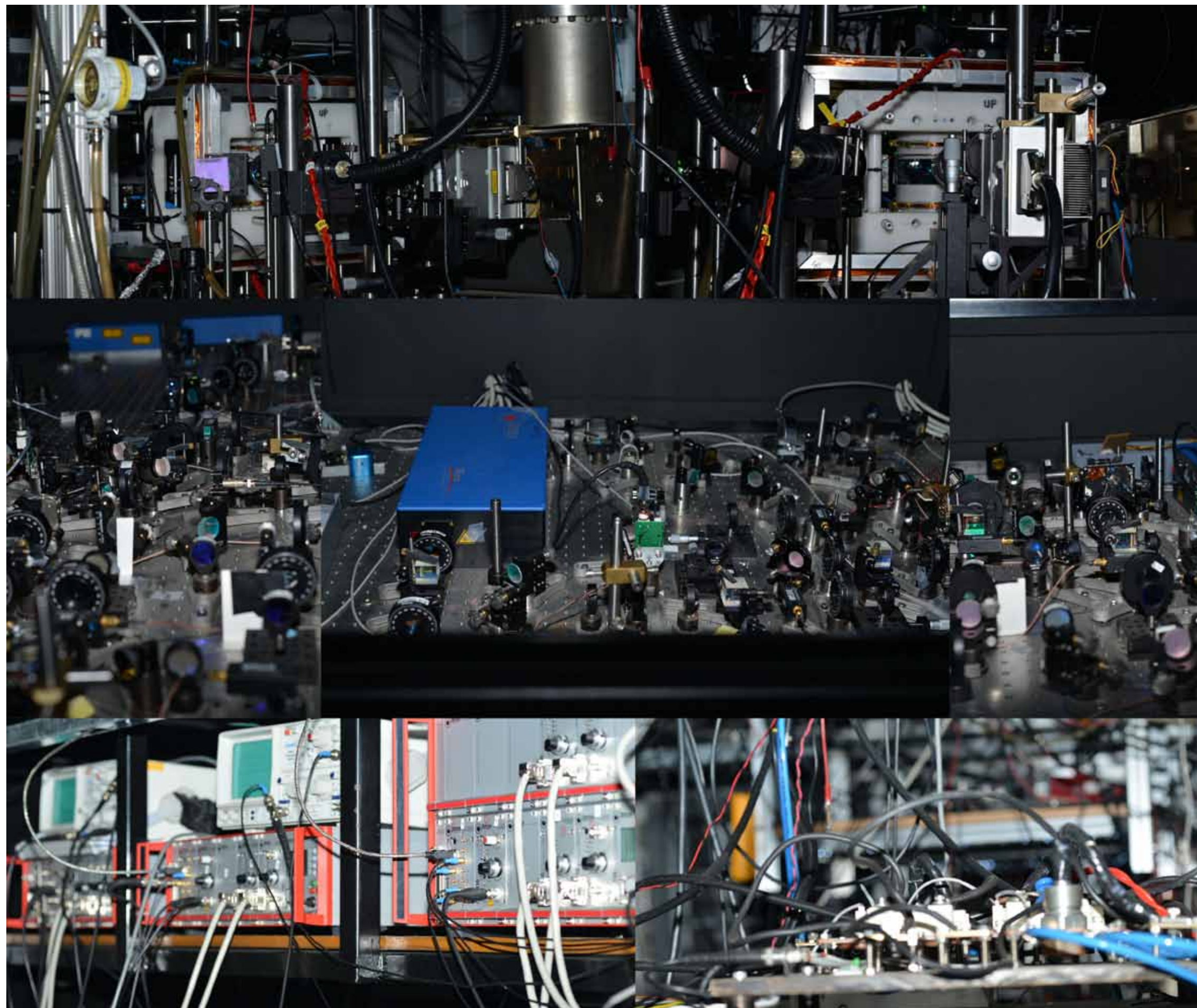


Above: X-ray Laue Diffractometer for crystal alignment from Photonic Science, UK.

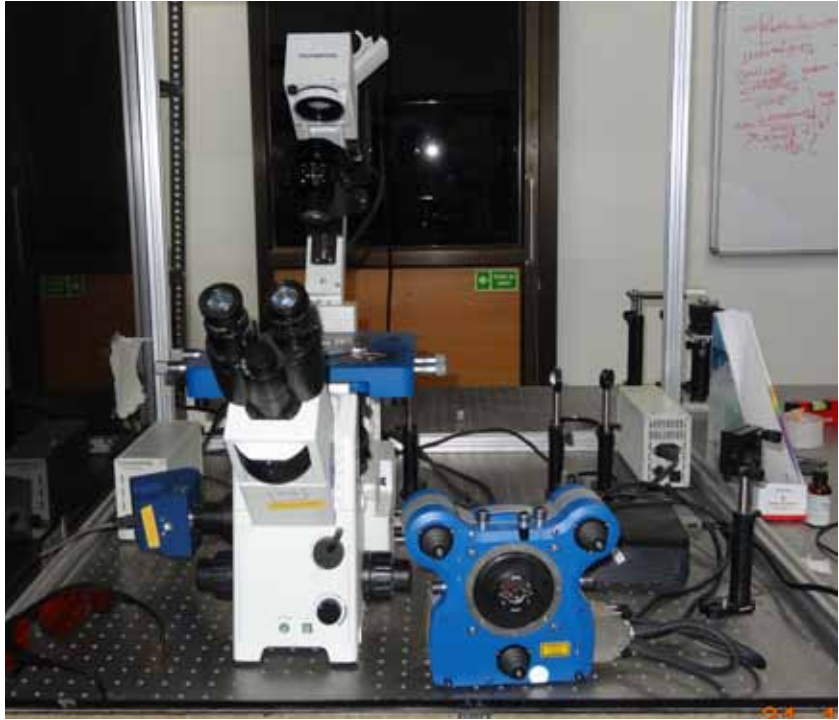
Below: Confocal Raman Microscopy system with multiple LASER excitation options (532, 632.8 and 785 nm).



Right: The complex experimental setup used to produce an ultracold sample of quantum gas: the Bose-Einstein condensate.

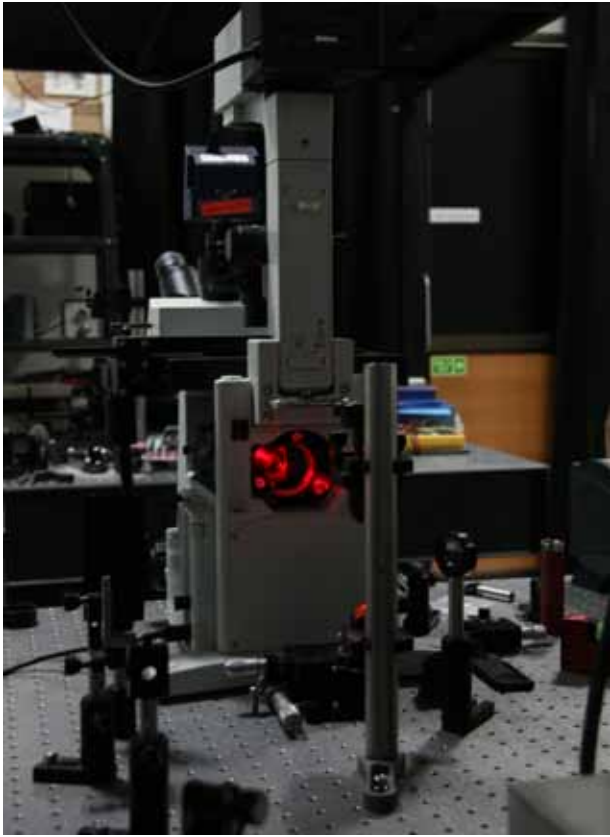


Thin-film Deposition Chamber from Moorfield, UK. This state-of-the-art deposition chamber is equipped with several evaporation, RF and DC sputtering techniques for thin-films and multi-layer depositions.



Atomic Force Microscope

Below: Optical Fourier Microscope for studying the directional emission from nano-antennas



Below: Nuclear Magnetic Resonance (NMR) spectrometer: This 500 MHz Bruker NMR spectrometer operates at a magnetic field of 11.7 Tesla and is capable of controlling nuclear spin dynamics in both liquid and solid state samples. It is being routinely used for quantum information studies as well as for chemical characterization. IISER Pune also has a Bruker 600 MHz, a Bruker 400 MHz, and a JEOL 400 MHz spectrometer.



Below: Thin-film Deposition Chamber from Fourvac, Pune.



Below: Closed-cycle Refrigerator: Temperatures as low as 4 °K can be reached for studying the temperature dependence of various physical properties.



Teaching Programme



Academic Curriculum

Three distinct degree programmes are offered in Physics at IISER Pune: an integrated 5-year B.S.-M.S. programme, an integrated M.S.-Ph.D. programme and a Ph.D. programme. Students join the B.S.-M.S. programme straight after their 12th standard (equivalent to high school) through a common admissions procedure across all the IISER's. For the integrated Ph.D. programmme, started in 2011, students join after a Bachelor's degree and typically take upto 6 years to get a doctorate. The regular Ph.D. programme selects students who have completed a Master's degree, and normally lasts 5 years. More details on each programme are provided below.

In the IISER system, B.S.-M.S. students all take the same courses during their first two years, thereby gaining a basic exposure to Biology, Chemistry, Mathematics and Physics as well as, more recently, Earth and Climate Sciences. For the subsequent two years they are allowed to choose freely from among the courses offered in the different disciplines. This provides them the flexibility to tailor an interdisciplinary curriculum for themselves if they so desire. Students wanting to specialise in one of the disciplines can choose a large fraction of their courses from within that discipline, subject to the requirement of a few courses outside their main discipline. Students also have the possibility of undergoing guided study projects on specific topics. Such projects are counted as courses under the heading "Lab Training/Theory Project". The fifth and last year is completely dedicated to research, leading to a Master's thesis defended in a seminar at the end of the year. During this year students are free to work with a guide at IISER Pune or at another institution, within or outside India. They do not take any regular courses during this year, which allows them both mobility and the ability to pursue a research problem in depth frequently leading to one or more publications. In the last four years nearly twenty physics papers have been published involving undergraduates as authors.

Integrated Ph.D. students take two years of courses along with the 3rd and 4th year undergraduates. After this, they are essentially on par with Ph.D. students. During this period they are encouraged to avail of guided study with individual faculty members to customise their training in the direction of their intended research.

Ph.D. students are required to take a minimal load of courses during their first year. We have very recently started Ph.D. level courses specifically aimed at them, however the

number of such courses at the time of writing is very small and we expect it to increase as our faculty and student strength grows. Therefore at present, Ph.D. students may take one or more of the Ph.D. level courses and also a few courses selected from the advanced (primarily 4th-year) segment of our undergraduate curriculum.

Courses at IISER are assigned 2,3 or 4 credits. For classroom courses, 2 credits corresponds to two one-hour lectures per week. No specific tutorial hours are assigned. 3-credit courses typically involve two one-hour lectures and an hour of tutorials. 4-credit courses are offered only in the 3rd and 4th year and for these courses there are three hours of lectures per week plus an hour of tutorials. For laboratory courses credits are roughly proportional to the extent of work done, but the number of contact hours is, naturally, larger than for classroom courses. All courses having at least 40 registered students are assigned one or more Teaching Assistants drawn from among the Ph.D. students, who are required to perform this duty for three semesters as part of their programme. Large courses, typically for first- or second-year undergraduates, can have as many as four TA's. For laboratory courses the dedicated Laboratory Staff also play an essential role.

The list of courses given below displays the semester in which the course is offered and the number of credits. Courses marked "interdisciplinary" are intended to cater to the needs of students interested in any of the major disciplines offered at IISER. Altogether seven Laboratory Courses in Physics are offered during the 5-year B.S.-M.S. programme, the first three are taken by all IISER students since they fall in the first two years, while the remaining four are more advanced. Courses aimed at semesters V-VIII are optional courses. Even though they are primarily targeted at students of a given year, most of them are open to both 3rd and 4th year students subject to certain prerequisites. Wherever two courses appear as alternates in the list below, it means each one is typically offered in alternate years.

At the time of writing, all classroom courses in Physics are offered in the Lecture Hall Complex which features a variety of classrooms holding between 50-200 students, as well as a larger auditorium. All laboratory courses in Physics are offered in four dedicated undergraduate laboratories on the first floor of the Main Building.

List of Courses

FALL SEMESTER
I World of Physics I – Mechanics (3) Physics Lab I (2)
III World of Physics III – Electricity & Magnetism (3) Thermodynamics (2) : Interdisciplinary Physics Lab II (2)
V Mathematical Methods in Physics (4) Classical Mechanics (4) Electrodynamics (4) Quantum Mechanics I (4) Physics Lab IV (3) Electronics I (3) Lab training/Theory Project (3)
VII Physics Lab VI (4) Condensed Matter Physics I (4) Computational Physics (4) Statistical Mechanics II (3) Methods of Experimental Physics (3) Astronomy & Astrophysics (3) / Fluid mechanics (3) Lab training/Theory Project (3)

SPRING SEMESTER
II World of Physics II – Waves and Matter (3) Mathematical Methods(2) : Interdisciplinary
IV World of Physics IV – Quantum Physics (3) Physics Lab III (2) Optics (2) : Interdisciplinary
VI Physics Lab V (4) Statistical Mechanics I (4) Quantum Mechanics II (4) Electronics II (3) / Physics at Nanoscales (3) Gravitation and Cosmology (3) / Quantum Information (3) Group theory in Physics (3) / Nonlinear Dynamics (3) Lab training/Theory Project (3)
VIII Atomic and Molecular Physics (4) Classical and Quantum Optics (4) Nuclear and Particle Physics (4) Physics Lab VII (3) Condensed Matter Physics II (3) Quantum Field Theory (3) / Plasma Physics(3) Advanced Material Science (3) Lab training/Theory Project (3)

Physics Ph.D. Theses

Name	Advisor	Thesis title	Degree awarded
V. Resmi	G. Ambika	Environmental effects on the dynamics of coupled non-linear systems	2012
Soumya Singha Roy	T. S. Mahesh	Nuclear spins as quantum testbeds: Singlet state, quantum correlations and delayed choice experiments	2013
Appala Venkata Ramana Murthy	Shivaprasad Patil	Photo physical properties of single semiconductor nano-structures using flourescence correlation spectroscopy	2014
Kanika Bansal	Shouvik Datta	Electrical and optical Investigations of the condensed matter physics of junction diodes under charge carrier injection	Thesis submitted
Padmashri Vilasrao Patil	Shouvik Datta	Synthesis of semiconductor quantum dots, study of its optical properties and its application in sensitized solar cells	Thesis submitted
Arun Babu K. P.	Prasad Subramanian	Coronal mass ejections from the sun - propagation and near earth effects	Thesis submitted
Arthur Varghese	Shouvik Datta	Role of fluid dynamics in nanofabrication: Growth mechanism and optical properties of ligand free CdS nanotubes made using alumina nano-reactor.	Thesis submitted

Selected IISER alumni studying for an advanced degree in Physics

2011	Name	University
	Sushant More	Ohio State University, USA
	C. B. Ajit	Pennsylvania State University, USA
	Abhijeet Kumar	IQC-Waterloo, Canada
	Bedartha Goswami	University of Potsdam, Germany
	Sheetal Kumar Jain	Aarhus University, Denmark
	Shadab Alam	Carnegie Mellon University, USA
	Darshan Joshi	TU-Dresden, Germany
	Sarthak Parikh	Princeton University, USA
2012	Hemant Katiyar	IQC-Waterloo, Canada
	Ashutosh Agnihotri	Centrum Wiskunde & Informatica (Sponsored by Shell), Netherlands
	Md. Noaman	University of Mainz, Germany (Marie Curie Fellow)
	P. Shruthi	Rice University, US
	Jammi Sindhu	University of Nottingham, UK
	Madhusudan Raghunath	EPFL, Switzerland
	Anirban Choudhary	University of New Mexico, USA
	Monika Dash	ETH Zurich, Switzerland
2013	Akash Gadekar	National University of Singapore, Singapore
	Rohit Chikkaraddy	University of Cambridge, UK (Manmohan Singh Fellow)
	Avani Gowardhan	Cornell University, USA
	Shubham Pandey	King's College London, UK

The year indicated is the year of graduation from the IISER BS-MS Programme.



*Map of IISER Alumni in
Physics Programmes*

produced by Aashay Patil using Google Maps



Physics Publications with Undergraduate Authors

“Scaling relation for determining the critical threshold for continuum percolation of overlapping discs of two sizes”, Ajit C Balram and Deepak Dhar. <i>Pramana J. Phys.</i> 74,109 (2010).	“Evolution of quantum discord and its stability in two-qubit NMR systems”, Hemant Katiyar, Soumya Singha Roy, T. S. Mahesh and Apoorva Patel. <i>Phys. Rev. A</i> 86, 012309 (2012).
“Revisiting the Langer–Ambegaokar–McCumber–Halperin theory of resistive transitions in one-dimensional superconductors with exact solutions”, Darshan Joshi and Arijit Bhattacharyay, <i>J. Phys. Cond. Mat.</i> 23, 342203 (2011).	“Palladium adjoined gold split-ring resonators: a prospective nanoplasmonic hydrogen sensor”, G.V. Pavan Kumar and Mohit Raghuwanshi, <i>Optics Comm.</i> 300, 65 (2013).
“A manifestly MHV Lagrangian for N=4 Yang-Mills”, Sudarshan Ananth, Stefano Kovacs and Sarthak Parikh, <i>JHEP</i> 1105:051 (2011).	“A new tuning fork based instrument for oscillatory shear rheology of nanoconfined liquids”, Karan Kapoor, Vindo Kanavade, Vibham Shukla and Shivprasad Patil, <i>Rev. Sci. Inst.</i> 84, 025101 (2013).
“Non-perturbative corrections to mean-field critical behavior: the spherical model on a spider-web graph”, Ajit C Balram and Deepak Dhar, <i>J. Phys. A: Math. Theor.</i> 45:125006 (2012).	“Microsphere-coupled organic waveguides: Preparation, remote excitation of whispering gallery modes and waveguiding property”, Rohit Chikkaraddy, Arindam Dasgupta, S. Dutta Gupta and G. V. Pavan Kumar. <i>Appl. Phys. Lett.</i> 103, 031112 (2013).
“Gauge invariant correlation functions in light-cone superspace”, Sudarshan Ananth, Stefano Kovacs and Sarthak Parikh, <i>JHEP</i> 1205:096 (2012).	“Plasmo-fluidic single-molecule surface enhanced Raman scattering from dynamic assembly of plasmonic nanoparticles”, Partha Pratim Pathra, Rohit Chikkaraddy, Ravi P. N. Tripathi, Arindam Dasgupta and G.V. Pavan Kumar, <i>Nature ommunications</i> 5, 4357 (2014).
“Plasmon-assisted light propagation and Raman scattering hot-spot in end-to-end coupled silver nanowire pairs”, Rohit Chikkaraddy, Danveer Singh, G.V. Pavan Kumar. <i>Appl. Phys. Lett.</i> 100, 43108 (2012).	“Cubic interaction vertices in higher spin theories”, Y.S. Akshay, Sudarshan Ananth. <i>J. Phys. A: Math. Theor.</i> 47, (2014).
“Evanescent field-assisted intensity modulation of surface enhanced Raman scattering from a single plasmonic nanowire”, Sruthi Polali, Danveer Singh, and G.V. Pavan Kumar, <i>J. Phys. D: Appl. Phys.</i> (2013).	“Light-cone gravity in AdS4”, Y.S. Akshay, Sudarshan Ananth and Mahendra Mali. <i>Nucl. Phys. B</i> 884, 66 (2014).
“Palladium adjoined gold split-ring resonators: a prospective nanoplasmonic hydrogen sensor”, G.V. Pavan Kumar and Mohit Raghuwanshi, <i>Optics Communications</i> 300, 65 (2013).	“Stability analysis of anisotropic spacetimes”, Bhavesh Khamesra and V. Suneeta, <i>Phys. Rev. D</i> 90, 024044 (2014).
“Plasmonic nanowires arranged in Fibonacci number chain: Excitation angle-dependent optical properties”, Mohit Raghuwanshi and G.V. Pavan Kumar. <i>AIP Advances</i> 3:022112 (2013).	



Master's Theses

1 * Antony Shashwat Statistics of bursts in the solar corona at x-ray wavelengths.	2 Adwiteey Mauriya Study of tokamak equilibria using variational moment method.	3 Akash Ramesh Gadekar Optoelectronic characterization of photovoltaic devices & application of nanofibers for charge storage.
4 * Shreyash Tandon A study on optical and plasmon based trapping: towards structured light fields.	5 * Amey Anant Apte Ultrasensitive detection of D-glucose and TNT molecules using vertically aligned self-assembled gold nanorods.	6 * Rohit Chikkaraddy Emission characteristics of organic meso/nanowires coupled with dielectric and plasmonic structures.
7 * Sharad Joshi Quantum stimulation using nuclear quantum processor.	8 * Pravu Prasad Dhal Structural and magnetic studies of orthoferrite BaFeO 3–δ.	9 Siddhartha Das Semi-leptonic b-meson decay.
10 * Shibananda Das A multiscale simulation scheme to investigate dynamics of membrane confined polymer.	11 * C Gaurav Effect of O-spacer layer in the interaction between graphene and graphone with a ferromagnetic metal substrate.	12 Mohit Dixit Molecular Simulations of hydrocarbon water interfaces.
13 Avani Gowardhan A blind Ka- and Q- band survey for molecular absorption.	14 * Pallavi Dilip Patil Search for OH megamasers at redshift z = 1.7 in the GOODS-North field	15 * Aashay Prakash Patil Correlation of categorical and random matrix data.
16 * Bhavesh Khamesra Stability analysis of spherically symmetric space-time sourced by anisotropical fluid,	17 * Shivraj Prajapat Noncommutative quantum mechanics and noncommutative geometry.	18 * Sri Haritej Kolagani Study of Higgs mechanism in Yang-Mills and Chern-Simons field theory.
19 * Rashmi Runjhun Synthesis and characterization of transparent and conducting thin films.	20 Shreya Ray Precision triple-slot experiment in the microwave regime.	21 Shubham Pandey Numerical schemes for conservation laws on moving mesh.
22 * Prashant Sharma Interferometer based small amplitude atomic force microscope.	23 Sandesh Bhat Models of inflation in the light of Planck data 2013.	24 Aravind H. V. Path-integrals and quantum-walks in multi-slit systems.
25 Ashok Choudhary Modelling of gravitational waves.	26 * Tanya Kumari Synthesis of metal oxides for energy and environmental application.	27 B. Anand Deepika On metric independent perturbation scheme and associated relativistic acoustic geometry for spherical accretion.

* research conducted at IISER Pune

28 * Prashant Bhaskar Plasmon-exciton interaction in gold-CdTe nanostructures.	29 * Somil Subhash Chandra Gupta Modelling Fe-Cr alloys: a multiscale approach.	30 Aparna Pilli Physical and chemical characterization of colloidal floc systems.
31 Karishma Bansal Multi-frequency study of pulsar radio emission.	32 Naveen Aerpula Modelling of electroabsorption of ions in a flow cell.	33 Dinesh Kumar Study of light transport in multilayered turbid media.
1 * Aswathy V.G. Photo-thermal properties of localized plasmonic nanostructures.	2 * Akshay Y. S. Deriving interaction vertices in quantum field theories describing higher spin fields in flat spacetime background.	3 Yagyik Goswami Exploration of existence, structure and characteristics of simultaneously stable groups of synchronized nodes in a connected, directed network of oscillators.
4 * Sukruti Bansal Flat directions in higher dimensional supergravity theories.	5 * Urvashi Gupta Electromagnetically induced transparency in ultra-cold Rydberg atoms.	6 Sourav Sarkar Explorations in gauge-gravity duality.
7 Arshad Arjunan Nair Lightning distribution during the active and break down monsoon periods over South Asia.	8 * K. Sriram Quantum simulations of spin chains with 1/r2 interactions in a cols ion crystal.	9 V.R. Krithika Phase sensitive optical amplification.
10 * Neha Dilip Bora Random walks on complex media.	11 Utkarsh Giri Phenomenological investigations of BSM physics at colliders.	12 Siddharth Rajiv Mohite Exploring the possibility of probing a stochastic gravitational wave background using an array of bar detectors.
13 Abhijith Gandrakota Studies of entanglement entropy in holography.	14 * Meghana Raghunandan Bright solutions in dipolar Bose-Einstein condensates.	15 * Shanu Dengre Magnetism of some potential multiferroic systems.
16 * Kshiti Mishra Investigations of geometrically frustrated magnets.	17 * Sagar Fakirchand Lokhande Worldsheet string theory and black hole physics.	18 * Vishnu V. Krishnan Transport in nonequilibrium stochastic systems.
19 * Pranav Kumar Nonlinear (in)stability of asymptotically anti-de sitter spacetimes.	20 Prathamesh Dhananjay Tamhane Properties of faint galaxies in deep, multiwavelength surveys.	21 Mihir Sanjay Kulkarni Studying cross-correlation of HI-21 cm signal and Lyman-forest using simulations
22 * M. Sainath Storage and control of quantum information using macroscopic gas samples.	23 Sree Vani J. Diffuse radio emission from galaxy clusters.	24 * Ajith V. J. A novel near-field instrument for measurement of molecular mobility in nano-confined liquids under shear stress.
25 Revati Sudam Mandage The turbulent solar magnetic field.	26 Anilkumar Tolamatti Topics in post-Newtonian computations for in-spiralling compact binaries.	27 * C. Lattlanzuala NMR experiments with optional control techniques.

* research conducted at IISER Pune



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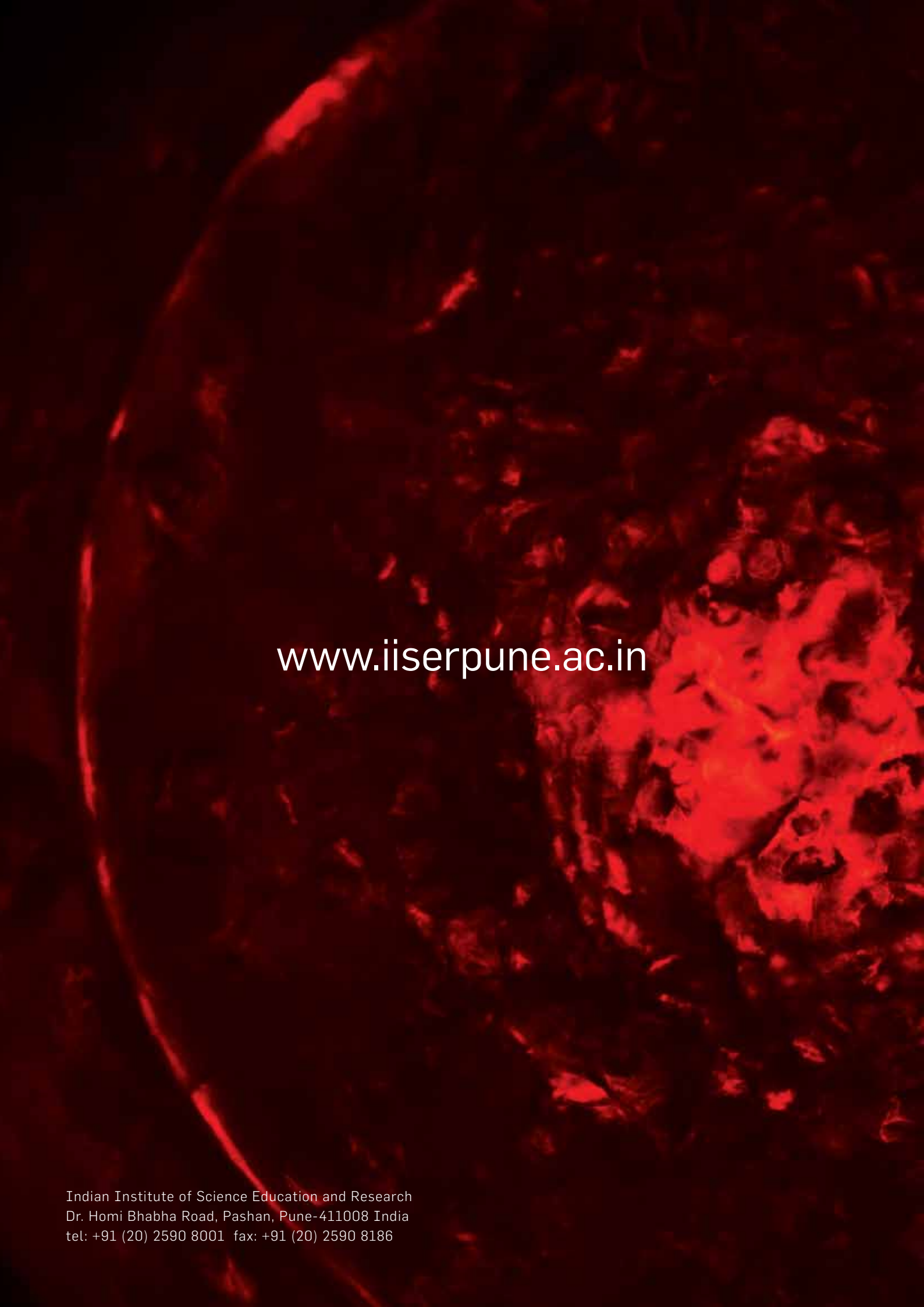
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