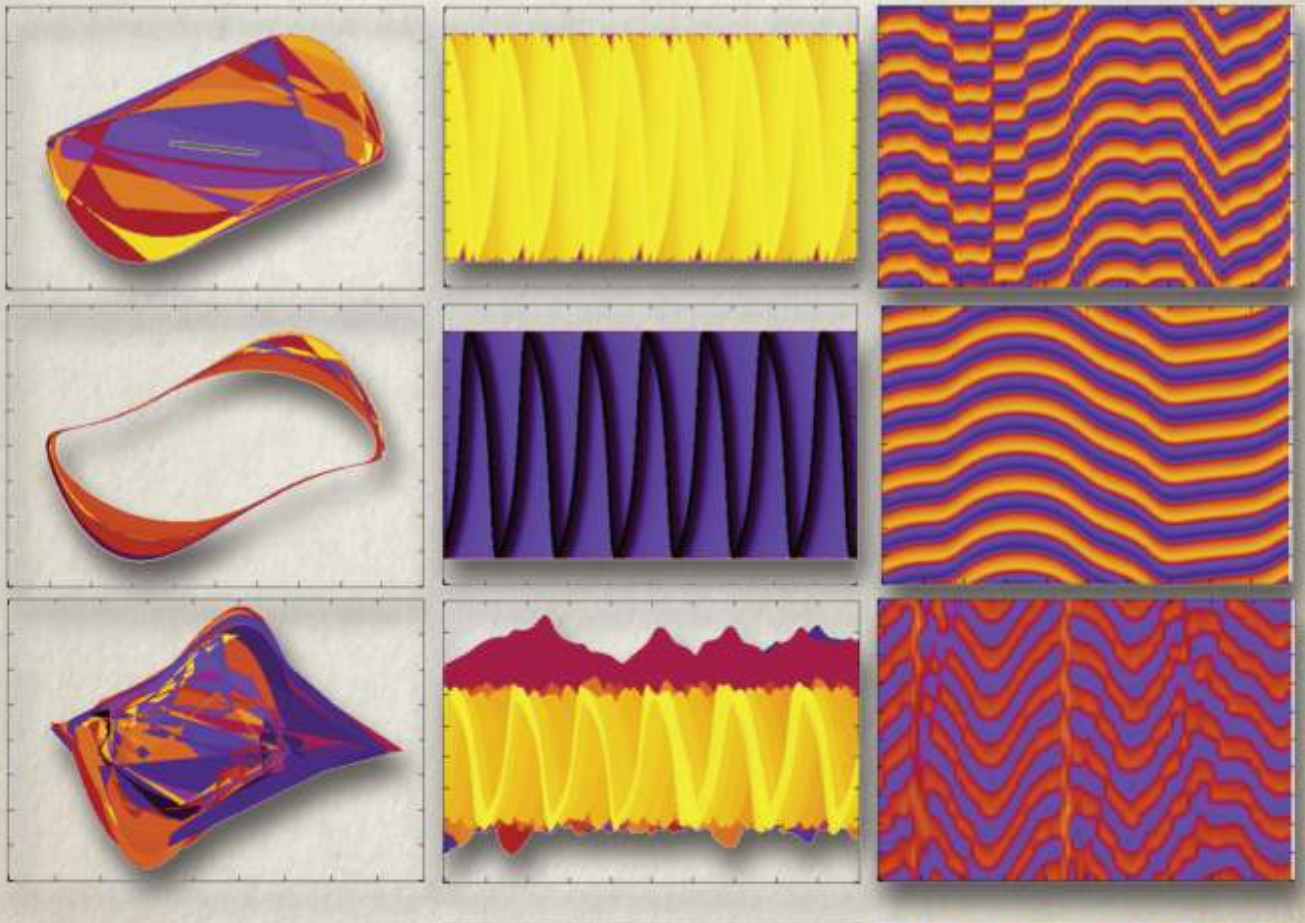
DEPARTMENT OF PHYSICAL SCIENCES

IISER Mohali



September 2017

Welcome from the Head

IISER Mohali has completed ten years of operation and in these years the institute has completed the initial growth phase and has entered the consolidation phase. The department of physical sciences has grown into a young and vibrant department. Our mission is to contribute to the advancement of the understanding of our physical world through basic and applied research, and engage students in the excitement in the world of physics.

In the following pages you will see a description of research interests of faculty members and post-doctoral fellows. Research in this Department covers incredible range, encompassing phenomena spanning length scales from nanometers to megaparsecs, and time scales from attoseconds to billions of years! There is great variety in the Department, and we house many state-of-the-art research laboratories.

The number of publications in peer reviewed publications from the department is more than 230, with 50 of the publications appearing in the last year. We expect the number of publications to increase further as more and more groups reach a critical number and begin to publish their research at a stable rate. A number of publications have dealt with topics that excite curiosity of interested citizens and have been covered in newspapers.

The number of PhD students in the department has grown significantly in the last three years. We have gone from a total of twenty PhD students in early 2013 to more than 100 PhD and Integrated PhD students. Of these, more than 70 students have completed the course work and passed the comprehensive exam. Remaining students are doing course work or doing project work before taking the comprehensive exam.

Members of this Department are part of national bodies. They have received significant external funding and awards from several sponsored projects from DST, DBT and CSIR. The total amount sanctioned for such projects and fellowships is in excess of Rs.30 crore.

The Department has been pro-active in running a successful teaching program, and my colleagues are seeking bright and energetic students to further strengthen and sustain the activities of the research groups, through the BS-MS, Integrated PhD, PhD and post-doctoral programs. Physics has remained amongst the top two choices for majors in the last five years. You will find a detailed description of teaching programs in the following pages.

Hope you enjoy this virtual walk through our Department!

J S Bagla Sep.6, 2017

Physics Programme

The BS-MS Dual Degree

The BS-MS dual degree is the flagship program of all the IISERs. At IISER Mohali the program has been structured to promote interdisciplinarity and a significant research component. The core part of the program provides comprehensive training in all basic sciences during the first two years. Students are expected to choose a subject to major in for the remaining three years where the curriculum is divided between mandatory courses, subject electives and open electives. Open electives can be taken in any subject and allow students to fashion their own programs. Apart from courses in specific subjects, some inter-disciplinary courses are also offered on a regular basis. These courses are in areas that are useful to multiple branches of science, or are in distinct areas like Astronomy, Earth, Planetary and Environmental sciences, Computational sciences, etc. Courses in humanities & social sciences are also offered. Students have no dearth of choices with more than 60 elective courses to choose from. The students are expected to work on short research projects during summer vacations, either at IISER Mohali or at research laboratories and institutes elsewhere. Each year, several students make use of scholarships to do summer research in other countries. The institute also has a student exchange program with some universities and research institutes in different parts of the world to facilitate visits by bright students. Research by students has already led to a number of publications authored by students, some of these by students themselves. The students spend much of their time during their final year on a research project. The project culminates in a thesis and is expected to contain at least some original work. Some of the projects lead to publications in peer reviewed journals, giving our students an exposure to all stages of a research project at an early stage of their career.

There are more than 900 students in the BS-MS program at IISER Mohali at present. Selection of students is done in three channels: KVPY (Kishor Vaigyanik Protsahan Yojana) scholars and

students who have cleared the IIT JEE advanced test are elligible for admissions. The direct channel of admissions, where top 1% of students in each board can apply became operational in 2010 and a number of students are joining the IISERs through this channel. The BS-MS graduates of IISER Mohali are expected to take up science as a career, although the diverse skills gained will equip them to pursue high-profile careers in any field, including education, industry and government.
The department of physical sciences is involved in teaching and coordinating a number of courses in the core years. The physics courses offered in core years are: Mechanics, Electricity and Magnetism, Waves and Optics, and, Thermodynamics and Statistical Physics. There is a physics laboratory course offered in each semester of the core that closely follows the theory course being offered in the semester. The department also offers core elective courses on Astronomy, and Quantum Physics. The department offers two inter-disciplinary courses and participates in teaching of a third course: Hands on Electronics, Workshop techniques, and, Introduction to computing.
Physics major students take seven mandatory theory courses: Classical Mechanics, Electrodynamics, Quantum Mechanics, Atoms and Molecules, Statistical Mechanics, Solid State Physics, and, Nuclear and Particle Physics. The students take four laboratory courses: Advanced optics and spectroscopy, Advanced electronics and instrumentation, Nuclear Physics, and, Condensed Matter Physics.
The department offers a number of electives each year. These include courses related to methods, e.g., two courses on mathematical methods, a course on computational methods. There are courses introducing different areas of research: Physics of fluids, non-linear dynamics, quantum field theory, general theory of relativity, quantum information and computing, quantum optics, advanced condensed matter physics, etc. The department also offers electives with experimental component. A number of advanced electives are also offered from time to time.
Six batches of BS-MS students have graduated and a majority of these are enrolled in research programs in some of the finest research institutes in India as well as elsewhere. The total number of physics majors who have graduated is 90 of which more than 55 are enrolled in PhD programs. A list of all the physics majors alumni is given towards the end of this booklet.
At present there are 134 Physics majors in the department out of about 490 students in majors in all the departments.

PhD and the Integrated PhD program

IISER Mohali started its PhD program in 2008 and more than ten scholars have graduated during the last four years. At present there are about 400 students at various levels in the PhD program in biology, chemistry, mathematics, physics, earth and environmental sciences, and humanities and social sciences. The PhD program at IISER Mohali involves course work, a qualifying examination, thesis work and a thesis examination, leading to the award of a PhD degree. Besides research, the scholars are involved in several activities such as helping the faculty in laboratory sessions, seminars, journal clubs, workshops, etc.
Students are required to pass a national level test to be eligible for applying to the PhD program at IISER Mohali. Screening tests and interview are conducted to select the best students. Majority of doctoral students at IISER Mohali have qualified for fellowships given by CSIR, UGC, DST, DBT, ICMR and other agencies.
Doctoral graduates from IISER Mohali are doing post-doctoral research or teaching.
The department of physical sciences has more than 74 PhD students. Of these, six are doing course work or project work while the remaining students have completed the comprehensive exams and are involved in research.
During $2012-2013$ the institute initiated the integrated PhD program, which is meant for students

who have completed an undergraduate degree from elsewhere and wish to pursue the Masters and PhD program at IISER Mohali. This program identifies talented students at an early stage and brings them into the research fold. About 100 students have been admitted to this stream so far. The integrated PhD program consists of two years of course work and research projects. Qualifying students can then go on to do a PhD at the institute under the guidance of any faculty member. Under normal circumstances, the integrated PhD program saves one year for the student as the course work enables them to progress at a much faster pace than a student in a typical Msc/PhD program.

The department of physical sciences has more than 25 students in this stream. A few students chose to leave after an MS thesis though the majority have continued with research and the first students from this stream should start graduating in a couple of years.

There is considerable interaction amongst students at different levels and PhD students contribute significantly to mentoring fifth year MS students in research laboratories.

Post-Doctoral Fellowship

The institute has a post-doctoral research program where scholars from other universities and institutes join after completing their PhD for gaining research experience while working with the faculty at IISER Mohali.

The institute hosts many post-doctoral researchers with independent funding in schemes like the DST fast track scheme for young scientists, National Post-Doctoral Fellowship, DBT post-doctoral fellowship, NBHM post-doctoral fellowship, etc.

Post-doctoral researchers gain experience from teaching and mentoring young students, at the same time they have access to world class facilities for research and the opportunity of working with some of the best researchers.

The department of physical sciences has 10 post-doctoral fellows, including post-doctoral fellows hired in sponsored projects.

The Faculty

Arvind

Professor

Academic Background

Prof. Arvind obtained his Masters in Physics in 1990 from Indian Institute of Technology Kanpur and his PhD from the Department of Physics and the Centre for Theoretical Studies, Indian Institute of Science Bangalore in 1997. He was a faculty member of the physics department of Guru Nanak Dev University Amritsar from 1997-2005, visited the Physics Department of Carnegie Mellon University Pittsburgh USA as a special faculty during 2002-2004, was a faculty member in the physics department of the Indian Institute of Technology-Madras during 2005-2007, and moved to IISER Mohali in August 2007 as first regular faculty of Institute.

Research Interests

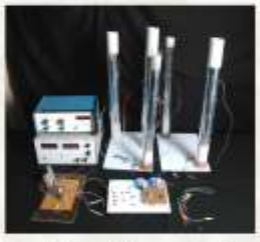
Arvind is a theoretical physicist whose research interests span the areas of quantum information processing, quantum optics, foundations of quantum mechanics and research in physics education.

Quantum Physics, Quantum Computing and Quantum Optics

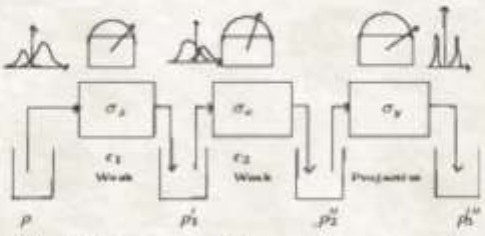
Arvind has worked on issues related to bound quantum entanglement, quantum entanglement in the context of the Deutsch-Jozsa algorithm and Parity Determining algorithm, quantum dissipation and its control, optical schemes for quantum computers and NMR quantum information processing. He has worked on the connection of Bell's inequalities with non-classicality of states of the radiation field. He has worked on the quantum measurement problem and is currently working on quantum contextuality and its use in quantum key distribution protocols.
Arvind's research in quantum optics includes looking for signatures of non-classical behavior for the radiation field such as squeezing, sub-Poissonian photon statistics and antibunching, and applying group theoretic methods in quantum optics.

Physics Education

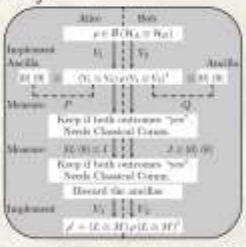
Arvind is working on building new experiments for physics teaching which are designed around a certain conceptual theme. Experiments developed so far at the undergraduate and postgraduate levels, have been introduced in various laboratory courses all over the country.



A teaching lab experiment



Weak Measurment based tomography



Measurement based filters

Representative Publications

Quantum key distribution protocol based on contextuality monogamy, *Jaskaran Singh, Kishor Bharti and Arvind*, Phys. Rev. A, Vol 95, 062333 (2017).

Witnessing nonclassical correlations via a single-shot experiment on an ensemble of spins using nuclear magnetic resonance, *Amandeep Singh, Arvind and Kavita Dorai*, Phys. Rev. A, Vol. 95, 062318 (2017).

Quantum Private Comparison over noisy channels, *Vikesh Siddhu and Arvind*, Quantum Information Processing, Vol 14, 3005 (2015).

Estimation of quantum states by weak and projective measurements, *Debmalya Das and Arvind*, Phys. Rev. A, Vol 89, 062121 (2014).

Extremal extensions of entanglement witnesses: Finding new bound entangled states, *Ritabrata Sengupta and Arvind*, Phys. Rev. A, 84(3), 032328,1-7, 2011.

Simulating a single-qubit channel using a mixed-state environment, *Geetu Narang and Arvind*, Phys. Rev. A, 75(3), 032305,1-7 (2007).

Two-mode quantum systems: Invariant classification of squeezing transformations and squeezed states, *Arvind, B. Dutta, R. Simon, and N. Mukunda*, Phys. Rev. A, 52(2):1609-1620, (1995).

Research Group

PhD Students: Chandan Kumar, Harpreet Singh, Aakash Sharawat, Jaskaran Singh, Akshay Gaikwad.

MS Students: Gaurav Saxena, Akanksha Gautam.

Alumni: Dr. Geetu Narang (Faculty at UIET, PU Chandigarh) Dr. Paramdeep Singh (SO, IISER Mohali), Dr. Ritabrata Sengupta (Faculty, IISER Behrampur), Dr. Debmalya Das (Post Doc, HRI Allahabad), Dr. Shruti Dogra (Visiting Fellow, University of Dortmund Germany).

Grants and Awards

INSA Medal for Young Scientists, *2000.*

Exploring the quantum measurement problem in the context of weak quantum measurements , *PI: Arvind*, DST Funded Project, 2015-2018.

Outreach Activities

Prof. Arvind is the coordinator of the outreach activities of the Institute. In the context of physics outreach, he organized several one-day programs on physics experiments in colleges and universities in the region. He has organized an Academy sponsored Lecture Workshop at GNDU (October 2015) and several Teachers Training programmes at IISER Mohali including the academy sponsored workshop on physics experiments for physics faculty from the region.

Charanjit Singh Aulakh

Professor

Academic Background

Prof. Charanjit Singh Aulakh obtained his BSc.(Hons-Physics) in 1973 from Delhi University (St. Stephen's College) followed by an M.Sc. degree in 1975 also from Delhi University. He obtained his PhD in Theoretical Particle Physics from the City University of New York in 1983. During 1983-1988, he worked as a postdoctoral fellow at the International Centre for Theoretical Physics, Trieste, the Institute de Physique Nuclear, Orsay, the Niels Bohr Institute, Copenhagen and the Centre for Theoretical Studies, Indian Institute of Science, Bangalore. He was a member of the faculty at Institute of Physics, Bhubaneswar (1988-1994) and the Physics Department, Panjab University (1994-2013), where he served as Chairperson during 2010-2013. He joined IISER, Mohali in June, 2014.

Research Interests

My research is currently mainly in Supersymmetric Grand unification, its Phenomenology/Cosmology, Grand Unified Flavour unification and on the links between Grand Unification and Gravity. The two most compelling reasons for new theoretical structures beyond the Standard Model (BSM) are neutrino masses as seen in neutrino oscillations and gauge coupling convergence in the Minimal Supersymmetric Standard Model at Grand Unified scales (10^{16} GeV). Supersymmetric (Susy) SO(10) GUTs are the ideal, ample yet minimal, framework for models of BSM physics since they naturally and predictively incorporate "seesaw" mechanisms for neutrino masses as well as exhibiting deep links between Baryon and Lepton violation. They have a host of novel phenomenological and cosmological implications. The Supersymmetric SO(10) GUT based on $\mathbf{210} + \mathbf{126} + \overline{\mathbf{126}}$ Higgs set proposed with R.N. Mohapatra in 1983 has emerged as the minimal realistic and fully calculable model of Grand Unification compatible with Seesaw mechanisms for neutrino mass and gauged R-Parity. We have used the completely soluble symmetry breaking and mass spectra to calculate threshold effects at TeV and GUT scales. This has been used to find completely realistic fits of MSSM data that predict novel Susy spectra. We anticipated(2008) the Higgs Discovery (2012) driven acceptance of large soft Susy breaking parameter (A_0). We presented a novel and generic resolution of the long standing problem of fast proton decay in Susy GUTs based on the wave function renormalization of MSSM Higgs by superheavy particles. Susy Seesaw Inflation, Dynamical Yukawa generation with gauged flavour, dynamical generation of the Planck scale, and Black Holes are other novel directions we are currently exploring in the context of this GUT.

Representative Publications

MSSM Higgs: Window into Susy GUTs, *C. S. Aulakh*, PoS PLANCK 2015, 010,(2015).

NMSGUT emergence and Trans-Unification RG flows, *C. S. Aulakh, I. Garg and C. K. Khosa*, arxiv:1509.00422.

Bajc-Melfo vacua enable Yukawon ultraminimal grand unified theories, *C. S. Aulakh*, Physical Review D, 91, 055012,(2015).

Baryon stability on the Higgs dissolution edge: threshold corrections and suppression of baryon violation in the NMSGUT, *C. S. Aulakh, I. Garg and C. K. Khosa*, Nuclear Physics B, 882, 397, (2014).

SO(10) grand unified theories with dynamical Yukawa couplings, *C. S. Aulakh and C. K. Khosa*, Physical Review D, 90(4), 045008, (2014).

Supersymmetric Seesaw Inflation, *C. S. Aulakh and I. Garg*, Physical Review D, 86, 065001, (2012).

Research Group

Dr. Ram Lal Awasthi and Dr. Shri Krishna are post-doctoral fellows working with me on Supersymmetric SO(10) GUTs.

Grants and Awards

DST project on Phenomenology and Cosmology of the New Minimal Supersymmetric SO(10) GUT(2015-2018). ICTP Senior Associate (2013-2019).

Jasjeet Bagla

Professor

Academic Background

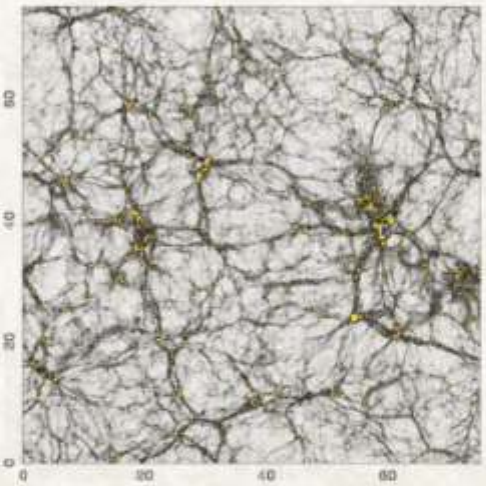
Prof. Jasjeet Singh Bagla did B.Sc. at the S.G.T.B. Khalsa College, Delhi University and followed this with a masters from Delhi University. He did his PhD work at IUCAA, Pune during 1992–1996. In 1996 he joined the Institute of Astronomy, University of Cambridge as a post-doctoral fellow. He spent a bit more than a year at the Harvard-Smithsonian Centre for Astrophysics before returning to India towards the end of 1999. He worked at the Harish-Chandra Research Institute, Allahabad from Nov. 1999 to July 2010. He has been at IISER Mohali since July 2010.

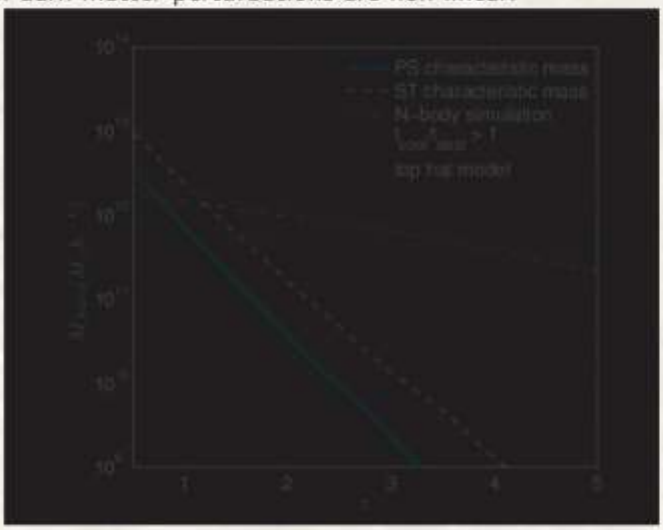
Research Interests

Jasjeet works on various aspects of cosmology and galaxy formation. Much of the work is done using cosmological N-Body simulations. He devised the TreePM method (Bagla, 2002) for doing such simulations and developed this subsequently with Suryadeep Ray and then Nishikanta Khandai to optimize it further. This algorithm is used in a number of simulation codes as it provides better speed and force accuracy than alternatives.

He has used these simulations to model distribution of neutral Hydrogen in the early universe (Bagla, Khandai and Datta, 2010). The modelled distribution for one epoch is shown in the left panel below. Another use of simulations for studying galaxy formation was a study of the competition between infall and outflows from galaxies (Singh et al, 2016). The right panel below illustrates this.

He has studied models of dark energy (Bagla, Jassal and Padmanabhan, 2003) and is studying the growth of dark energy perturbations when dark matter perturbations are non-linear.





Representative Publications

Suppression of galactic outflows by cosmological infall and circumgalactic medium, *Priyanka Singh, Sandeep Rana, J S Bagla, Biman Nath*, Monthly Notices of the Royal Astronomical Society, 459, 2, (2016).

H I as a probe of the large scale structure in the post-reionization universe, *J S Bagla, Nishikanta Khandai, Kanan K. Datta*, Monthly Notices of the Royal Astronomical Society, 407, 567, (2010).

Fractal dimensions as a measure of the scale of homogeneity, *Jaswant Yadav, J S Bagla, Nishikanta Khandai*, Monthly Notices of the Royal Astronomical Society, 405, 2009, (2010).

Effects of the size of cosmological N-Body simulations on physical quantities — I: Mass Function, *J S Bagla, Jayanti Prasad*, Monthly Notices of the Royal Astronomical Society, 370, 993, (2006).

Cosmology with Tachyon Field as Dark Energy, *J S Bagla, H K Jassal, T Padmanabhan*, Physical Review D, 67, 063504, (2003).

TreePM: A code for Cosmological N-Body Simulations, *J S Bagla*, Journal of Astrophysics and Astronomy, 23, 185, (2002).

Evolution of Galaxy Clustering, *J S Bagla*, Monthly Notices of the Royal Astronomical Society, 299, 417, (1998).

Crisis in Cosmology — Observational Constraints on Ω_0 and H_0, *J S Bagla, T Padmanabhan, J V Narlikar*, Comments on Astrophysics, 18, 275, (1996).

Research Group

Jasjeet's research group has a number of PhD students, most of the students are at an early stage. Sandeep Rana is working on aspects of radio sources. He is studying clustering of point sources in the TGSS survey. Ankit Singh is setting up simulations to study galaxy interactions and quenching of star formation. He and a former post-doc Mamta Gulati are studying quenching of star formation due to RAM pressure stripping. Manvendra Pratap Rajvanshi is studying aspects of dark energy perturbations: he is studying fully relativistic models of dark energy in the vicinity of dark matter halos. Ashish Meena is studying aspects of strong gravitational lensing. His primary focus is on studying unstable caustics.

Jayanta Dutta, a post-doc, is working on simulations of first stars.

Professional Recognition

Jasjeet was the chair of the GMRT (Giant Meterwave Radio Telescope) time allocation committee during June 2012 to May 2015.

Outreach Activities

Jasjeet has been involved in many outreach activities. These include lecture and interaction sessions with school and college students and development of resource materials.

Samir K. Biswas

Assistant Professor

Academic Background

I have finished B.Sc honors in Physics from Presidency College, Calcutta(2001-2004). After completing my master program from IIT-Bombay, I joined IISc Bangalore in 2006 for my PhD program under medical physics and instrumentation domain. I worked as a postdoctoral fellow at the University of Twente, Netherlands from 2012 to 2014 and at the NUS Singapore from 2014-2015. I was working at IIT-Hyderabad as Assistant Professor from 2015 to 2016 and then, I joined IISER Mohali as Assistant Professor in June 2016.

Research Interests

I am working in interdisciplinary area where the knowledge from basic physics, mathematics, engineering and biology are integrated to develop advance medical devices and algorithms for diagnosing angiogenesis under various diseases model. In-vivo angiogenesis diagnosis and monitoring it in living subject would be a solace for multiple disease diagnosis and drug design under a single diagnostic unit. Medical Physics and Bioengineering is one of the leading interdisciplinary research area where, particularly our lab design and develop advance medical instruments, next generation microscope and algorithms to address the health related problems such as angiogenesis in solid cancer, arthritis in joints, inflammation etc. In that path, we work with PDEs for modeling tissue functionality, instrumentation, inverse problem, soft radiation for example EM wave, ultrasound, optical signal, electrical current etc for diagnosing diseases at advanced stage in living subjects.

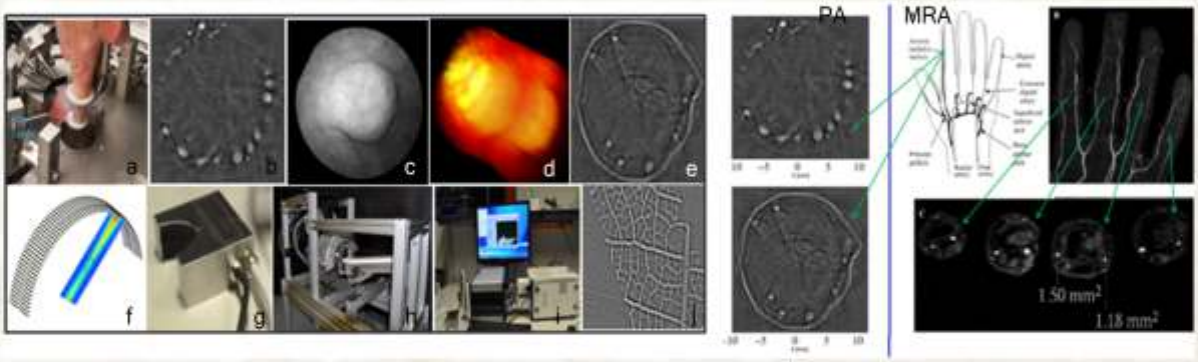


Fig.1 New instrumentation for diagnosing angiogenesis & comparing our finding with MRA.

Representative Publications

A new method for delineation of bone surfaces in photoacoustic computed tomography of human finger, *S. K. Biswas, Peter. V. Es, W. Steenbergen and S. Manohar*, Ultrasonic Imaging, 38(1), 63-76, (2015).

Initial results of finger imaging using Photoacoustic Computed Tomography, *Peter V. Es, S. K. Biswas, H. Moen, W. Steenbergen and S. Manohar*, J. Biomed. Opt. Let., 19(6), 060501 (2014).

Flux density calibration in diffuse optical tomographic systems, *S. K. Biswas, K. Rajan and R. M. Vasu*, J. Biomed. Opt., 18(2), 026023 (2013).

Practical fully 3D reconstruction algorithms for diffuse optical tomography, *S. K. Biswas, K. Rajan and R. M. Vasu*, J. Opt. Soc. Am. A., 29, 1017, (2012).

Accelerated gradient based diffuse optical tomographic image reconstruction, *S. K. Biswas, K. Rajan and R. M. Vasu*, Medical Physics, 38, 539, (2011).

Research Group

Medical Physics Lab (IISER Mohali)

Grants and Awards

Grants:

1. 3D Printed Lower Limb Orthotics. Ministry of Health and Family Welfare and DiponEd BioIntelligence LLP (Approved). (Team Dr. Falguni Pati, Dr. S N Rath, Dr. S K Biswas)

Award:

1. Gandhian Young Technological Innovation Award 2014.
2. Foundation for Academic Excellence and Access (FAEA), from 2003-2006, New Delhi 110016.

Dipanjan Chakraborty

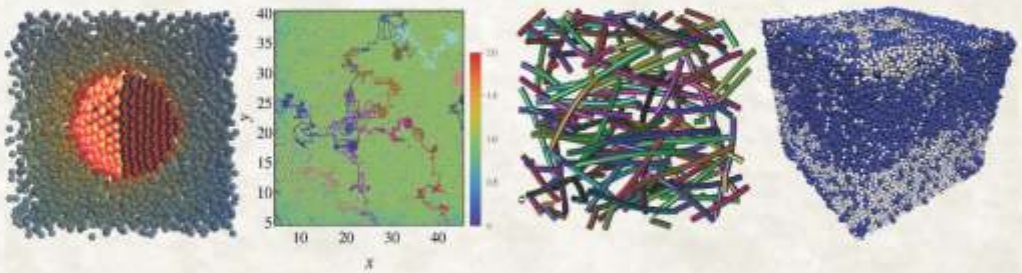
Assistant Professor

Academic Background

Dr. Dipanjan Chakraborty did his undergraduate in Physics honours from Presidency college, Kolkata affiliated to the Calcutta University. He obtained his master degree in Physics from Indian Institute of Technology, Kanpur in 2001 and his doctoral degree from Indian Association for the Cultivation of Sciences in 2010. He was a visiting scientist and later a staff scientist in the Institute for Theoretical Physics, University of Leipzig, Germany during the period of 2009-2010. Subsequently, he was an Alexander von Humboldt fellow in Institue for Theoretical Physics, University of Leipzig from 2010-2012 and a Max-Planck research Fellow at the Max-Planck Institute for Intelligent Systems, Stuttgart, Germany, from 2012 -2013. He joined the physics department at IISER Mohali on July 2013.

Research Interests

The research interest of the group lies in the physics of soft matter systems. A wide range of collective phenomena resulting in complex structure and dynamics emerge at such mesoscopic length scales. While theoretical formulations of such emergent phenomena rely on the formulations of statistical mechanics out of equilibrium, a more microscopic insight can be gained using computer simulations, bridging the gap between theory and experiments. They serve as an indispensable tool to validate theoretical predictions and gain access to phenomena which are otherwise difficult to observe or measure in experiments. The research activities of the group are strongly build on large-scale coarse-grained simulations of soft matter systems, with a goal to understand the rich physics at such mesoscopic length scales.



A collage of ongoing research activities of the group: From left to right - simulation snapshots of a self-propelled Janus particle in a solvent, directed motion in two-dimensional colloidal suspension, a solution of stiff polymers with transient bindings and a binary solvent below its consolute point.

Representative Publications

Stochastic ratcheting of two dimensional colloids : Directed current and dynamical transitions, *Dipanjan Chakraborty and Debasish Chaudhuri*, Physical Review E (Rapid Communications), 91, 050301(R), (2015).

Geometry-Induced Superdiffusion in Driven Crowded Systems, *Olivier Bénichou, Anna Bodrova,* Dipanjan Chakraborty, *Pierre Illien, Adam Law, Carlos Mejía-Monasterio, Gleb Oshanin, Raphaël Voituriez* , Physical Review Letters, 111, 260601, (2015).

Rotational hot Brownian Motion, *D. Rings,* D. Chakraborty *and K. Kroy* , New Journal of Physics, 14, 053012 (2012).

Generalized Stokes-Einstein relation for Hot Brownian Motion, D. Chakraborty, *M. V. Gnann, D. Rings, J. Glaser, F. Otto, F. Cichos and K. Kroy*, Europhysics Letters , 96, 60009 (2011).

Tube Width Fluctuations in F-Actin Solutions, *J. Glaser,* D. Chakraborty, *K. Kroy, I. Lauter,M. Degawa,N. Kirchgeßner, B. Hoffmann, R. Merkel and M. Giesen*, Physical Review Letters, 105 037801 (2010).

Research Group

Current group members: From left to right - Shubhendu Shekhar Khali, Anirban Ghosh, Dipanjan Chakraborty and Mayank Srivastava.

Postdocs: Dr. Yogyata Pathania.

Grants and Awards

Self-propulsive mechanisms of autonomous microswimmers, *DST-SERB grant*, India, 2014.

Max-Planck Fellow, *Max-Planck Institute for Intelligent Systems* , Stuttgart, 2012-2013.

Alexander von Humboldt Fellowship, *Institute for Theoretical Physics*, University of Leipzig, 2010-2012.

Outreach Activities

Dr. Chakraborty has participated in Teachers Training programme at IISER Mohali.

Abhishek Chaudhuri

Assistant Professor

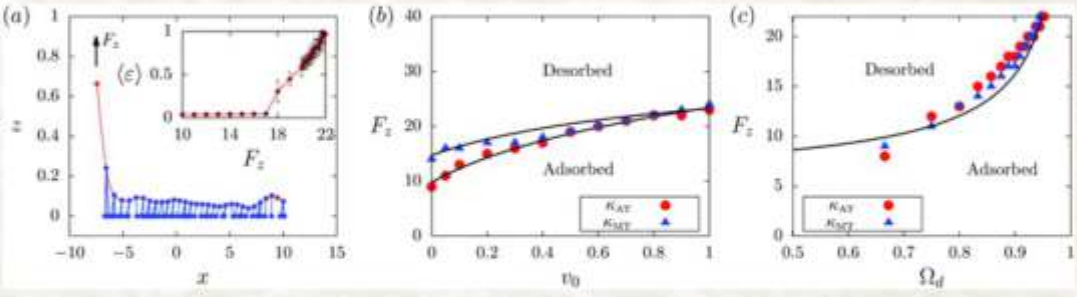
Academic Background

Dr. Abhishek Chaudhury obtained his PhD degree from S. N. Bose National Center for Basic Sciences, India in Soft Condensed Matter Physics in 2007. He has been a postdoc at University of Oxford and University of Sheffield, UK, Raman Research Institute and Indian Institute of Science, Bangalore, India between 2006-2012. He joined the institute as an Assistant Professor in September 2012.

Research Interests

The aim of our group is to understand the physical properties of biological and soft condensed matter systems that are driven out of equilibrium. We use both analytical approaches (Equilibrium and Non-equilibrium Statistical Mechanics, Hydrodynamics) and computational methods (Molecular Dynamics, Brownian Dynamics, Monte Carlo) to investigate the dynamics of systems ranging from the cell membrane and the cell cytoskeleton to polymers and colloids in confinement.

The cell is an active dynamical medium, constantly generating and dissipating energy to sustain the various life processes. It is subject to active stresses arising from a meshwork of filaments (cell cytoskeleton) and motor proteins driven out of equilibrium. We have developed a mesoscopic molecular dynamics scheme to study the emergent dynamics, and structure formation in a collection of cytoskeltal filaments and motor proteins. We use an active hydrodynamics approach for the coupled dynamics of these filaments and the motor proteins to determine the organization of molecules on the cell surface. The role of motor proteins and their collective transport properties are also being investigated. The central goal of our study is to provide new understanding on the mechanisms by which cytoskeletal network generate, transmit and respond to mechanical stresses in both in vitro and in vivo situations.



In soft condensed matter, our aim is to understand the emergent properties of colloids and polymers in confinement or otherwise, when they are subjected to time dependent external drives. Specifically,

we are interested in the problem of polymer translocation through a nanopore which is of fundamental importance in a lot of biological problems and also has technological implications.

Representative Publications

Forced desorption of semiflexible polymers, adsorbed and driven by molecular motors, *Abhishek Chaudhuri and Debasish Chaudhuri*, Soft Matter, 12, 2157, (2016).

Effect of catch bonding on transport of cellular cargo by dynein motors, *Anil Nair, Sameep Chandel, Mithun K. Mitra, Sudipto Muhuri, and Abhishek Chaudhuri*, Phys. Rev. E, 94, 032403, (2016).

Spatiotemporal regulation of chemical reactions by active cytoskeletal remodeling, *Abhishek Chaudhuria, Bhaswati Bhattacharya, Kripa Gowrishankar, Satyajit Mayor, and Madan Rao*, Proc. Natl. Acad. Sci., 108, 14825, (2011).

Stochastic Sensing of Polynucleotides Using Patterned Nanopores, *Jack A. Cohen, Abhishek Chaudhuri, and Ramin Golestanian*, Phys. Rev. X, 2, 021002, (2012).

Active Polymer Translocation through Flickering Pores, *Jack A. Cohen, Abhishek Chaudhuri, and Ramin Golestanian*, Phys. Rev. Lett., 107, 238102, (2011).

Research Group

The current reseacrch group comprises of three PhD students - Sameep Chandel, Nisha Gupta and Aman Kumar; and four BS-MS students - Arjit Kant Gupta, Harikrishnan P. S., Bharti Yadav and Shivam..

Grants and Awards

Co-recepient of IISER-Mohali Best Teacher Award 2015, for contributions in teaching.

DST-SERB project (DST-15-0084) on "Collective Dynamics Of Active Polymers: Implication For Cytoskeletal Structure And Dynamics" from 2015-2018.

Outreach Activities

Dr. Chaudhury has participated and delivered a lecture at DST INPIRE Science Camp on 26th January 2012 at HBN University Srinagar Garhwal. He has also Delivered a lecture at BBK DAV College for Women on 10th September 2016 and had a counselling session as part of an effort to inspire women towards research.

Kavita Dorai

Associate Professor

Academic Background

Kavita Dorai obtained her PhD from the Indian Institute of Science Bangalore in 2000. After stints as a postdoctoral fellow at the University of Frankfurt in Germany, University of Dortmund in Germany, and Carnegie-Mellon University in Pittsburgh USA, she joined the Department of Physics, IIT-Madras as a faculty member in 2005. She moved to IISER Mohali in August 2007, when the institute was established, and has set up the NMR Research Facility here.

Research Interests

Kavita Dorai is an experimental physicist whose research is poised at the interface of Physics & Biology. On-going research projects in her group include: NMR Quantum Computing, NMR Metabolomics, Diffusion NMR using Pulsed Field Gradients, NMR Spin Relaxation and NMR Methodology Development. Recent research from her group in NMR Quantum Computing encompasses the protection of fragile quantum states against decoherence, investigations of multi-qubit entanglement and quantum contextuality. Her group achieved the first experimental demonstration of the super-Zeno effect which can be used to freeze evolution of quantum states. Her group also demonstrated the first experimental exploitation of a single qutrit to achieve a computational speedup on an NMR quantum computer. Research in NMR metabolomics from her group uses one- and two-dimensional proton NMR experiments in conjunction with multivariate statistics to investigate the effect of stress on the metabolism of a wide range of organisms including plants, insects and humans.

Representative Publications

Experimental protection of unknown states in a two-qubit subspace by nested Uhrig dynamical decoupling, *Harpreet Singh, Arvind, Kavita Dorai*, Phys. Rev. A, 95, 052337, (2017).

Fast profiling of metabolite mixtures using chemometric analysis of a speeded-up 2D heteronuclear correlation NMR experiment, *Rakesh Sharma, Navdeep Gogna, Harpreet Singh, Kavita Dorai*, RSC Adv., 7, 29860, (2017).

Witnessing nonclassical correlations via a single-shot experiment on an ensemble of spins using NMR, *Amandeep Singh, Arvind, Kavita Dorai*, Phys. Rev. A, 95, 062318, (2017).

Experimentally freezing quantum discord in a dissipative environment using dynamical decoupling, *Harpreet Singh, Arvind, Kavita Dorai*, EPL , 118, 50001, (2017).

Entanglement detection on an NMR quantum information processor using random local measurements, *Amandeep Singh, Arvind, Kavita Dorai*, Phys. Rev. A, 94, 062309, (2016).

Maximum Likelihood Estimation for Constructing Valid Density Matrices on an NMR Quantum Information Processor, *Harpreet Singh, Arvind, Kavita Dorai*, Phys. Lett. A, 380, 3051, (2016).

NMR-based investigation of the *Drosophila melanogaster* metabolome under the influence of daily cycles of light and temperature, *Navdeep Gogna, Viveka Singh, Vasu Sheeba, Kavita Dorai*, Molecular BioSystems, 11, 3305, (2015).

Investigating correlations in the altered metabolic profiles of obese and diabetic subjects in a South Indian Asian population using an NMR-based metabolomic approach, *Navdeep Gogna, K. Murahari, Anup M. O., Kavita Dorai*, Molecular BioSystems, 11, 595, (2015).

Research Group

PhD Students: *Harpreet Singh, Amandeep Singh, Satnam Singh, Navdeep Gogna, Rakesh Sharma, Jyotsana Ojha, Sumit Mishra, Akshay Gaikwad, Dileep Singh.*
MS Students: *Guru Gaurav, Ankit, Aditya Mishra, Agrim Gupta.*
Alumni: *Dr. Begam Elavarasi, Dr. Amrita Kumari, Dr. Matsyendranath Shukla, Dr. Shruti Dogra.*

Grants and Awards

Investigations of protein-DNA G-quadruplex interactions using cross-correlated NMR spin relaxation and novel numerically optimized pulses, *PI: Kavita Dorai, Co-PI: Janez Plavec*, Joint Indo-Slovenia DST-ARRS Funded Project, 2015-2018.

Experimental investigation of quantum decoherence on an NMR quantum information processor, *PI: Kavita Dorai*, DST Funded Project, 2016-2019.

Outreach Activities

Dr. Dorai has delivered a number of lectures on interdisciplinary NMR, hands-on NMR and NMR quantum computing at several DST INSPIRE science camps and Ishaan Vikaas programmes. She has also developed a hands-on training module at IISER Mohali to train PhD and MS students to operate an NMR spectrometer on their own.

Sandeep K. Goyal

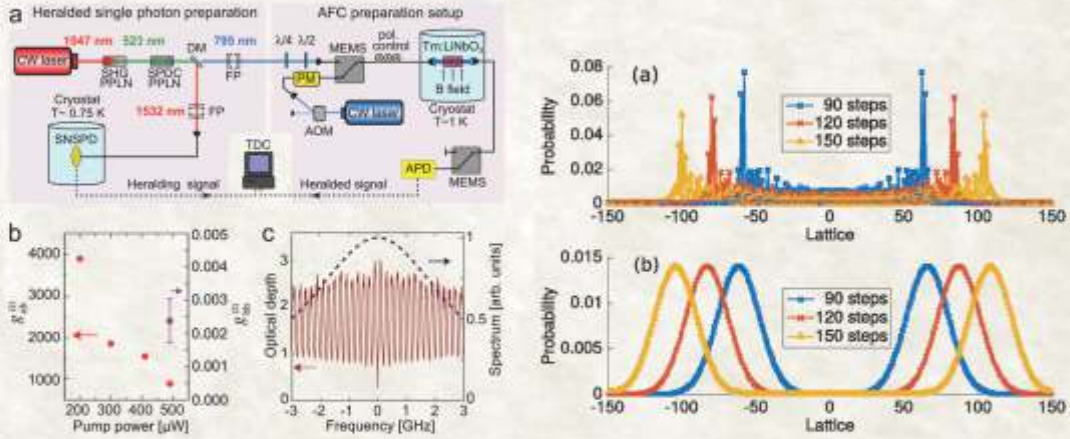
Assistant Professor

Academic Background

Dr. Sandeep Goyal did his integrate Ph.D from the Institute of Mathematical Sciences in Chennai (2005-2012). He worked as a postdoctoral fellow at the University of KwaZulu-Natal in Durban, South Africa from 2012 to 2014 and at the Institute for Quantum Science and Technology, University of Calgary, Canada from 2014 to 2016. He joined as an Assistant Professor at IISER Mohali in June 2016.

Research Interests

He is a theoretical physicist working in the field of open quantum systems, quantum information theory, quantum optics, condensed matter systems and mathematical physics. His research interests are directed toward understanding the possibilities and limitations of photonic quantum information processing and devising methods to control the effects of noise therein. The aim of his research is to realize scalable and universal quantum computing devices. He has developed various methods to perform quantum teleportation in the orbital angular momentum states of a single photon. He has devised implementation schemes to realize one- and multi-dimensional quantum walks using classical optical setup. Currently, he is working on simulating quantum algorithms such as Shor's algorithm using optical systems. He is also working on Quantum memories. He is interested in studying the effect of the thermal and phononic bath on the efficiency of the quantum memory which is realized in various systems.



Representative Publications

Entanglement between more than two hundred macroscopic atomic ensembles in a solid, *P. Zarkeshian, C. Deshmukh, N. Sinclair, S.K. Goyal, G.H. Aguilar, P. Lefebvre, M. Grimau Puigibert, V.B. Verma, F. Marsili, M.D. Shaw, S.W. Nam, K. Heshami, D. Oblak, W. Tittel, C. Simon*, Accepted in Nature Communications, (2017).

Decomposition of split-step quantum walks for simulating Majorana modes and edge states, *Wei-Wei Zhang, Sandeep K. Goyal, Christoph Simon, Barry C. Sanders*, Phys. Rev. A, 95, 052351, (2017).

Creating cat states in one-dimensional quantum walks using delocalized initial states, *Wei-Wei Zhang, Sandeep K. Goyal, Fei Gao, Barry C. Sanders, Christoph Simon*, New J. Phys., 18, 093025, (2016).

Implementation of Multidimensional Quantum Walks using Linear Optics and Classical Light, *Sandeep K. Goyal, Filippus S. Roux, Andrew Forbes, Thomas Konrad*, Phys. Rev. A, 92, 040302(R) (2015).

Implementing quantum walks using orbital angular momentum of classical light, *Sandeep K Goyal, Filippus S Roux, Andrew Forbes and Thomas Konrad*, Phys. Rev. Lett., 110 263602 (2013).

Research Group

Currently, four Ph.D (Vikash Mittal, Teja G.P., Andri Sharma, and Ankit Dhanuka) and Three M.Sc. students (Shilpa Muralidharan, Haritha A., and Ankit Pandey) are working with him.

(Back row L-R) : Ankit Dhanuka, Ankit Pandey
(Middle row L-R) : Teja G. P., Sandeep K. Goyal, Vikash Mittal
(Front row L-R) : Andri Sharma, Shilpa Muralidharan, Haritha A

Harvinder Jassal

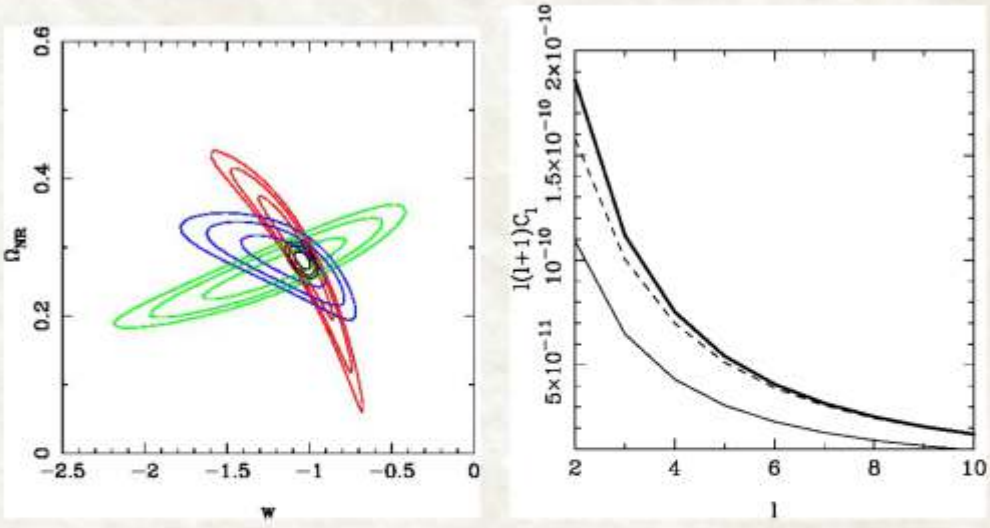
Assistant Professor

Academic Background

Harvinder did her undergraduate in Physics honours at S.G.T.B Khalsa college in Delhi University. She obtained her MSc. and PhD. from Department of Physics and astrophysics, University of Delhi. After postdoctoral research at HRI and IUCAA Pune, I joined as a DST fellow in HRI. She joined as Assistant Professor at IISER Mohali in March 2011.

Research Interests

Her primary research interest is Cosmology wherein she studies the early universe and the late time acceleration which is believed to be driven by dark energy. She works on theoretical and observational aspects of dark energy. Given a large number of dark energy models: and the relative lack of understanding, it becomes important to constrain and if possible, rule out various models using observations. She works on obtaining constraints on the cosmological parameters, especially dark energy equation of state. On the theoretical front, she investigates how dark energy perturbations affect the formation of structures in the universe. The main focus is to see whether the dark energy perturbations enhance or suppress dark matter perturbations and how the effect can be measured observationally.



Representative Publications

Scalar field dark energy perturbations and the Integrated Sachs Wolfe effect, *H. K. Jassal*, JCAP, 1706, (2017).

Scalar field dark energy perturbations and the Integrated Sachs Wolfe effect, *H. K. Jassal*, Phys. Rev. D86, 043528, (2012).

A comparison of perturbations in fluid and scalar field models of dark energy, *H. K. Jassal*, Phys. Rev. D79, 127301, (2009).

Understanding the origin of CMB constraints on Dark Energy, *Mon. Not. Roy. Astron. Soc.*, H. K. Jassal, J. S. Bagla, T. Padmanabhan, 405, 2639 (2010).

Cosmology with tachyon field as dark energy, *J. S. Bagla, H. K. Jassal, T. Padmanabhan*, Phys. Rev. D67, 063504, (2003).

Stabilization of branes in a cosmological setting, *H. K. Jassal*, e-Print: hep-th/0312253.

Research Group

Dr. Ankan Mukherjee, Post Doctoral Fellow, works on scalar field models of dark energy and alternative theories of gravity. Ms. Archana Sangwan, PhD student, works on cosmological parameter constraints from observations. Mr. Avinash Singh, PhD student, studies perturbations in dark energy, for fluid dark energy, canonical and non canonical scalar field dark energy models. Mr. Ranbir Sharma worls on reconstructing equation of state parameter of dark energy via Principal COmponent Analysis..

Grants and Awards

Project titled: Cosmological parameters: Observational aspects and theoretical issues, funded by DST.

Outreach Activities

She has been resource person in Astronomy Olympiad training schools and she was a part of the team in the Olympiad held at Romania, 2014. She was on the academic committee of Astronomy Olympiad held in Bhubaneswar in December 2016..

Satyajit Jena

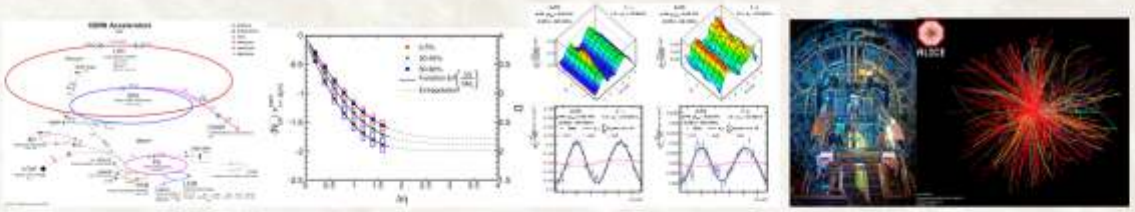
Assistant Professor

Academic Background

Dr. S. Jena is an experimental physicist in high energy nuclear and particle physics. He has completed his PhD from IIT Bombay, Mumbai in 2013. He worked as postdoctoral fellow at University of Houston, Texas & CERN Geneva from 2013 to 2016 in ALICE collaboration at Large Hadron Collider (LHC), CERN. He joined IISER Mohali in 2016.

Research Interests

The research interests of Dr. Jena span the areas in experimental high energy nuclear and particle physics. In particular, he is working in the search and precision measurement of the various predictions of Quantum Chromodynamics (QCD) and Lattice QCDs, as well as experimental verification of neutrino physics. In general, the high-energy physics is the study of the fundamental constituents of matter and the forces that act upon them. This information is one of the basic pillars for our understanding of nature and the origin of the universe. He has been participating in Indian High Energy Physics community's exceptionally diverse physics programs both as a member of the Indian based neutrino Observatory (INO) and as A Large Ion Collider Experiment (ALICE) collaboration for past eight years.



QGP Physics: Dr. Jena's research focuses in the study of the phase transition from hadronic matter to quark-gluon plasma in heavy ion collisions and to the experimental investigation of soft non perturbative QCD in high-energy collisions in large accelerator like LHC. Among several type of collisions in collider, the heavy-ion collisions are considered since a long time as a mean to create and study QGP, which is a deconfined state of matter where quarks and gluons are not bound into nucleons. The measurements of the signatures of QGP provide precision tests of the predictions of Quantum Chromodynamic (QCD) & Lattice QCD and are sensitive to the presence of new physics. It entails almost all experimental aspects of heavy ion physics and aims to connect them in the best possible way to the fundamental interaction, which is described by the theory of QCD.

Neutrino physics at INO Collaboration: The INO project is a multi-institutional effort in India to study neutrinos. The 50000 tons of magnetized iron calorimeter (ICAL) detector in INO is going to address long-standing problems in neutrino physics such as the determination of masses and mixing parameter of neutrinos. The main experimental aim is to build a world-class underground laboratory with a rock cover of approx. 1200m for non-accelerator based high energy and nuclear physics research in India. Dr. Jena has been involved in the study of neutrinos and detector R&D activities in INO collaboration.

Instrumentation and R&D: Dr. Jena is actively participating various detector R&D programs at the technological frontier for current and future particle physics experiments via national/international mega-science programs. His main contributions are in the development of gas-ionising detectirs like RPC, PMD, MWPC and silicon detectors. These technological developments have numerous applications over wide range of disciplines starting from physical sciences, nuclear physics experiments, radiation physics, accelerator driven research to medical imaging and applications.

Selected Publications

Enhanced production of multi-strange hadrons in high-multiplicity proton-proton collisions, Nature Phys., 13 (2017), 535-539.

Production of muons from heavy-flavour hadron decays in p-Pb collisions at $\sqrt{s_{\rm NN}} = 5.02$ TeV, Phys. Lett. B., 770 (2016), 459-472.

Inclusive photon production at forward rapidities in proton-proton collisions at 0.9, 2.76 and 7 TeV, Eur. Phys. J. C, 75, 4, 146 (2015).

Precision measurement of the mass difference between light nuclei and anti-nuclei, Nature Phys., 11 (2015) no.10, 811-814.

Net-charge fluctuations in Pb-Pb collisions at center of mass energy 2.76 TeV, *(Thesis Work)*, Phys. Rev. Lett., 110, 152301 (2013).

Test and characterization of a prototype silicon-tungsten electromagnetic calorimeter, Nucl.Instrum.Meth, A764 (2014) 24-29.

Development of glass resistive plate chambers for INO experiment, Nucl. Instr.and Meth. A, 602 (2009) 744748.

Research Group

Ph.D. Students: Rohit Gupta, Nishat Fiza, Anjali Krishnan, Kartik Joshi; BSMS & MSc: Anjaly Menan, Akhil Bharadwaj, Ashish Moharana, Subham Dillip Verma, Shahina Ali, Neeraj Maan, Tasha Gautam

Ramandeep S. Johal

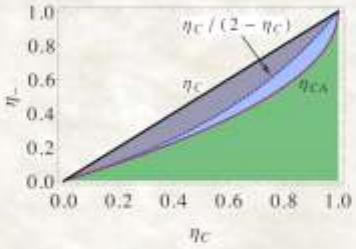
Associate Professor

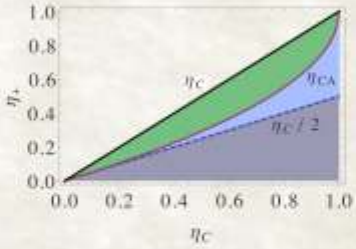
Academic Background

Dr. Ramandeep Johal did his M.Sc. (Honours School) from Guru Nanak Dev University, Amritsar, and Ph.D in 1999, from Panjab University, on the topic of q-deformed algebras and their applications in nuclear and molecular physics. He was post-doctoral fellow of Alexander von Humboldt Foundation, at Institute of Theoretical Physics, Technical University Dresden, Germany. He did his second post-doctoral term at University of Barcelona, Spain. He joined IISER Mohali in 2008.

Research Interests

I am a theoretical physicist with experience in different areas of physics such as mathematical physics, statistical physics, thermodynamics and quantum theory. At present, I am interested in the concept of information in physics, non-equilibrium and finite-time thermodynamics and optimal performance characteristics of realistic thermal machines. In our group at IISER Mohali, we have explored aspects at the interface of thermodynamics and quantum theory, by investigating the concept of non-equilibrium temperature, the use of prior information for making inductive inference, quantum friction, and characterization of heat and work in quantum heat cycles, level-degeneracy as thermodynamic resource, a few of the topics encompassed by the field of quantum thermodynamics. A related goal is to understand the interplay of subjective/objective information in the formulation and interpretation of physical theories. Further, interesting analogies have been elucidated between quasi-static models of work extraction and time-dependent power generation models. Recently, new results have been obtained connecting performance of thermal machines with the properties of algebraic means. These results also contribute to pedagogy in thermodynamics.





a) Maxwell's demon: a paradigmatic model showing extraction of work from the use of information. b)& c) Obtaining engine efficiencies observed in finite-time models, using quasi-static processes (From Ref. [1]). Here η_C is Carnot efficiency and $\eta_{CA} = 1 - \sqrt{1 - \eta_C}$ is referred to as Curzon-Ahlborn efficiency.

Representative Publications

Quantum Otto engine with exchange coupling in the presence of level degeneracy, *V. Mehta and R. S. Johal*, Phys. Rev. E, in press (2017).

Heat engines at optimal power: Low-dissipation versus endoreversible model, *R. S. Johal*, Phys. Rev. E, 96, (2017) 012151.

Optimal performance of heat engines with a finite source or sink and inequalities between means , *R. S. Johal* , Phys. Rev. E, 94, (2016) 012123.

Near-equilibrium universality and bounds on efficiency in quasi-static regime with finite source and sink, *R. S. Johal, R. Rai*, Europhys. Lett., 113 (2016) 10006.

Estimating performance of Feynman's ratchet with limited information, *G. Thomas and R. S. Johal*, J. Phys. A: Math. Theor., 48 (2015) 335002.

Reversible Heat Engines: Bounds on thermal efficiency from inference, *R. S. Johal, R. Rai, and G. Mahler*, Found. Phys., 45 (2015) 158.

Friction due to inhomogeneous driving of coupled spins in a quantum heat engine, *G. Thomas and R. S. Johal*, Eur. Phys. J. B, 87 (2014) 166.

Work extremum principle: Structure and function of quantum heat engines, *A. E. Allahverdyan, R. S. Johal and G. Mahler*, Phys. Rev. E, 77 (2008) 041118.

Research Group

At present, two Phd students are working with me: Venu Mehta and Varinder Singh. The past members of the group include Dr. George Thomas (post-doc at IMSc, Chennai) and Dr. Preety (Assistant Professor at DAV College, Jalandhar).

Rajeev Kapri

Assistant Professor

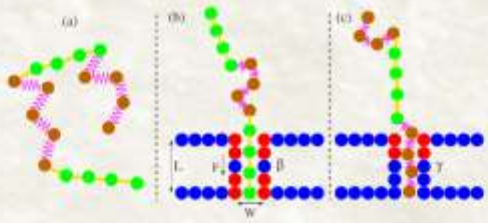
Academic Background

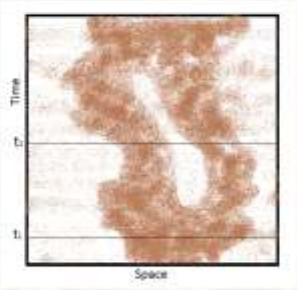
Dr. Rajeev Kapri was a doctoral scholar at Institute of Physics (IOP) Bhubaneswar and obtained his Ph.D. in Physics from Homi Bhabha National Institute (HBNI) Mumbai, India. Before joining the institute in 2009, he was a visiting fellow at Department of Theoretical Physics, Tata Institute of Fundamental Research (TIFR) Mumbai.

Research Interests

His broad research interests are in Statistical Mechanics, Soft-condensed Matter and Biological Physics. He studies coarse grained models using tools of statistical physics like generating functions, exact transfer matrix, Brownian dynamics and Monte Carlo simulations. Presently, he is working on following problems:

Polymer translocation through a narrow pore: The aim is to study the translocation of semiflexible polymer through narrow pores having both cylindrical and conical shapes. A polymer having alternate flexible and rigid segments when translocated through pores with different patterned stickiness is found to be sequenced with high accuracy from the translocation time statistics. His group is also studying the flow driven translocation by using multiparticle collision dynamics (MPCD), which is a particle based mesoscale simulation technique that fully incorporates thermal fluctuations and hydrodynamic interactions for the complex fluid.





Fluctuation dominated phase ordering: The aim is to study the characterization of order in a passive scalar system, in which a passive species is driven by an autonomously evolving field, e.g., particles driven by a fluctuating surface. In this system fluctuations are anomalously strong, but it has a propensity to order, leading to fluctuation-dominated phase ordering (FDPO). A single macroscopic ordered region (time t_1) breaks relatively easily into a larger number of such regions (time t_2). As a result, multi-cluster states occur for a finite fraction of the time. For such systems a single scalar order parameter does not suffice to properly characterize the order and one needs to monitor a larger set. This set is built from the long-wavelength Fourier components of the

density profile, which are able to capture the continuous break-up and re-merging of macroscopic particle-rich regions.

Dynamic transitions in DNA: The aim is to study the unzipping of a double stranded DNA whose ends are subjected to a time dependent periodic force. It was found that the DNA can be taken *dynamically* from the zipped to an unzipped phase (or vice versa) either by changing the frequency of the force at fixed amplitude, or by changing the amplitude of the force at fixed frequency. In both cases a hysteresis is observed. The goal is to find similarities and/or differences from the magnetic systems where the dynamic transitions are studied in great detail.

Representative Publications

Order-parameter scaling in fluctuation-dominated phase ordering, *Rajeev Kapri, Malay Bandyopadhyay, and Mustansir Barma*, Phys. Rev. E, **93**, 012117 (2016).

Unzipping DNA by a periodic force: Hysteresis loop area and its scaling, *Rajeev Kapri*, Phys. Rev. E, **90**, 062719 (2014).

Hysteresis and nonequilibrium work theorem for DNA unzipping, *Rajeev Kapri*, Phys. Rev. E, **86**, 041906 (2012).

Can a double stranded DNA be unzipped by pulling a single strand ?: Phases of Adsorbed DNA, *Rajeev Kapri*, J. Chem. Phys., **130**, 145105 (2009).

Randomly Forced DNA, *Rajeev Kapri and S. M. Bhattacharjee*, Phys. Rev. Lett., **98**, 098101 (2007).

Complete Phase Diagram of DNA Unzipping : Eye, Y-Fork and Triple point, *Rajeev Kapri, S. M. Bhattacharjee and F. Seno*, Phys. Rev. Lett., **93**, 248102 (2004).

Research Group

At present his research group has one post-doctoral fellow, one doctoral scholar, and one undergraduate student.

Grants and Awards

Fast-track scheme of DST India during 2011-2014 for project entitled "Exploring polymer-surface interactions via forcing of the polymer".

Best PhD Thesis Award at 53rd DAE Solid State Physics Symposium, 2008.

Outreach Activities

Whenever he gets an opportunity, he gives talks in DST Inspire Science Camps organized for school students and refresher courses conducted for school and/or collage teachers.

Sanjeev Kumar

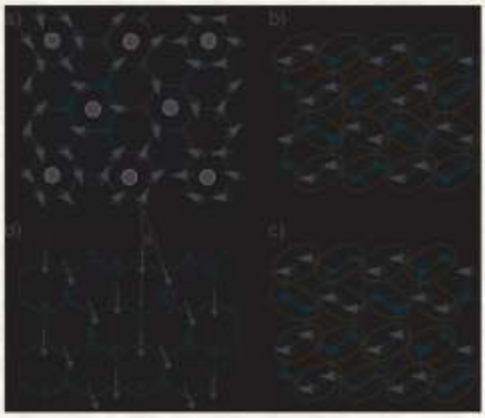
Associate Professor

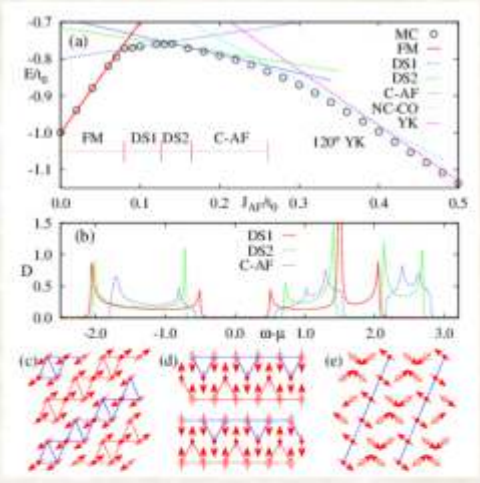
Academic Background

Dr. Sanjeev Kumar completed his undergraduate studies from DAV College, Kangra in 1996. He obtained MSc from IIT Kanpur (1996-1998), and PhD from Harish-Chandra Research Institute, Allahabad (1998-2004). He was a post-doctoral fellow at the University of Augsburg in Germany (2004-2007), Leiden University in The Netherlands (2007-2009), and IFW Dresden in Germany (2009-2010), before joining IISER Mohali in 2010.

Research Interests

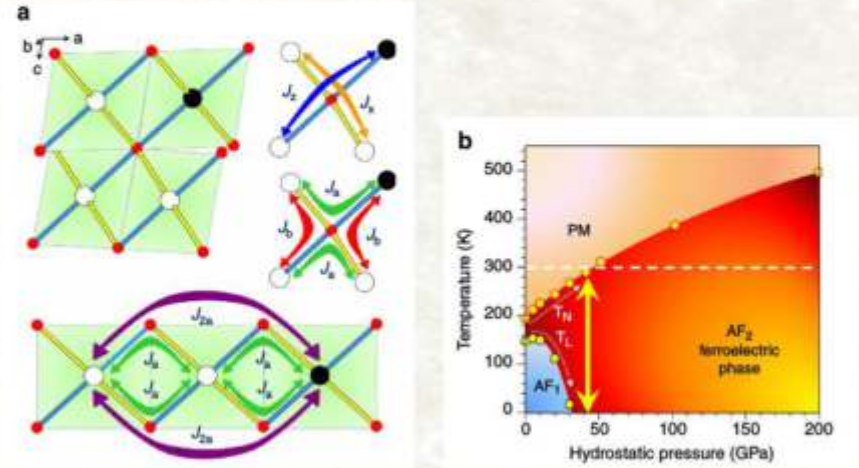
Dr. Kumar is interested in the study of correlated and disordered quantum systems using a combination of theoretical and computations methods. The specific topics of current interest are, frustrated itinerant magnetism, multiferroics, disordered superconductors, and the spin-orbit coupled systems. The central research theme is the search for unconventional ordering of charge, spin and orbital degrees of freedom in material-specific microscopic model Hamiltonians, and their consequences for macroscopic physical properties of the relevant materials.





Frustrated itinerant magnets: In recent studies we have shown that the competition between ferromagnetic double-exchange and antiferromagnetic superexchange on geometrically frustrated lattices stabilizes exotic magnetic order. For example, on a 2D checkerboard lattice we find that magnetic moments organize in a way that introduces fictitious magnetic fields for the electrons and leads to a graphene-like electronic dispersion. We show that a realization of the famous Haldane state in graphene is realized in this system with electrons coupled to localized magnetic moments.

Disordered superconductors: We have been trying to understand the effect of disorder on superconductivity using Bogoliubov-deGennes approach. In a recent work we have highlighted the difference between potential and kinetic disorder in terms of how they suppress s-wave superconductivity.



Pressure driven high-Tc multiferroicty in CuO: In a recent work, we predict that cupric oxide (CuO) under pressure can be a room-temperature multiferroic with strong coupling between magnetic and electric order parameters. The ferroelectricity in this material is driven by spin-spiral states. Our calculations predict that under pressure, this material will show room-temperature ferroelectric and magnetic order with strong coupling between the two order parameters.

Recent Publications

Noncollinear and noncoplanar magnetic order in the extended Hubbard model on anisotropic triangular lattice, *Kanika Pasrija, Sanjeev Kumar*, Phys. Rev. B, 93, 195110, (2016).

Electronic route to stabilize nanoscale spin textures in itinerant frustrated magnets, *S. Reja, J. v. d. Brink, S. Kumar*, Phys. Rev. B, 93, 155115, (2016).

Coupled spin charge order in frustrated itinerant triangular magnets, *S. Reja, R. Ray, J. v. d. Brink, S. Kumar*, Phys. Rev. B, 91, 140403(R) (2015).

High temperature non-collinear magnetism in a bilinear-biquadratic Heisenberg model, *K. Pasrija, S. Kumar*, Phys. Rev. B, 88, 043813 (2013).

Room-temperature spin-spiral multiferroicity in high-pressure cupric oxide, *X. Rocquefelte, K. Schwarz, P. Blaha, S. Kumar, J. v. d. Brink*, Nat. Comm., 4, 2511 (2013).

Research Group

The Research group, at present, consists of five PhD students and two MS thesis students.

Grants and Awards

Ramanujan Fellowship (2011-2016).

Ketan Patel

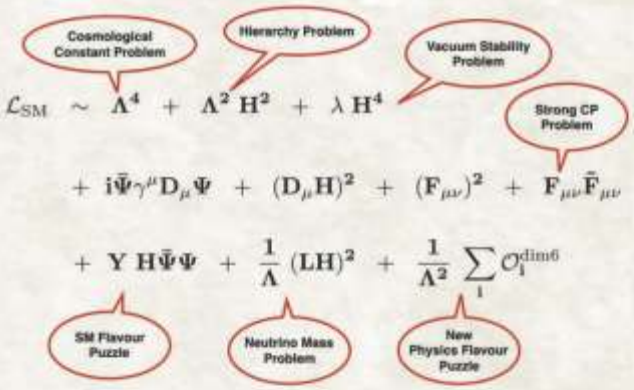
Assistant Professor

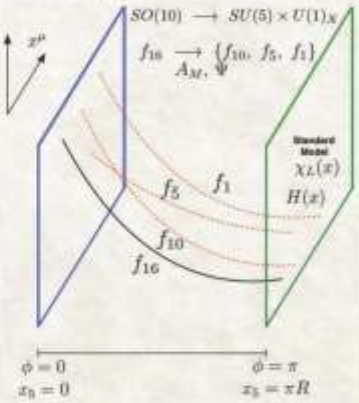
Academic Background

Ketan did his Ph.D at the Physical Research Laboratory, Ahmedabad (2012). Thereafter he held postdoctoral positions at the Tata Institute of Fundamental Research, Mumbai (2012-2013) and at the Istituto Nazionale di Fisica Nucleare (INFN), Padua in Italy as an INFN Postdoctoral Fellow (2013-2015). He joined IISER Mohali in November 2015.

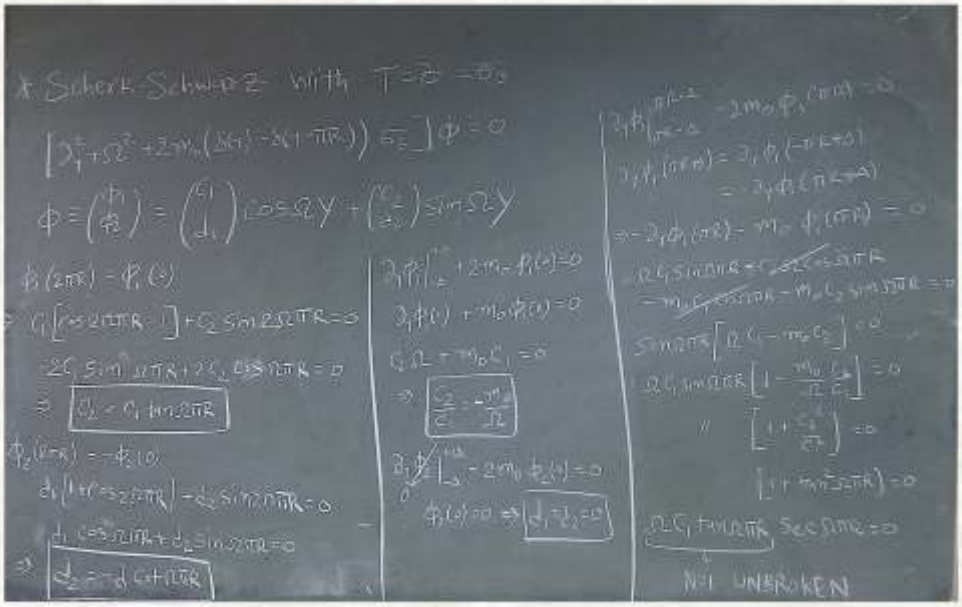
Research Interests

Ketan works in the areas of theoretical High Energy Physics with keen interests in the phenomenology of Beyond Standard Model (BSM) physics. His research has been primarily focused in understanding an origin of masses and mixing of fundamental fermions in the theories based on supersymmetry, extra dimension(s), extended gauge and/or flavour symmetries. Some of the specific areas in which he has made contributions are: understanding an interplay of grand unification and flavour symmetries, exploring some novel consequences of finite discrete flavour symmetries on neutrino mass hierarchy and mixing pattern, studying the signatures of supersymmetric unification in the direct and indirect search experiments and exploring the phenomenology of models with extra scalars.





He is currently carrying out research in the areas of gauge and supersymmetry breaking through compactification of extra spatial dimensions and alternative mechanisms to address the gauge hierarchy problem. In the coming years, his major focus will be on understanding and interpreting the new results from the LHC and other ongoing experiments in the context of various BSM theories and to address the fermion mass puzzle in the new theories based on naturalness.



Recent Publications

Discrete symmetries for electroweak natural type-I seesaw mechanism, *Pratik Chattopadhyay, Ketan M. Patel*, Nucl. Phys. B921 (2017) 487-506.

Indirect Searches of the Degenerate MSSM, *Debtosh Chowdhury, Ketan M. Patel, Xerxes Tata, Sudhir K. Vempati*, Phys. Rev. D95 (2017) 075025.

Residual Z_2 symmetries and leptonic mixing patterns from finite discrete subgroups of $U(3)$, *Anjan S. Joshipura, Ketan M. Patel*, JHEP 1701 (2017) 134.

Interpreting 750 GeV diphoton excess in SU(5) grand unified theory, *Ketan M. Patel, Pankaj Sharma*, Phys. Lett. B757 (2016) 282-288.

Generalized μ-τ symmetry and discrete subgroups of O(3), *Anjan S. Joshipura, Ketan M. Patel*, Phys. Lett. B749 (2015) 159-166.

A realistic pattern of fermion masses from a five-dimensional SO(10) model, *Ferruccio Feruglio, Ketan M. Patel, Denise Vicino*, JHEP 1509 (2015) 040.

Limiting two-Higgs-doublet models, *Alessandro Broggio, Eung Jin Chun, Massimo Passera, Ketan M. Patel, Sudhir K. Vempati*, JHEP 1411 (2014) 058.

Research Group

Ph.D Student: Vishnu PK. Vishnu is currently working on Renormalization Group Evolution in theories with Split-Supersymmetry and High Scale Supersymmetry.

Grants and Awards

Early Career Research Award, SERB, Govt. of India, (2017 - 2020).

INSPIRE Faculty Award, DST, Govt. of India, (2015 - 2020).

INFN Fellowship, Istituto Nazionale di Fisica Nucleare, Italy, (2013 - 2015).

Kamal P. Singh

Associate Professor

Academic Background

Dr. Kamal P. Singh completed his PhD from University of Rennes 1, France in Laser Physics. He has done two postdocs at Max Planck Institute Dresden and JRM Lab. Kansas State University, USA. He joined the institute in 2009.

Research Interests

Dr. Singh has setup a Femtosecond Laser Laboratory and is currently working in broad area of Atomic Molecular and Optical Physics. His research interest span developing novel optical techniques for precision peasurements, measurements of photons momentum in fluids. He has also interest in bio-materials such as spider silk and transparent insect wings. He has developed several techniques and original setups exploiting role of fs pulses to process bio-materials. He has interest in developing shortest possible attosecond burst of light at XUV frequencies.

Shedding light on changing properties of photons

KAMAL SINGH AND GOPAL VERMA

FROM THE LAB

A WEEKLY UPDATE FROM INDIA'S FINEST RESEARCH INSTITUTES

THE RESEARCH

Finding out whether the momentum of light photons increases or decreases when it enters another medium like water or glass

The Indian EXPRESS

Representative Publications

Vectorial detection of ultra-low curvature by laser beam profile, *Gopal Verma and Kamal P. Singh*, Appl. Phys. Lett., 107, 164101 (2015).

Universal long-range nanometric bending of water by light, *Ish Dhand, Sandeep K. Goyal*, Phys. Rev. Lett., 115, 143902 (2015).

Optical probing of long range correlations and symmetry in transparent insect wings, *P. Kumar, D. Shamoon, D. P. Singh, S. Mandal, K. P. Singh*, Laser Physics Letters, 12, 025901 (2015).

Fatigueless response of spider draglines facilitated by reversible molecular deformation, *B. Kumar and Kamal P. Singh*, Appl. Phys. Lett., 105, 213704 (2014).

Time-resolved interference unveils nanoscale surface dynamics in evaporating sessile droplet, *G. Verma and Kamal P. Singh*, Appl. Phys. Lett., 104, 244106 (2014).

Microscopic modulation of mechanical properties of transparent insect wings, *A. Pradhan, P. Kumar, J. Bhagwati, K. P. Singh and G. Sheet*, Appl. Phys. Lett., 104, 063702 (2014).

Optically Probing Torsional Superelasticity in spider silk, *B. Kumar, A. Thakur, B. Panda and Kamal P. Singh*, Appl. Phys. Lett., 103, 201910 (2013).

Comment on: Low Power Laser Deformation of Air-Liquid Interface , *opal Verma, James Nair, Kamal P. Singh*, Phys. Rev. Lett., 110, 079401 (2013).

Media Coverage

His research has been covered in The Hindu, Nature India, The Indian Express and Laser Focus World.

Research Group

Currently, his research group has three PhD students, one postdoc and five MS students.

Grants and Awards

He was a Ramanujan Fellow of DST, he has received Max Planck-DST Visiting Fellowship. Recently, he has been awarded the prestigeous Max-Planck DST partners group.

Mandip Singh

Assistant Professor

Academic Background and Research Interests

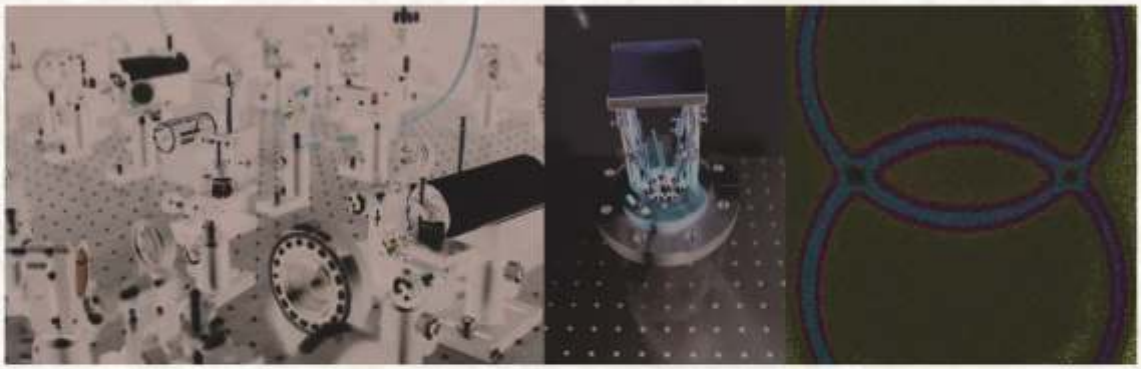
Dr. Mandip Singh is a quantum physicist. He is doing research on the foundations of quantum physics, quantum optics and Bose-Einstein condensation. He has produced original ideas of new quantum systems to realise quantum entanglement at a macroscopic scale. His research interests are quantum physics, quantum optics, Bose-Einstein condensation, hybrid quantum systems and physics education. He did his Post Doc at the institute for quantum optics and quantum information (IQOQI) in the group of Prof. Anton Zeilinger, University of Vienna, Austria. He has obtained a PhD in 2008 from Swinburne University of Technology, Melbourne, Australia.

Research at IISER

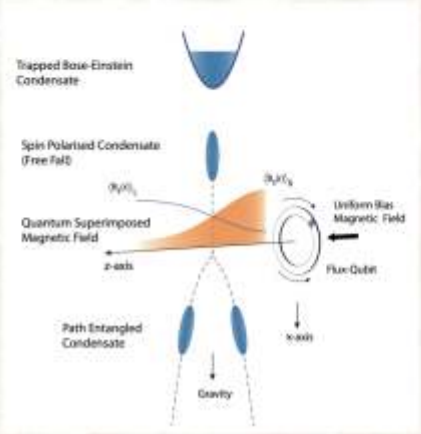
At IISER Mohali, Dr. Mandip Singh has established a laser cooling and Bose-Einstein condensation laboratory. The laser cooling experiment on an atom chip in this lab is the first experiment in India. Atom chip for this experiment is completely designed and developed in India (IISER Mohali). In addition, quantum optics experiments on photon entanglement are started at IISER Mohali. Two photon entanglement has been realised and a violation of CSHS inequality has been verified.

Dr. Mandip Singh has conceptualised new quantum systems which can be of interest to realise a quantum entanglement at a macroscopic level [1]. One of the main advantages of these proposed quantum systems is that the coupling between quantum variables is natural and it can be increased by increasing an external magnetic field which can be controlled independently. Dr. Mandip Singh has also conceptualised a quantum Stern-Gerlach experiment where the magnetic field is considered in a quantum superimposition state [2]. In this thought experiment, a spin polarised Bose-Einstein condensate is interacted with the quantum superimposed magnetic field of a flux-qubit. As a consequence, the magnetic flux and the path of a Bose-Einstein condensate become quantum entangled with each other. Such an entangled quantum state (Schrodinger's cat quantum state) corresponds to macroscopically observable quantities. A Bose-Einstein condensation can be prepared in a path entangled quantum state if it is disentangled from the quantum state of the flux-qubit.

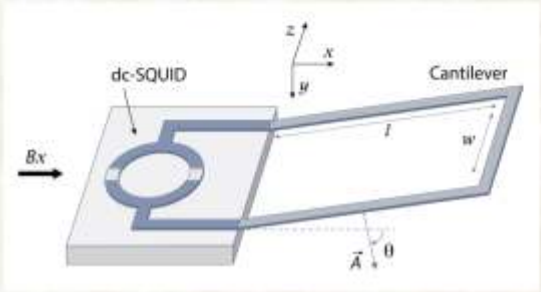
In addition, Dr. Mandip Singh has conceptualised new ideas and developed experiments for physics education.



Laser Cooling Lab.



Quantum-SG thought experiment.



Schematic of Flux-Qubit-Cantilever.

Recent Publications

1. **Macroscopic quantum oscillator based on a flux qubit**, *Mandip Singh*, Phys. Letts. A, 379, 2001-2006, (2015.).
2. **Quantum Stern-Gerlach experiment and path entanglement of a Bose Einstein condensate**, *Mandip Singh*, Phys. Rev. A. 95, 043620, (2017).

Research Group

PhD student (Samridhi Gambhir) is doing her research on quantum optics experiments. One MS project student is working for her MS thesis. In addition to major MS project students, many summer project students have been supervised on different theory projects. .

Awards

Best teacher award (2016) from IISER Mohali.

Outreach Activities

Delivered talks and developed experiments for students and other outreach activities organised by IISER Mohali..

Yogesh Singh

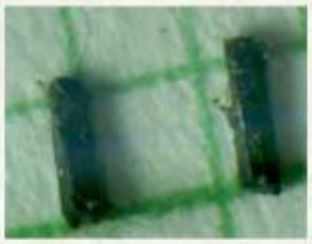
Assistant Professor

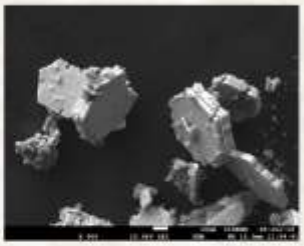
Academic Background

Dr. Yogesh Singh did his B.Sc.(honors) in Physics from the Aligarh Muslim University (1993 – 1996). He obtained his M.Sc. from IIT Kanpur (1996 – 1998), and PhD. from the Tata Institute for Fundamental Research, Mumbai (1998 – 2004). Dr. Yogesh was a postdoctoral research associate at the Ames National Lab, Iowa, USA from 2005 to 2009 and a Humboldt postdoctoral fellow at the 1^{st} Physik Institut, University of Goettingen, Germany from 2009 to 2011. He joined as an Assistant Professor at IISER Mohali in February 2011.

Research Interests

Dr. Yogesh's group is working in the field of experimental condensed matter physics. His research involves the discovery, synthesis, and single crystal growth of new and/or improved strongly correlated materials with potentially novel electronic, magnetic and thermal properties. The current research topics being pursued in his group are : (i) Study of the Spin-Liquid state in geometrically frustrated quantum magnets $Na_4Ir_3O_8$ and $Ca_{10}Cr_7O_{28}$, (ii) Single crystal growth and study of magnetism in the Kitaev-Heisenberg candidate materials A_2TO_3, (iii) Search for exotic quantum magnetism near the metal-insulator transition in doped Si, (iv) Magneto-transport and thermal transport study across a Topological quantum critical point in $Bi_{1-x}Sb_x$, and (v) Interplay between charge density waves and superconductivity in certain transition metal compounds.





(i) a section from the crystal lattice of the "Spin Liquid" Calcium-Chromium Oxide showing how the spins are subject to conflicting demands. In this ball-and-stick model, the green and red sticks connecting the atoms (grey and black balls) represent ferromagnetic interactions while the blue sticks represent anti-ferromagnetic interactions, (ii) Single crystals of the low-dimensional magnet Na_2RuO_4, (iii) Hexagonal crystals of Li_2RuO_3.

Recent Publications

Physical realization of a quantum spin liquid based on a complex frustration mechanism, *C. Balz et. al.*, Nature Phys., (2016).

First-order density-wave-like transitions in surface-doped Na_2IrO_3, *Kavita Mehlawat and Yogesh Singh*, Phys. Rev. B, 94, 041109(R) (2016).

The H-T and P-T Phase Diagram of the Superconducting Phase in Pd:Bi_2Te_3, *Amit Vashist and Yogesh Singh*, J. Supercond. and Novel Magn., 29, 1975 (2016).

Raman signatures of strong Kitaev exchange correlations in $(Na_{1-x}Li_x)_2IrO_3$: Experiments and theory, *S. N. Gupta, PV Sriluckshmy, Kavita Mehlawat, Ashwini Balodhi, DK Mishra, S. R. Hasan, Yogesh Singh, T. V. Ramakrishnan, A. K. Sood*, Euro Phys. Lett., 114, 47004 (2016).

Fragile magnetic order in the honeycomb lattice Iridate Na_2IrO_3 revealed by magnetic impurity doping, *Kavita Mehlawat, G Sharma, and Yogesh Singh*, Phys. Rev. B, 92, 134412 (2015).

Evolution of magnetic, transport, and thermal properties in $Na_{4-x}Ir_3O_8$, *Ashwini Balodhi, A Thamizhavel, and Yogesh Singh*, Phys. Rev. B, 92, 224409 (2015).

Spin dynamics in $Na_{4-x}Ir_3O_8$ (x = 0.3 and 0.7) investigated by ^{23}Na NMR and μSR, *S. Yoon, SH Baek, Ashiwini Balodhi, WJ Lee, KY Choi, I Watanabe, JS Lord, B Buechner, BJ Suh, and Yogesh Singh*, J. of Phys.: Cond. Matt., 27, 485603 (2015).

Direct Evidence for Dominant Bond-directional Interactions in a Honeycomb Lattice Iridate Na_2IrO_3, *S. H. Chun et al.*, Nature Phys., 11, 3322 (2015).

Research Group

The group currently has 5 graduate students : Ashiwini Balodhi, Kavita Mehlawat, Jaskaran Singh, Anzar Ali, and Amit Vashist and 1 project assistant Kavita Chaudhary.

Grants and Awards

DST Ramanujan Fellow (2011 – 2016).

SERB grant : Rs. 27 lakhs (2014 – 2017).

Outreach Activities

Dr. Yogesh has participated in KVPY camps several times in the past. In 2015 his lab hosted a team of 9 students and their science teacher from a school in Bihar under the "Child Scientist" program of the DST. He has also been in charge of the physics demo's during the open house on science day in 2014.

Sudeshna Sinha

Professor

Academic Background

Prof. Sudeshna Sinha did her Integrated Masters from IIT Kanpur, and went on to do a PhD from the Tata Institute of Fundamental Research, Mumbai. After that she worked as a visiting scientist at the International Centre for Theoretical Physics, Trieste. She has held faculty positions in the Indian Institute of Astrophysics, Bangalore (1994-1996) and the Institute of Mathematical Sciences, Chennai (1996-2011), before joining IISER Mohali as a Professor in 2010.

Research Interests

Sudeshna Sinha's research focusses on nonlinear dynamics, complex systems and networks, and is interdisciplinary in nature. In particular her research interests include control and synchronization of chaotic systems, collective behaviour of dynamical networks and the role of connection topology on the emergent spatiotemporal patterns. In a different direction, Sudeshna's work has also explored dynamics-based computing paradigms and probed the interplay of noise and nonlinearity to construct reliable logic elements.

Representative Publications

Emergence of Persistent Infection due to Heterogeneity, *V. Agrawal, P. Moitra and Sudeshna Sinha*, Scientific Reports (Nature), 7, 41582, (2017).

Are network properties consistent indicators of synchronization?, *P.D. Rungta, A. Choudhary, C. Meena and Sudeshna Sinha*, Europhysics Letters, 117, 20003, (2017).

Taming Explosive Growth through Dynamic Random Links, *A. Choudhary, V. Kohar and Sudeshna Sinha*, Scientific Reports (Nature), 4, 4308, (2014).

Noise-free logical stochastic resonance, *A. Gupta, A. Sohane, V. Kohar, K. Murali and Sudeshna Sinha*, Physical Review E (Rapid Communication), 84, 055201, (2011).

Synthetic gene networks as potential flexible parallel logic gates, *H. Ando, Sudeshna Sinha, R. Storni and K. Aihara, Europhysics Letters, 93, 50001, (2011).*

A Noise-Assisted Reprogrammable Nanomechanical Logic Gate, *D. N. Guerra, A. R. Bulsara, W. L. Ditto, Sudeshna Sinha, K. Murali and P. Mohanty*, Nano Letters, 10, 1168, (2010).

Reliable Logic Circuit Elements that Exploit Nonlinearity in the Presence of a Noise-Floor, *K. Murali, Sudeshna Sinha, W.L. Ditto and A.R. Bulsara*, Physical Review Letters, 102, 1041014, (2009).

Dynamics Based Computation, *Sudeshna Sinha and W.L. Ditto*, Physical Review Letters, 81, 2156, (1998).

Classical Resonances and an Arbitrary Trajectory Quantization Scheme for a Chaotic System, *D. Biswas and Sudeshna Sinha*, Physical Review Letters, 71, 3790, (1994).

Adaptive Dynamics on a Chaotic Lattice, *Sudeshna Sinha and D. Biswas*, Physical Review Letters, 71, 2010, (1993).

Theory of fluctuations in pseudo-integrable system, *D. Biswas and Sudeshna Sinha*, Physical Review Letters, 70, 916, (1993).

Noisy Uncoupled Chaotic Map Ensembles Violate the Law of Large Numbers, *Sudeshna Sinha*, Physical Review Letters, 69, 3306, (1992).

Spatiotemporal Intermittency on a Sandpile, *A. Erzan and Sudeshna Sinha*, Physical Review Letters, 66, 2750, (1991).

Research Group

Currently the group has five doctoral students (C. Meena, S.S. Chaurasia, P. Moitra, M. Aravind and P.D. Rungta) and three masters students (I. Katyal, M. Yadav and A. Amodkar). Past members of the group include nine who have completed their masters (A. Kumar, V. Agrawal, S.P. Kang, C. Meena, A. Sharma, P.D. Rungta, S. Kumari, K. Jain and R. Bansal), two who have obtained PhD degrees (V. Kohar and A. Choudhary) and three postdoctoral fellows (S. De, A. Sharma and A.D. Kachhvah).

Grants and Awards

Associate Member of the *International Centre for Theoretical Physics*, Trieste, Italy (1995-2000).

Awarded the B.M. Birla Prize for Physics (1998).

Elected Fellow of the *Indian Academy of Science*, Bangalore (2010).

Elected Fellow of the *Indian National Science Academy*, New Delhi, (2014).

Awarded the J.C. Bose National Fellowship, (2015).

Goutam Sheet

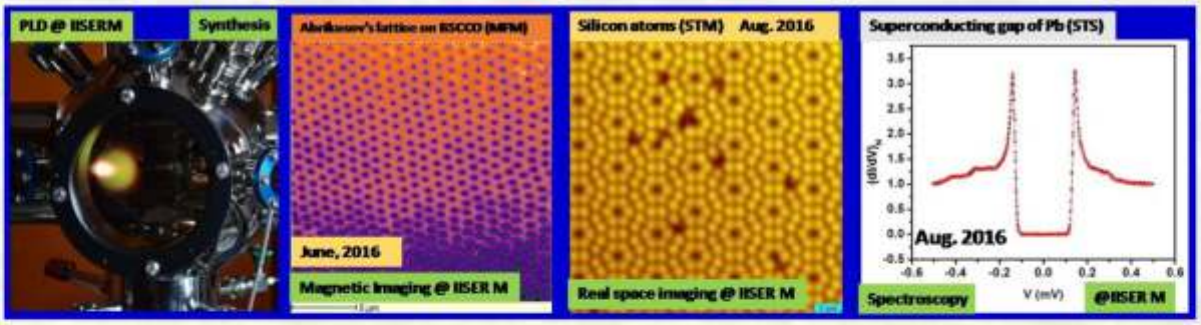
Assistant Professor

Academic Background

Dr. Sheet obtained his PhD degree from Tata Institute of Fundamental Research (TIFR) in 2007. He attended Northwestern University and Argonne National Laboratories for postdoctoral research. Dr. Sheet joined IISER Mohali in May, 2012.

Research Interests

Dr. Sheet's principal research interest includes the experimental investigation of the topologically non-trivial systems like, topological insulators, topological superconductors, Weyl semimetals, Dirac semimetals etc. using scanning probe microscopy and transport spectroscopy at ultra-low temperatures and high magnetic fields. Dr. Sheet also studies the long range interaction in artificially designed lattices to realize tunable topological and magnetic properties for applications in spintronics and magnonics. Dr. Sheet has recently started working on biological systems. For example, at present he is working with biologists and medical doctors to study certain biological systems that might be useful for developing artificial cornea.



Representative Publications

Unconventional Superconductivity at Mesoscopic Point-contacts on the 3-Dimensional Dirac Semi-metal Cd_3As_2, *Leena Aggarwal, Abhishek Gaurav, Gohil S. Thakur, Zeba Haque, Ashok K. Ganguli & Goutam Sheet*, Nature Materials, 15, 32, (2016).

High spin polarization and the origin of unique ferromagnetic ground state in CuFeSb, *A Sirohi, CK Singh, GS Thakur, P Saha, S Gayen, A Gaurav, S Jyotsna, Z. Haque, L. C. Gupta, M. Kabir, A. K. Ganguli, G. Sheet*, Applied Physics Letters, 108, 242411 (2016).

Mesoscopic superconductivity discovered at metallic point-contacts on the topological crystalline insulator $Pb_{0.6}Sn_{0.4}Te$, *S. Das, M. Aslam, S. Roychowdhury, L. Aggarwal, S. Gayen, K. Biswas, G. Sheet*, Applied Physics Letters, to appear in Applied Physics Letters.

Transport spectroscopy on trapped superconducting nano-islands of Pb: Signature of unconventional pairing, *Anshu Sirohi, Preetha Saha, Sirshendu Gayen, Avtar Singh, Goutam Sheet*, Nanotechnology, 27, 285701 (2016).

Local Ferroelectricity in SnTe above Room Temperature Driven by Competing Phonon Instabilities and Soft Resonant Bonding, *Leena Aggarwal, Ananya Banik, ShashwatAnand, Umesh V. Waghmare, Kanishka Biswas, Goutam Sheet*, Journal of Materiomics, 2, 196 (2016).

The role of substrates and environment in piezoresponse force microscopy: A case study with regular glass slides, *Shilpa Sanwlani, Mohammad Balal, Shubhra Jyotsna, Goutam Sheet* , Solid State Communications, 246, 17-22 (2016).

Evidence of a pseudogap in the ferromagnetic superconductor $Sr_{0.5}Ce_{0.5}FBiS_2$ **driven by competing orders of multi-band origin**, *M. Aslam, A. Paul, G. S. Thakur, S. Das, S. Gayen, U. Waghmare, G. Sheet*, Journal of Physics - Condensed Matter, 28, 195701 (2016).

Voltage induced local hysteretic phase switching in silicon, *J. S. Sekhon, L. Aggarwal, G. Sheet*, Applied Physics Letters, 104 (16), 162908 (2014).

Ferroelectric-like response from the surface of SrTiO3 crystals at high temperatures, *S. Jyotsna, A. Arora, J. S. Sekhon, G. Sheet*, Journal of Applied Physics, 116 (10), 104903 (2014).

Direct evidence of strong local ferroelectric ordering in a thermoelectric semiconductor, *L. Aggarwal, J. S. Sekhon, S. N. Guin, A. Arora, D. S. Negi, Ranjan Datta, K. Biswas & G. Sheet*, Applied Physics Letters, 105, 113903 (2014).

Microscopic modulation of mechanical properties in transparent insect wings, *A. Arora, P. Kumar, J. Bhagavathi, K. P. Singh, G. Sheet*, Applied Physics Letters, 104 (6), 063702 (2014).

Research Group

There are two postdocs and 6 PhD students working in the group: **www.spinlab-iisermohali.net**

Grants and Awards

High Field Magneto-Transport & Spectroscopic Studies on Topologically Non-Trivial Systems at Sub-kelvin Temperatures. Approved by SERB-DST.

Spectroscopy and imaging down to sub-nanometer length scales on novel electronic systems and their nano-structured devices. DST Nanomission.

Ramanujan Fellowship: Awarded by DST, Govt. of India, 2012.

Outreach Activities

Dr. Sheet delivers lectures in universities and research institutes in India and abroad regularly.

Ananth Venkatesan

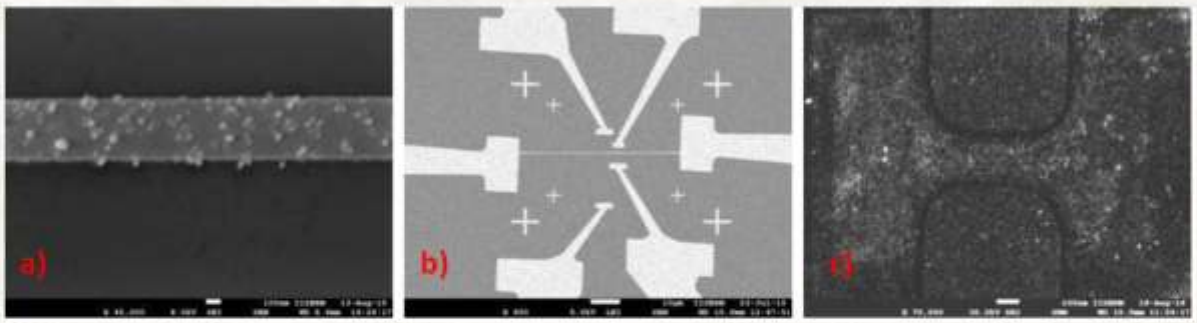
Assistant Professor

Academic Background

Dr. Ananth Venkatesan completed his PhD in Physics from Northeastern University, Boston working on 2-D electron systems. He did a Post-Doc un UBC, Canada followed by a Post-Doc at the University of Nottingham, U.K..

Research Interests

We study mesoscopic devices like nano-electromechanical systems(NEMS) and 2-D electron gas systems (2-DEGS) at ultra low temperatures. Our activities revolve around a state of the are Ultra low temperature lab that can reach temperatures as low as 10 mK for our measurements. Our group has also set up a nano-scale Fabrication facility in IISER that includes tools like electron microscope and e-beam lithography. Our work focuses on patterning commercially available materials as well as semiconductor hetero-structures from collaborators. The geometry and device schematic often reflects the physics we intend to study. In NEMS we focus on understanding quantum friction at low temperatures and interplay of electronic degrees of freedom with mechanical motion. We also actively look at spin transport and pure spin currents as opposed to charge transport in metals as well as 2-D electronic systems.



SEM micrograph of some devices (a) A large grain sized Au wire (b) A metallic spin valve (c) A gate defined constriction

Representative Publications

Nonlinear modal coupling in a high-stress doubly-clamped nanomechanical resonator, *K.J. Lulla, R.B. Cousins, A. Venkatesan, M.J, Patton, A.D. Armour, C.J. Mellor and J.R. Owers-Bradley*, New J. Phys. , 14, 113040, (2012).

Dissipation due to tunneling two-level systems in gold nanomechanical resonators, *A. Venkatesan, K. J. Lulla, M. J. Patton, A. D. Armour, C. J. Mellor, and J. R. Owers-Bradley*, Phys. Rev. B, 81, 073410 (2010).

Electrical Generation of Pure Spin Currents in a Two-Dimensional Electron Gas, *S. M. Frolov, A. Venkatesan, W. Yu, J. A. Folk, and W. Wegscheider*, Phys. Rev. Lett, 102, 116802 (2009).

Magnetization of a Strongly Interacting Two-Dimensional Electron System in Perpendicular Magnetic Fields, *S. Anissimova, A. Venkatesan, A. A. Shashkin, M. R. Sakr, S. V. Kravchenko, and T. M. Klapwijk*, Phys. Rev. Lett., 96, 046409 (2006).

Research Group

Grauate Students: Mr Shelender Kumar, Mr Soumyadip Halder, Mr Shyam Sundar, Miss Jasleen Kaur, Miss Guratinder Kaur Mr Vivek Singh , A. Pegu, Miss Ushma Pahuja (visiting summer student) .

Postdocs: Dr Minaxi Sharma.

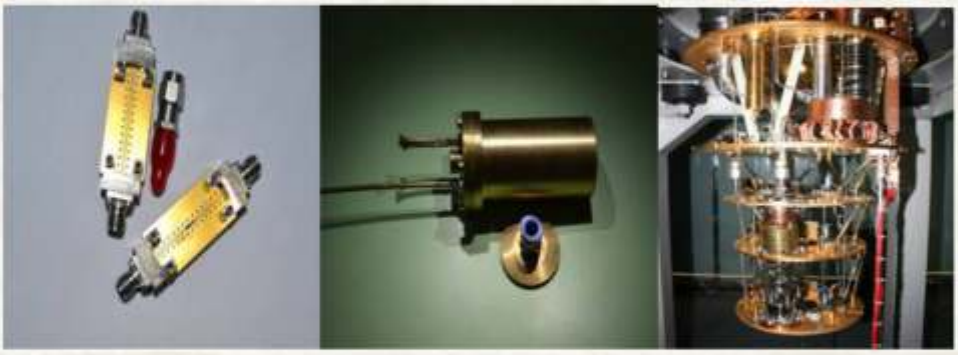
Alumni: Dr S.P. Pal (Now working on INTEL Fellowship at IIT Mandi) Mr Indrajeet Sagar (PhD Syracuse University) Mr Abhishek Kumar (PhD Italy) Mr Aaveg Aggarwal (PhD Northwestern).

Grants and Awards

DST Nano-mission Project and DST Ramanujan Fellowship.

Outreach Activities

Delivered several popular talks on nanoscale systems and nobel prized on LEDs Graphene etc.



Some images from our lab.

The INSPIRE Faculty Fellows

Vishal Bhardwaj

INSPIRE Faculty

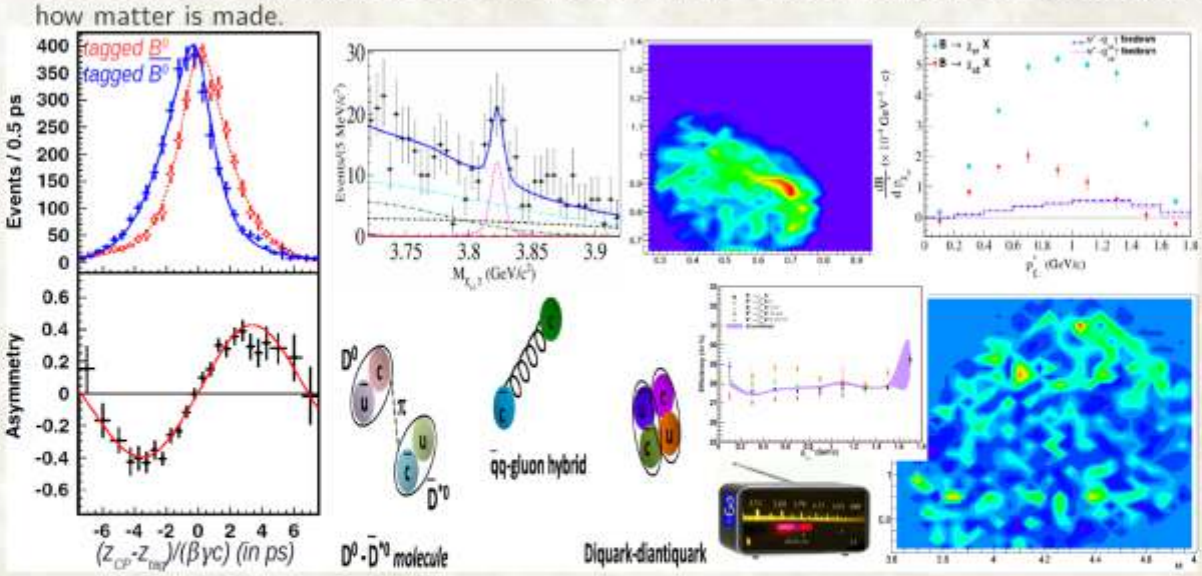
Academic Background

Vishal Bhardwaj completed his doctoral degree from Panjab University in 2011. Then he joined Nara W. University (Nara, Japan) as MEXT Kakenhi post-doctoral researcher, where he worked till 2014. Later he moved to University of S. Carolina (South Carolina, U.S.A.) as post-doctoral researcher. He joined IISER Mohali in January 2016 after being awarded INSPIRE faculty award by the Department of Science and Technology (DST), India.

Research Interests

He is an experimental high energy physicist, working in Belle I/II collaboration. Belle I is name of detector situated at the KEKB asymmetric-energy e^+e^- collider (Tsukuba, Japan), which has collected the world's largest and cleanest $\Upsilon(4S)$ data. Belle II is a next-generation high precision B factory which will search for New Physics (NP) beyond the Standard Model (SM). After his joining as INSPIRE faculty, IISER Mohali is now the official member of the Belle I/II collaboration.
His research interests are:

- Rare D meson decays and search for CP violation in the D decays - Precise measurement and validating the predictions of SM is a way to search for the NP.
- Find the unfound states - These are higher states consist of $c\bar{c}/b\bar{b}$ pairs. Till know only few states have been found. Finding new states will improve our QCD understanding and our knowledge of how matter is made.



- Searching the eXoTiCs - Finding a tetra-quark or a molecular state will complete our knowledge of how quarks come together to build the universe.
- Measurement of T-violation in B decays - Compliment the CP violation and crucial in search for physics beyond the SM.
- Detector readout electronics - interested in detector readout electronics.

Representative Publications

Inclusive and exclusive measurements of B decays to χ_{c1} and χ_{c2} at Belle, V. Bhardwaj *et al. (Belle Collaboration)*, Phys. Rev. D, **93** 052016 (2016).

Observation of $X(3872)$ in $B \to X(3872)K\pi$ decays., *A. Bala*, V.Bhardwaj, *et al. (Belle Collaboration)*, Phys. Rev. D, **91** 051101(R) (2015).

Measurement of $B \to J/\psi\eta K$ decay branching fraction and search for narrow resonances in $J/\psi\eta$ final state, *T. Iwashita, K. Miyabayashi*, V. Bhardwaj *et al. (Belle Collaboration)*, Prog. Theor. Exp. Phys., **2014** 043C01 (2014).

Evidence of a new narrow resonance decaying to $\chi_{c1}\gamma$ in $B \to \chi_{c1}\gamma K$, V. Bhardwaj *et al. (Belle Collaboration)*, Phys. Rev. Lett., **111** 032001 (2013).

Precise measurement of the CP violation parameter $\sin 2\phi_1$ in $B^0 \to (c\bar{c})K^0$ decays, *I. Adachi,...*, V. Bhardwaj *et al. (Belle Collaboration)*, Phys. Rev. Lett., **108** 171802 (2012).

Observation of $X(3872) \to J/\psi\gamma$ and search for $X(3872) \to \psi'\gamma$ in the B decays, V. Bhardwaj *et al. (Belle Collaboration)*, Phys. Rev. Lett., **107** 091803 (2011).

Research Group

Currently, his group consists of two M.S. students. With one student he is trying to understand the nature of famous poster boy of the tetra-quark/molecular states, the $X(3872)$, using its B meson decay. While the other student will compare the not-yet measured D_s decays to test the SM prediction and search for NP. He is also working in collaboration with Panjab University and IIT Bhubaneswar research students.

Grants and Awards

Dec. 2005 Cleared UGC-CSIR JRF NET exam and awarded JRF.

2014 Selected for INFN fellowship at Torino but joined University of South Carolina (U.S.A.) as post-doctoral fellow due to commitment.

2015 Innovation in Science Pursuit for Inspired Research Faculty (INSPIRE) Award by DST, India.

Outreach Activities

Dr. Vishal Bharadwaj is a member of the advisory panel for the science movement launched by the Subhadra Charitable Trust to popularize science in both rural and urban areas.

Sanjib Dey

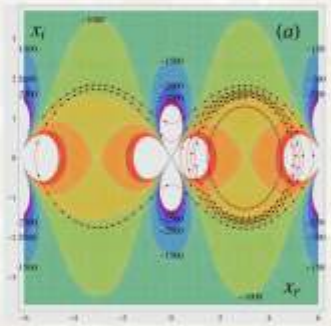
INSPIRE Faculty Fellow

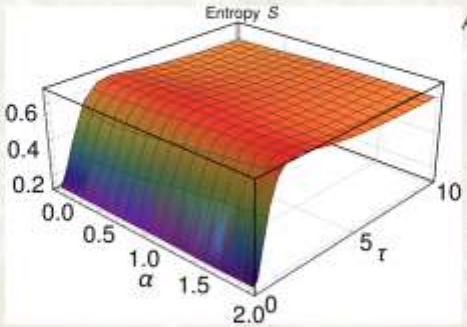
Academic Background

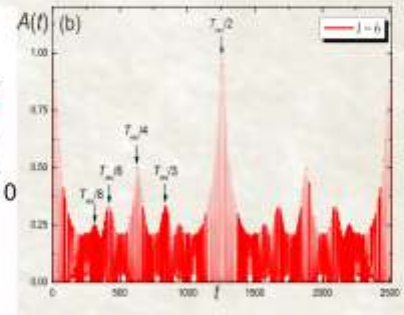
Dr. Sanjib Dey obtained his PhD from the City University of London, UK (2011-2014), before which he completed his M.Sc. in Physics from the University of Calcutta (2008-2010). Immediately after his PhD, he joined at the University of Montréal in Canada as a postdoctoral fellow and worked there for two years and three months (2014-2016). Later, he received a CARMIN postdoctoral fellowship from the Ministry of French Higher Education & research and continued his research at the Institut des Hautes Études Scientifiques (IHES) in France (2017) for six months before joining at the IISER Mohali as a DST-INSPIRE Faculty fellow on July 2017.

Research Interests

Dr. Dey is a theoretical physicist working in the field of quantum gravity (QG) phenomenology, quantum optics and information theory, PT-symmetric non-Hermitian systems and mathematical physics. His research interests are directed mainly towards the understanding of information theoretical aspects of QG, where quantum optical systems like coherent states, nonclassical states as well as the theory of quantum entanglement play major roles. He has worked on various QG models arising from the generalization of the Heisenberg uncertainty principle, from which the concept of discreteness of space-time emerges naturally. This discreteness of space-time is a characteristics of almost all approaches of QG and is implemented easily via noncommutative space-time coordinates. He developed some new models in this context and explored their behavior. He has also contributed to the construction of generalized coherent states and some entangled nonclassical states, which not only provide many interesting features, but also create an explicit connection between the theory of quantum information and the models of QG.







Representative Publications

Properties of soliton surfaces associated with integrable CP^{N-1} sigma models, *S. Dey and A. M. Grundland*, J. Phys. A: Math. Theor., 50, 335201, (2017).

Modification of Schrödinger-Newton equation due to braneworld models with minimal length, *A. Bhat, S. Dey, M. Faizal, C. Hou and Q. Zhao*, Phys. Lett. B, 770, 325–330, (2017).

Noncommutative q-photon-added coherent states, *S. Dey and V. Hussin*, Phys. Rev. A, 93, 053824, (2016).

Entangled squeezed states in noncommutative spaces with minimal length uncertainty relations, *S. Dey and V. Hussin*, Phys. Rev. D, 91, 124017, (2015).

q-deformed noncommutative cat states and their nonclassical properties, *S. Dey*, Phys. Rev. D, 91, 044024, (2015).

Milne quantization for non-Hermitian systems, *S. Dey, A. Fring and L. Gouba*, J. Phys. A: Math. Theor. (Fast Track Communication), 48, 40FT01, (2015).

Noncommutative quantum mechanics in a time-dependent background, *S. Dey and A. Fring*, Phys. Rev. D, 90, 084005, (2014).

Non-Hermitian systems of Euclidean Lie algebraic type with real energy spectra, *S. Dey, A. Fring and T. Mathanaranjan*, Ann. Phys., 346, 28–41, (2014).

Bohmian quantum trajectories from coherent states, *S. Dey and A. Fring*, Phys. Rev. A, 88, 022116, (2013).

Time-dependent q-deformed coherent states for generalized uncertainty relations, *S. Dey, A. Fring, L. Gouba and P. G. Castro*, Phys. Rev. D, 88, 084033, (2013).

PT-symmetric non-commutative spaces with minimal volume uncertainty relations, *S. Dey, A. Fring and L. Gouba*, J. Phys. A: Math. Theor., 45, 385302, (2012).

Squeezed coherent states for noncommutative spaces with minimal length uncertainty relations, *S. Dey and A. Fring*, Phys. Rev. D, 86, 064038, (2012).

Grants and Awards

INSPIRE Faculty Award, DST, Govt. of India (2017-2022).

CONICYT Fellowship & **Research Grant**, National Fund for Scientific and Technological Development, Chile, *declined* (2017-2020).

CARMIN Fellowship, Ministry of French Higher Education and Research (2017).

UNESCO conference travel grant, USA (2016).

Visiting Grant (Fully funded), Perimeter Institute, Canada (2016).

CRM postdoctoral Fellowship, University of Montréal, Canada (2014-2016).

Doctoral Research Fellowship, City University of London, UK (2011-2014).

Several conference Grants (Fully funded) by the University of Minnesota (USA, 2016), Durham University (UK, 2013) University of York (UK, 2012), University of Glasgow (UK, 2011).

Kinjalk Lochan

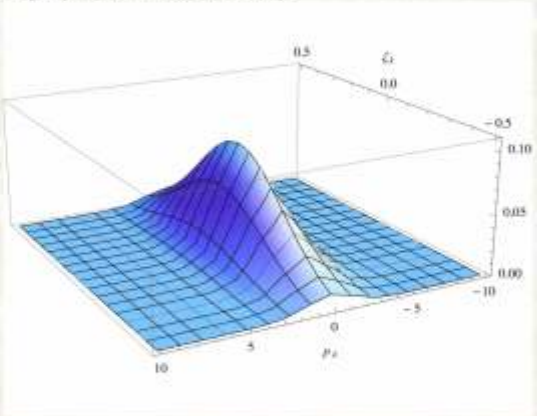
Inspire Faculty

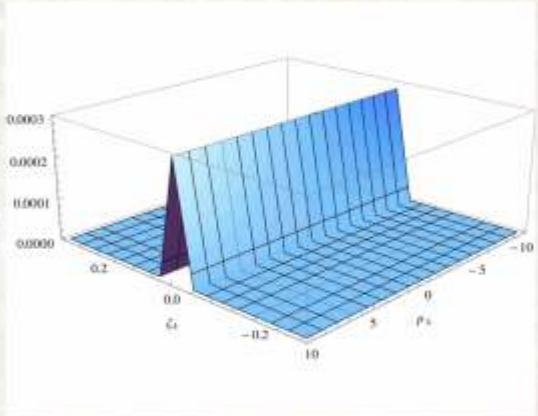
Academic Background

Kinjalk Lochan did his undergraduate from Indira Gandhi National Open University. He did his Masters and PhD in Physics from the Tata Institute of Fundamental Research, Mumbai (2007-13). Subsequently he worked at IUCAA, Pune (2013-2016) and briefly at IISER Trivandrum (July-Dec 2016) in the Max-Planck Partner group on Gravity, for his Post-Doctoral research. Presently he is a DST-INSPIRE Faculty at IISER Mohali since December 2016.

Research Interests

Dr. Lochan is a a theoretical physicist working in the field of Gravitation, Early Universe, Quantum Field Theory on Curved Spacetime and Foundations of Quantum Theory. His research interests are broadly on the interface of gravitation and quantum physics. His recent research activities involve semiclassical as well as quantum gravity motivated analysis of black holes' horizon structure and quantum charges apart from the emission profiles thereof. He is also involved in studying the quantum imprints, as well as the quantum information content of early universe surviving till late times. These studies explore the usability of quantum correlations to to peek into the regime where classical laws no longer hold or when the region of spacetime is masked behind a horizon for a classical probe. His interests also involve studies of physically realizable frameworks which turn the quantum perturbations into classical reality, especially in context of inflation. He is also interested in investigating the quantum mechanical systems interacting with classical gravity and the structure of such theories through the prism of causality, in the light of the fact that classical gravity is a highly non-linear theory.





Research Group

Presently two M.S. students are working in the group of Dr. Lochan. Mr. Shailesh Kumar is working on thermodynamical properties of black holes in generalized gravity theories whereas Ms. Sonali Maurya is working on the Lagrangian formulation of gravity.

Representative Publications

Black Holes: Eliminating Information or Illuminating New Physics? , *Sumanta Chakraborty, Kinjalk Lochan*, Universe, 03, 55, (2017).

Information retrieval from black holes , *Kinjalk Lochan, Sumanta Chakraborty, T. Padmanabhan*, Phys. Rev. D, 94, 044056, (2016).

Extracting information about the initial state from the black hole radiation, *Kinjalk Lochan, T. Padmanabhan* , Phys. Rev.Lett., 116, 051301(2016).

Gravitational Lensing by Self-Dual Black Holes in Loop Quantum Gravity , *Satyabrata Sahu, Kinjalk Lochan*, Phys. Rev. D, 91, 063001 (2015) .

Quantum to Classical Transition of Inflationary Perturbations - Continuous Spontaneous Localization as a Possible Mechanism - , *Suratna Das, Kinjalk Lochan, Satyabrata Sahu, T. P. Singh*, Phys. Rev. D, 88, 085020 (2013) .

Models of Wave-function Collapse, Underlying Theories, and Experimental Tests , *Angelo Bassi, Kinjalk Lochan, Seema Satin, Tejinder P. Singh, Hendrik Ulbricht*, Rev. Mod. Phys. , 85, 471-527 (2013) .

Grants and Awards

Gold Medal , *Bachelors in Science*, IGNOU, (2006).

Marian Miésowicz Fellowship , *53-rd Cracow School of Theoretical Physics Conformal Symmetry and Perspectives in in Quantum and Mathematical Gravity* , Zakopnae, Poland, (2013).

DST-INSPIRE , *Faculty Grant*, (2016).

Smriti Mahajan

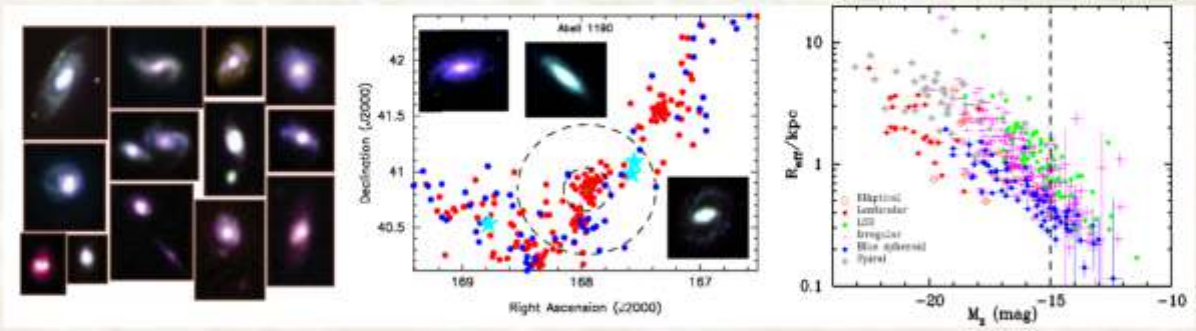
INSPIRE Faculty Fellow

Academic Background

Dr. Smriti Mahajan graduated with a B.Sc.(Honours) Physics (2004) and M.Sc. (Physics) (2006) from Delhi University. She finished her Ph.D. in Astronomy and Astrophysics from the University of Birmingham, UK in 2011. During this time she was also a Pre-doctoral fellow at the Harvard-Smithsonian Center for Astrophysics in Cambridge, USA (2010-11). She has worked as a Postdoctoral fellow at the University of Queensland, Australia (2012-14) and as a DST Fast Track Fellow at IISER Mohali (2014-16), before joining the latter as an INSPIRE Faculty fellow in April 2016.

Research Interests

Dr. Mahajan is an observational astrophysicist studying evolution of galaxies, and the symbiotic relationship between galaxy properties and the large-scale structure of the Universe in which they reside. Just like human behaviour is influenced by their social surroundings, properties of galaxies are influenced by their surrounding "environment". Dr. Mahajan's research interest lies in exploring and quantifying correlations between physical properties of galaxies such as colour, mass, morphology, dust content, star formation and metallicity to the properties of the environment: how clustered are the surroundings? Is the surrounding structure a group, a cluster or a filament? Dr. Mahajan is also interested in studying dwarf galaxies. These galaxies are typically less massive and less luminous than an average galaxy found in the nearby Universe, and tend to show properties somewhat different from their larger counterparts. For her research she has exploited arsenal of multi-wavelength data that are now becoming available for millions of galaxies. Currently Dr. Mahajan is working on a set of nearby galaxies to test how the global star formation rates determined using data in ultraviolet, optical, far-infrared, and, radio waveband compare with each other. These metrics can then be used as a baseline for calibrating star formation rate for higher redshift galaxies for which multi-wavelength data seldom exist.



Representative Publications

Galaxy And Mass Assembly (GAMA): the unimodal nature of the dwarf galaxy population, *Smriti Mahajan, Michael J. Drinkwater, Simon Driver, et al.*, MNRAS, 446, 2967 (2015).

Evidence for galaxies being pre-processed before accreted into clusters, *Smriti Mahajan*, MNRAS, 431, 117 (2013).

Plunging fireworks: why do infalling galaxies light up on the outskirts of clusters?, *Smriti Mahajan, Kevin A. Pimbblet, Somak Raychaudhury*, MNRAS, 427, 1252 (2012).

The velocity modulation of galaxy properties in and near clusters: quantifying the decrease in star formation in backsplash galaxies, *Smriti Mahajan, Gary A. Mamon, Somak Raychaudhury*, MNRAS, 416, 2882 (2011).

Star formation, starbursts and quenching across the Coma supercluster, *Smriti Mahajan, Chris P. Haines, Somak Raychaudhury*, MNRAS, 404, 1745 (2011).

Grants and Awards

Over the years Dr. Mahajan has been granted several travel and research grants, some of which are listed below.

2013: AUD 16,800 towards UWA-UQ Bilateral Research Collaboration award.

2011, 2009, 2008: Travel bursary by the Royal Astronomical Society for attending different conferences in Europe and the UK.

2009: Travel and maintenance support by Universitas 21 (Birmingham, UK and Queensland, Australia) for attending the conference 'Galaxy Metabolism', Sydney and visiting University of Queensland, Australia.

2008: Travel support by NEON for attending the NEON observing summer school, La Palma.

2007: Fully funded by the Max Planck Institute of Astronomy, Heidelberg for attending IMPRS.

2006-09: Overseas Research Studentship (ORS) for University of Birmingham, UK.

2006-09: School of Physics & Astronomy Scholarship, University of Birmingham, UK.

Post-Doctoral Fellows

Jayanta Dutta

Institute Post-Doctoral Fellow, August, 2016 - August, 2017
National Post-Doctoral Fellow (NPDF), since September, 2017

Academic Background

He obtained his PhD from the University of Evora in Portugal (2010-2016) in collaboration with Raman Research Institute, Bangalore and IMPRS Heidelberg, Germany. He worked as a research associate at Indian Institute of Science (Oct 2014 - Dec 2015) and Scuola Normale Superiore, Pisa Italy (Feb - July 2016). Recently he has received the prestigious National Post-Doctoral Fellowship.

Research Interests

He is an astrophysicist working in the field of high-redshift universe, particularly the physics of very First stars in the universe. He uses hydrodynamics simulations to study the gravitational gas collapse in dark matter halos. His research interests are also directed towards understanding the Reionization and Black Hole.

Representative Publications

Angular momentum distribution during the collapse of primordial star-forming clouds, *Jayanta Dutta*, Ap&SS, 361, 35D (2016).

On the effects of rotation in primordial star-forming cloud, *Jayanta Dutta*, A&A, 585A, 59D (2016).

Ankan Mukherjee

Post-Doctoral Fellow (Since April, 2017)

Academic Background

He obtained his MSc. and PhD. from the Indian Institute of Science Education and Research Kolkata (2010-2017). He joined as a post-doctoral fellow at IISER Mohali in April 2017.

Research Interests

He is a theoretical physicist working in the field of theoretical cosmology. His research interests are directed toward understanding the nature of dark energy, the exotic component of the universe responsible for the accelerated expansion of the universe, form different observational data.

Representative Publications

Parametric reconstruction of the cosmological jerk from diverse observational data sets, *Ankan Mukherjee and Narayan Banerjee*, Phys. Rev. D, 93, 043002 (2016).

Reconstruction of interaction rate in Holographic dark energy, *Ankan Mukherjee*, JCAP, 11(2016)055.

Ram Lal Awasthi

Post-Doctoral Fellow (Since 2015)

Academic Background

He obtained his M.Sc. from Banaras Hindu University in Varanasi (2004-2006) and Ph.D. from Harish-Chandra Research Institute in Allahabad (2007-2014). He worked as a postdoctoral fellow at SOA University, Bhubaneswar from Sept 2014 to July 2015. He joined as an institute post-doctoral fellow at IISER Mohali in July 2015 and switched to national post-doctoral fellowship in Sept 2016.

Research Interests

He is a theoretical physicist working in the field of High Energy Physics (Phenomenology). He works in beyond standard model phenomenology with major focus in Supersymmetric and non-supersymmetric SO(10) Grand Unified Theories.

Representative Publications

Implications of the diboson excess for neutrinoless double beta decay and lepton flavor violation in TeV scale left-right symmetric model, *R. L. Awasthi, P. S. Bhupal Dev, M. Mitra*, Phys.Rev.D 93 (2015) 011701 (R).

Proton decay and new contribution to neutrino-less double beta decay in SO(10) with low-mass Z' boson, observable $n - \bar{n}$ oscillation, lepton flavor violation, and rare kaon decay, *M. K. Parida, R. L. Awasthi and P. K. Sahu*, JHEP 01 (2015) 045.

M. Suman Kalyan

Post-Doctoral Fellow (Since 2016)

Academic Background

He obtained his M.Sc from Osmania University (2003-2005) and Ph.D from University of Hyderabad (2007-2014). He worked as a Research Associate at Manipal University (2015). He joined as a post-doctoral fellow at IISER Mohali in May 2016.

Research Interests

He works in the field of non-equilibrium thermodynamics and Statistical Mechanics. His research interests include study of thermodynamic properties of systems which are in near-equilibrium regime or out of equilibrium and application of statistical mechanics in understanding the complex biological processes, with the help of numerical techniques like Monte Carlo.

Representative Publications

Joint Density of States Calculation Employing Wang-Landau Algorithm, *M. Suman Kalyan, R. Bharath, V. S. S. Sastry and K. P. N. Murthy*, J. Stat. Phys., **163**, 197, (2016).

Monte Carlo study of force induced melting of DNA hairpin, *M. Suman Kalyan and K. P. N. Murthy*, Physica A, **428**, 38, (2015).

Shri Krishna

Post-Doctoral Fellow (Since September 2015)

Academic Background

He obtained his M. Sc. and M. Phil. from the Chhatrapati Shahu Ji Maharaj University, Kanpur (2006, 2009). He obtained his Ph. D. from the Banaras Hindu University, Varanasi in 2015. He joined as a Post-Doctoral Fellow at IISER Mohali in September 2015.

Research Interests

He is a theoretical physicist working in the field of theoretical high energy physics such as: quantum field theory, higher p-form $(p = 1, 2, 3)$ qauge theories, superfield approach to BRST formalism, SUSY quantum mechanics, SUSY gauge theories and SO(10) GUTs.

Representative Publications

An interacting $\mathcal{N} = 4$ supersymmetric quantum mechanical model: Novel symmetries, *S. Krishna, D. Shukla and R. P. Malik*, Int. J. Mod. Phys. A, 31, 1650113, (2016).

A free $\mathcal{N} = 2$ Supersymmetric system: Novel Symmetries, *S. Krishna and R. P. Malik*, Europhys. Lett. , 109,31001, (2015).

Minaxi Sharma

Post-Doctoral Fellow (Since 2015)

Academic Background

She obtained her M.Sc. from Punjab University Chandigarh (2007-2009) and Ph.D. from National Institute of Technology, Hamirpur, Himachal Pradesh (2010-2014). She joined as a post-doctoral fellow at IISER Mohali in April 2015. Recently, she joined as National post-doctoral fellow (SERB) at IISER Mohali in September 2016.

Research Interests

She is an experimentalist working in the field of condensed matter physics. Her research interests in general are directed toward the study of the structural, electrical, magneto-transport and magnetic properties in multilayer systems as well as reduced dimensions in nano structures in Perovskite 2-D electron gas systems and gate quantum devices to observe time dependent fluctuations.

Representative Publications

Effect of superconducting spacer layer thickness on magneto-transport and magnetic properties of La0.7Sr0.3MnO3/YBa2Cu3O7/La0.7Sr0.3MnO3 heterostructures, *M. Sharma, P. K. Pandey, K. K. Sharma, R. Kumar, R. J. Choudhary, D. Venkateshwarlu and V. Ganesan*, J. Appl. Phys., 115, 013901-5, (2014).

Superconductivity suppression in YBa2Cu3O7-δ/La0.7Sr0.3MnO3 bilayer films, *M. Sharma, K. K. Sharma, R. Kumar and R. J. Choudhary*, J. Appl. Phys., 116, 233905-7, (2014).

Sirshendu Gayen

Post Doctoral Fellow (since 2015)

Research Interests

Dr. Gayen is a post-doctoral fellow. He is a graduate from the University of Calcutta (Saha Institute of Nuclear Physics). He is mainly involved in spectroscopic investigation of topological materials under mesoscopic point-contacts. His research interest also includes the study of correlated fluctuations, spin entanglement, order parameter symmetry *etc.* of topological superconductors through cross-correlated shot-noise measurements.

Mehra Singh Sidhu

MAX-PLANCK DST Post-Doctoral Fellow (Since 2016)

Academic Background

He obtained his PhD. jointly from the Korea Research Institute of Standard and Science and Korea University of Science and Technology in Daejeon, South Korea (2008-2014). He is worked as a Institute Postdoc Fellow from Nov 2014-2016 amd currently continuing as a MAX -PLANCK DST Postdoctoral fellow at Femtosecond laser lab, IISER Mohali.

Research Interests

He is a Medical physicist working in the field of Femtosecond laser based high resolution optical setups development for bio-medical applications. His research interests are directed toward understanding the femtosecond laser dynamics in biological materials including micron sized natural fibers (spider silk), semi-transparent tissues(Blood vessels, Cornea or Retina) and plant tissues(Pollens).He is exploring the non-invasive nano-processing and integration of spider silk fibers with bio-materials.

Representative Publications

The processing and heterostructuring of silk with light, *M. S. Sidhu, B. Kumar and Kamal P Singh*, Nature Materials, DOI: 10.1038/NMAT4942, (2017).

Single femtosecond pulse selection, *M. S. Sidhu and K. P Singh*, 13th Intern. Conf. on Fiber Optics and Photonics, IIT Kanpur, INDIA , Th3A.90,(2016).

Graduate Students

(list of students who have been assigned a supervisor after comprehensive examination)

Harpreet Singh (Since 2011)

He is an Experimental physicist working in the field of NMR Quantum Computing, Quantum Decoherence, and precision control of quantum systems. His research interests are directed toward understanding the decoherence of novel quantum states and its preservations using different protection schemes.

Manaoj Aravind V (Since 2012)

He is a theoretical physicist working in the field of nonliear dynamics and its applications. He joined as an Integrated PhD student in 2012 and started his PhD in 2015. His current research interests are directed towards understanding the dynamics of nonlinear systems in the presence of noise and creating novel applications of these dynamics.

Chandan Kumar (Since 2012)

He is a theoretical physicist working in the field of quantum optics, quantum information theory and mathematical physics. He studies nonclassicality, entanglement and the interplay between them using group theoretic method in continuous variable systems.

Rajneesh Kumar (Since 2012)

He is a theoretical physicist working in the field of soft condensed matter physics. His research interests are translocation dynamics of semi-flexible polymer through a functionalized pore, forced polymer translocation through an interacting conical pore and polymer injection through a nanopore in flow induced fluid using Molecular and Multi-Particle Collision Dynamics.

Swagatam Nayak (Since 2012)

He is a theoretical physicist working in the field of condensed matter physics with Dr. Sanjeev Kumar. His research interest is in strongly correlated electron systems, specifically understanding the competing orders of superconductivity and effects of disorder in superconducting systems using Bogoliubov-de Gennes Method.

Archana Sangwan (Since 2012)

She is a theoretical physicist working in the field of Cosmology. Her research interests are directed toward obtaining different cosmological constraints for cosmological models such as the fluid model, canonical scalar field and noncanonical scalar field models, using different types of observational data that is available today.

Satnam Singh (Since 2012)

He works in field of Diffusion of small molecules in different type of environments. Diffusion is probed by using Pulse Field Gradient NMR and Molecular Dynamics.

Ashiwini Balodhi (Since 2013)

His research focuses on the study of frustrated magnetism and quantum spin-liquid state (QSL) in strongly correlated electron systems. As an experimental physicist, he concentrates on crystal growth and characterization of magnetic materials. A particularly exciting goal of his research is to realize the QSL in frustrated magnets.

Navdeep Gogna (Since 2013)

She is currently working at the interface of Biology and Physics, using NMR. Her research area is NMR Metabolomics. She has worked on the metabolome of various model systems including plant samples, fruit fly Drosophila and human serum samples

Nisha Gupta (Since 2013)

She is theoretical physicist working in the field of soft condensed matter. She uses computational methods to study the dynamics of cytoskeltal system. Currently she is working on a passive polymer in presence of active forces due to motor proteins.

Deepak Singh Kathyat (Since 2013)

He is in theoretical condensed matter physics group and is working on the problem of electronic transport properties of systems with spin-charge and spin-orbit coupling. He uses classical Monte Carlo simulations and Travelling Cluster Approximation method for studies.

Shubhendu Shekhar Khali (Since 2013)

Shubhendu joined the department is 2013 and is working in the field of soft condensed matter physics. His current research interest lies in the investigation of static and dynamic physical properties of a two-dimensional colloidal suspension under the influence external ratchet potential, which has applications in micro and nano fluidics, targeted drug delivery and designing smart fluids.

Kavita Mehlawat (Since 2013)

She is an Experimental Condensed Matter physicist working in the field of the strongly correlated system. Her current interest based on the layered honeycomb lattice iridates A_2IrO_3 (A = Li, Na) have been proposed as possible material realizations of Kitaev-Heisenberg Model. In these materials to determine whether Kitaev-like physics can be realized.

Pooja Munjal (Since 2013)

She is an experimental research scholar working in the field of optics. Her research interests are to devise novel optical techniques to precisely measure the nanoscale displacement of various systems and study the surface profile of different materials.

Sandeep Rana (Since 2013)

He has been working on understanding structure formation and it's evolution by studying neutral hydrogen distribution in the universe. He uses both simulation and radio observations to constrain neutral hydrogen distribution and it's evolution at intermediate redshifts.

Rakesh Sharma (Since 2013)

He is a experimental physicist working in the field of NMR Methodology, NMR Relaxation and Metabolomics. His research focuses on cross-correlation effects in NMR (CSA, Dipolar) to study structure and dynamics of small molecules and studying the metabolism of various biosystems.

Amandeep Singh (Since 2013)

He is an experimental physicist working in the field of NMR quantum computing. His research interest are quantum entanglement, non-classical correlations, bound-entanglement, quantum contextuality as well as realization of related problems by means of NMR techniques.

Mayank Srivastava (Since 2013)

Mayank joined the department in 2013 and his research interest lies in the fields of equilibrium and non-equilibrium statistical physics, hydrodynamics and its applications in soft matter systems. He is at present actively pursuing the application of fluctuating hydrodynamics in non-equilibrium scenarios of Brownian motion.

Anzar Ali (Since 2014)

He is an experimental physicist working in the field of condensed matter physics. His research interest is directed toward understanding of strongly correlated electron systems. His focus is on fate of electron in the vicinity of metal to insulator transition. Basically he is looking for a quantum spin liquid state and metal to insulator transition in doped semiconductors.

Mohammad Aslam (Since 2014)

Aslam is a PhD student. He performs point contact Andreev reflection spectroscopy at low-temperatures and high magnetic fields to probe the symmetries of superconducting order parameters in unconventional superconductors. Aslam also investigates the physics of competing ground states in systems exhibiting multiple physical orders.

Sudhanshu Shekhar Chaurasia (Since 2014)

He is a research scholar working in the field of non-linear dynamics. His research is focussed on the simulation of complex systems with different nodal dynamics. In particular, he studies synchronization and control in such systems.

Shekhar Das (Since 2014)

Shekhar explores novel ground states in topologically non-trivial materials using a number of experimental techniques including Andreev reflection spectroscopy and scanning tunneling spectroscopy down to mili-Kelvin temperatures and at high magnetic fields. He has also developed special skills on cryogenic equipment engineering and automation.

Anirban Ghosh (Since 2014)

Anirban joined the physics department in 2014. His area of research encompasses equilibrium and non-equilibrium statistical physics. He is currently working on the persistence probability, defined as the probability that a stochastic variable has not changed sign, for different non equilibrium systems.

Chandrakala Meena (Since 2014)

She is a research scholar working in the field of Nonlinear Dynamics and Chaos. Her research focus on the study of dynamics on network. In particular, she has been studying the dynamics of the coupled complex systems using different type of coupling for example diffusively, conjugate, mean field and pulsatile coupling on star, chain and scale free networks.

Arnob Mukherjee (Since 2014)

He works with Dr. Sanjeev Kumar in the field of theoretical condensed matter physics, specifically in strongly correlated electron systems, disordered systems. His research interest is to study charge ordering, magnetic ordering, etc. in various lattice models. He uses Exact diagonalization and recently developing Variational Monte-Carlo technique.

Jyotsana Ojha (Since 2014)

She is working in the field of diffusion studies of macromolecules using NMR spectroscopy and molecular dynamic simulation. She is currently focused on analysing effects of dynamic motion inside polymeric networks and biomembranes.

Avinash Singh (Since 2014)

He is studying structure formation in the universe using quintessence and tachyonic dark energy models. By applying the scalar field Lagrangian he is analysing cosmology and constraining the cosmological parameters using observational data.

Ankit Singh (Since 2014)

He is working on ram pressure stripping in low stellar mass galaxies using hydrodynamical simulations. His other work includes working with Tree-code for structure formation. His interests are computational cosmology, structure formation and high performance scientific computing.

Anshu Sirohi (Since 2014)

Anshu's expertize is in the area of scanning tunneling microscopy and spectroscopy at LT-UHV conditions. She uses these techniques to study the physics of single molecules, magnetic adatoms on a non-magnetic matrix and their interactions with materials exhibiting exotic physical orders like unconventional superconductors and complex semimetals.

Ramu Kumar Yadav (Since 2014)

He has worked on 21cm HI signal from the epoch of post-reionisation. Currently he is interested in studying the soft-condensed matter physics under the supervision of Dr. Rajeev Kapri. His work includes numerical simulations and lots of computation to understand the theoretical details.

Amit (Since 2014)

He is working in the field of experimental condensed matter physics. His current research involve the study on topological insulator and superconductors. The collective insight about physical parameter can be obtained from the electrical, thermal and magnetotransport. These insulators may have applications in a spintronics and quantum computing.

Leena Aggarwal (Since 2015)

Leena is a PhD student. She investigates novel ground states realized at confined dimensions on topological systems like the Dirac semimetals and Weyl semimetals. Leena has also worked on narrow band gap thermoelectrics where she had shown the emergence of local ferroelectric ordering through piezoresponse force microscopy. Such works led to the discovery of ferroelectric thermoelectrics.

Samridhi Gambhir (Since 2015)

She joined IISER Mohali as an Integrated Ph.D. student in 2013 and started her Ph.D. under the supervision of Dr. Mandip Singh, in August 2015. She is working in the field of experimental quantum optics and presently working on experiments for studying entangled photons. She is interested in exploring the fundamental questions of quantum mechanics and light-matter interactions.

Soumyadip Halder (Since 2015)

He is an experimental physicist working in the field of condensed matter. His research interests are directed towards spintronics and gated quantum devices.

Suman Kamboj (Since 2015)

Suman works in the area of Magnetism, ferroelectricity and multiferroicity. Her primary interest is to study the origin of long range/quasi-long range ordering due to competing interactions in magnetic and ferroelectric systems using magnetic/piezo-response force microscopy at low temperatures. She employs integrated thin film deposition and lithographic techniques to fabricate artificial lattices where various long-range orders can be realized with ultimate tunability.

Ritesh Kumar (Since 2015)

Ritesh is building a low temperature scanning tunneling microscope for sub-Kelvin applications. He is also developing cross-correlation measurement techniques for shot noise measurements under extreme environments like ultra-low temperatures and high magnetic fields.

Sumit Mishra (Since 2015)

He is an NMR experimentalist. He is currently working in the field of NMR metabolomics. His research interest is structural biology and biophysics.

Jaskaran Singh Nirankari (Since 2015)

He is a theoretical physicist working in the field of foundations of quantum theory and quantum information theory. His research interests are aligned towards understanding the "weirdness" in quantum theory, especially quantum contextuality, and the ways it can be used to outperform classical information theoretic tasks.

Pranay Deep Rungta (Since 2015)

He is a research scholar working in the field of Non-linear dynamics and chaos. His research focuses on study of dynamics on network. In particular, he has been studying synchronization of bistable elements coupled diffusively on regular, small world and scale free networks.

Ayushi Singhania (Since 2015)

She is an Integrated PhD student since 2013. Presently, she is working with Dr. Sanjeev Kumar in the field of Theoretical and Computational Condensed Matter Physics. She is learning Cluster Mean Field and Quantum Monte Carlo techniques to study lattice models of quantum spins. Her research interests includes Quantum Spin Liquid states and Quantum Dimer Models.

Abhinay Vardhan (Since 2016)

He is a Ph.D. student who joined in Aug 2016. He is currently working on strongly correlated systems and density functional theory. His research interests are directed towards understanding the behavior and formation of non-trivial spin systems; using density functional theory to study metallic systems.

Shyam Sundar Yadav (Since 2015)

He is a experimental physicist working in the field of high quality factor superconducting nanoelectromechanical resonator and their dissipation at ultra low temperature.

Komal Chaudhary (Since 2016)

She is an experimental research scholar working in the field of laser and optics. Her area of interest is directed towards detecting the nano-mechanical effects on fluid interfaces due to radiation pressure of light and collecting the information about momentum transfer.

Anita Devi (Since 2016)

She is an experimental research scholar working in the field of optical trapping using single beam laser tweezers. Her research interests are directed toward understanding the mechanism of stable trapping of particles using femtosecond laser pulses. She's also interested in developing theoretical models in different particle size limits (namely, the Rayleigh regime, geometric optics regime and Mie regime).

Akshay Gaikwad (Since 2016)

He is working in the field of Quantum Information Processing and NMR Spectroscopy. His current research area is experimental characterization of quantum processes in closed and open quantum systems.

Shelender Kumar (Since 2016)

He is a Experimental physicist working in the field of condensed matter. His research interests are directed toward understanding the Quantum phase slip devices coupled with waveguide, to understand the coupling of superconducting resonators coupled with microwave cavity, dissipation in metallic system at low temperatures.

Manvendra Pratap (Since 2016)

He is working in non-linear structure formation in cosmology. His research interests include computational cosmology, non-linear dynamics, dark sector cosmology, general relativity, numerical simulations of differential equations.

Soumya Datta (Since 2016)

Soumya is interested in electronic transport properties of nano-structured devices for spintronic applications. Currently he is assigned with projects related to SP-STM and PCS at ULT, UHV and HMF. He also has expertise in theoretical first principles calculations and e-beam lithography.

Rohit Gupta (Since Jan 2016)

Rohit is an experimental particle physicist working under supervision of Dr. Satyajit Jena. He is studying the effect of Quark Gloun Plasma formation on transverse momentum and particle miltiplicity distribution using data from collider experiments like LHC and RHIC. He is also working towards parameterisation of Parton Distribution Function and studying effect of new data on it.

Ranbir Sharma(Since 2016)

He is working in the dark energy sector of cosmology. His interest is in different statistical techniques that can be applied to different cosmological data-set to reconstruct and constrain cosmological parameters and in selection of different cosmological models.

Nishat Fiza (January 2016)

Nishat is a particle physicist with keen interest in Neutrino physics. Her research interest lies in finding the neutrino oscillation parameters in experimental bounds using GLoBES. She is also studying the Neutral Current neutrino interactions in recent neutrino experiments like INO, JUNO, T2HK, MINERνA etc.

Vikash Mittal (Since 2016)

He is a theoretical physicist working in the field of open quantum systems, quantum information theory, quantum optics, and quantum field theory. He has joined in 2014 as an Integrated PhD student and has started his PhD in 2016. His research interest is directed towards the understanding of the nature of a two-level system coupled with different kinds of bath and to exploit it further to do quantum computation.

Gaurav Saxena (Since 2017)

His research interests lie in the field of quantum computation, quantum information theory and quantum optics. Presently, he is exploring quantum correlations in continuous variable systems.

Sunil Dahiya (Since 2017)

He joined as Int-Phd in 2014. He is an experimental research scholar working in the field of atto-second physics phenomenon . His work includes generation of atto-second coherent pulses , ultra short laser spectroscopy and ultra high vacuum techniques.

Staff Members

Staff Members

Balbir Singh (Since 2013)

He is working in the NMR Lab as Scientific Staff. He facilitates data acquision and enables NMR operation for those without training. He also provides basic experimental training for Ph.D students. He actively participates in NMR Spectrometer troubleshooting and maintenance.

Laxmi Maurya (Since 2015)

She is B.Sc and M.L.I.Sc from CSJM University, Kanpur and worked as a trainee in IIT Kanpur. She joined IISER Mohali as an Office Assistant in Department of Physical Sciences. She is responsible for document preparation, collation of data for various purposes and looking after the admistrative activities within the department.

Manoj Kumar (Since 2007)

He is working in Physics Teaching Lab as lab assistant. He provides technical support in the lab and performs tasks such as maintaining records, preparing specimens, ordering supplies, operating and maintaining laboratory equipments, interpreting results, and adhering to lab procedures.

Rajendra Kumar (Since 2007)

He is working in Phyics Teaching Lab as lab technician. He is adept in experimental instruction and techniques, and student mentoring and supervision. He has profound ability to assist the laboratory technical staff, knowledge of electronics and handling of electronics specimens. He is well versed with preparation of different specimens for testing, analysis of tests, maintaining records, and documentation of other necessary paperwork.

Tarun P. Roshan (since 2010)

He is working in the Physics Teaching Lab as skilled person. During his period of service he has provided skilled assistance in Mechanics, Modern Physics, Wave and Optics and Advanced Electronics lab and various related lab activities. He prefers to spend his time exploring the nature of the universe and observing evidence of various physical theories. He has utmost interest in the theoretical implications of a higher-dimensional universe.

Tejinder Kumar (Since 2013)

He is a Lab Technician working in the Department of Physical Science. He provide technical support in the design, development, testing, production and operation of electrical and electronic Instrument and systems involved in Physics Teaching and Research labs.

The Alumni

The BS-MS Alumni

Rgst. No.	Name	Supervisor	Thesis title	Present status
MS07004	Amol Arvind Deshmukh	Prof. Arvind	Topological quantum computation	PhD at City College New York
MS07005	Amol Ratnaparkhe	Dr. Pranaw Rungta	The nonlocility in bipartite quantum states	PhD at Case Western
MS07008	Chandan Kumar	Dr. Ananth Venkatesan	Proposed study on dissipation phenomena in palladium nanomechanical resonators	PhD at IISER Mohali
MS07013	Mohit Satish Tanga	Prof. J.S. Bagla	Aspects of galaxy formations	PhD at MPE Garching
MS07017	Prashant Mishra	Dr. Kavita Dorai	Interaction of silver nanoparticle with a liquid member and a polymer mesh	PhD at State University of New York, Syracuse
MS07021	Sameep Chandel	Dr. Sanjeev Kumar	Model and methods for classical spain systems	—
MS08003	Abhishek Goswami	Dr. Pranaw Rungta	Exact quantum Simulation of XY Hamiltoniam	PhD student at Buffalo University
MS08007	Ankit Kumar	Prof. Sudeshna Sinha	Complex dynamical network	PhD at North Carolina
MS08008	Anshu Gupta	Prof. J.S. Bagla	^{3}HeII: An aiternative probe for reionization	PhD at Australian National University
MS08021	Gagan Preet Singh	Prof. J.S. Bagla	Gas mass loss of dwarf galaxies in galaxy clusters	Senior Data Scientist at HARMAN International, Bengaluru
MS08041	Prabhanjan R. Borwankar	Dr. Baerbel Sinha	Measurement of black carbon during Monsoon season in Mohali	Technical Staff, Coriolis Technologies Pvt Ltd
MS08046	Shashank Yadav	Dr. K.P.Singh	High harmonic generation by femtosecond pulses: Numerical simulations and experimental setup design	PhD at TIFR Hyd

The BS-MS Alumni

Rgst. No.	Name	Supervisor	Thesis title	Present status
MS08053	Vikesh Siddhu	Prof. Arvind	Secure quantum key distribution and comparison over noisy channels	PhD at Carnegie-Mellon University
MS09001	Aakash Sharawat	Prof. Arvind	Applications of causal theory in quantum systems	PhD at IISER Mohali
MS09004	Abhishek Kumar	Dr. Ananth Vankatesan	Hermetic RF feedthroughs for probing hydrogen absorbed palladium cryogenic	PhD at SNS, Italy
MS09005	Abhishek Mishra	Dr. Kavita Dorai	NMR based diffusion and interaction and triblock copolymers	
MS09011	Akanksha Sharma	Prof. Sudeshna Sinha	Effect of the global warming constant and delay in couping in a coupled oscillator model of the El nino event	PhD at Buffalo University
MS09018	Ankush Checkervarty	Dr. Abhishek Chaudhuri	Active brownian particles	PhD at The Leibniz Institute of Polymer Research Dresden
MS09022	Anurag Kulshrestha	Dr. Mandip Singh	Study of neutralation traps and bose-hubbard model	Entrepreneur
MS09026	Ashima Arora	Dr. Goutam Sheet	Imaging,domain writing and spetroscopy using scanning probes	PhD at Helmholtz Zentrum, Berlin
MS09029	Ashish Verma	Dr. Sanjeev Kumar	Spin -wave excitations in quantum heisenberg models	
MS09031	Ashutosh Tripathi	Dr. H.K.Jassal	Constraining cosmological parameters	PhD at Shanghai
MS09033	Atul Mantri	Dr. Mandip Singh	Study of magnetic traps and radio frequancy dressed state polentials	PhD at SUTD University, Singapore

The BS-MS Alumni

Rgst. No.	Name	Supervisor	Thesis title	Present status
MS09036	Bharat Kumar Gehlot	Prof. J.S. Bagla	Optimization observation strategies for redshifted HI delection using upgraded ooty radio telescope (ORT)	PhD at Groningen
MS09039	Chandrakala Meena	Prof. Sudeshna Sinha	Investigating the effect of parametric non uniformity on synchronization in model of El nino event	PhD at IISER Mohali
MS09041	Danish Shamoon	Dr. K.P.Singh	Study of long range correlations in biophatonic architectures	PhD at Université de Bretagne Occidentale Brest, France
MS09050	Dhirendra Pratap Singh	Dr. K.P.Singh	Design of a flat-field XUV spectrometer for detection of intense field high harmonics	PhD at Nottingham
MS09057	Harsh Katyayan	Dr. R.S.Johal	Subjective Probability and inference in thermodynamics	
MS09058	Himanshu	Prof. Arvind	Solving mathematical problems using quantum mechanics	
MS09062	Indrajeet	Dr. Ananth Vankatesan	Dissipation in palladium nano mechanical resonator at ultra low temperatures	PhD at State University of New York at Syracuse
MS09064	Jithin Bhagavathi	Dr. Goutam Sheet	Scanning tunnelling microcopy and transport spectroscopy at low temperatures	
MS09071	Karandeep Singh	Dr. Abhishek Chaudhuri	Endocytosis of nanoparticles	PhD at Forschungszentrum Juelich
MS09082	Mayank Mishra	Prof. Arvind	Quantum cryptography using bound entangled state	
MS09087	Narendra Pal Singh	Dr. Yogesh Singh	Magnetism in doped honeycomb iridates Na2Ir1-xRuxO3	

Rgst. No.	Name	Supervisor	Thesis title	Present status
MS09096	Prateek Gupta	Dr. Goutam Sheet	Fabrication and characterization of multiferroics	Teacher at a Coaching centre, Kota
MS09104	Rajveer Nehra	Prof. Arvind & Dr. Kavita Dorai	Quantum simulation of molecular Hamiltonians on an NMR quantum computer	PhD at Virginia
MS09105	Ravi Yadav	Dr. Sanjeev Kumar	Electronic properties and magnetism at the interface between polar and non-polar oxides	PhD at IFW Dresden
MS09120	Shivpal Singh Kang	Prof. Sudeshna Sinha	Simulation and analysis of the coupled map lattices with SLM	
MS09124	Soniya Sharma	Prof. J.S. Bagla	Strong gravitationnal lensing and catastrophe theory	PhD at Australian National University
MS09133	Uttam Kumar Saini	Dr. Yogesh Singh	Evolution of magnetism and superconductivity in single crystals of $FeTe_{(1-x)}Se_x$	
MS09134	Vidit Agrawal	Prof. Sudeshna Sinha	Dynamics on network and lattices	PhD at Arkansas
MS10004	Pranay Deep Rungta	Prof. Sudeshna Sinha	Dynamics on small world network of Bi-stable elements	PhD at IISER Mohali
MS10024	Preetha Saha	Dr. Goutam Sheet	Point contact andreev reflection studies on super conductors	PhD at Virginia
MS10037	Abhishek Gaurav	Dr. Goutam Sheet	Unconventional super conductivity at mesoscopic point- contacts on the 3-dimensional dirac semi metal cd3As2	
MS10038	Rahul Chajwa	Dr. Abhishek Chaudhuri	Instabilities in sedimentation at low reynolds number	PhD at TIFR Hyderabad

The BS-MS Alumni

Rgst. No.	Name	Supervisor	Thesis title	Present status
MS10044	Shivam Umarvaishya	Dr. Manmohan Gupta	Quark mass matrices & Weyl's inequlity	
MS10055	Vikram Sharma	Prof. Arvind & Dr. Kavita Dorai	Quantum simulation of quantum tunneling	
MS10076	Tara George	Dr. Kavita Dorai	Diffusion studies of amyloid beta peptide in bicelle	
MS10084	Pushkal Srivastava	Prof. C.S.Aulakh	Knotted solution of maxwell's equations	PhD at ICTS-TIFR
MS10101	Aaveg Aggarwal	Dr. Ananth Venkatesan	Proposed study of spain currents in matalic nano strutures	PhD at North Western
MS10104	Shweta Kumari	Prof. Sudeshna Sinha	Effect of non-uniform delays in models of El-nino oscillations	Software Engineer at Log.OS, Vizag
MS11003	Atul Singh Arora	Prof. Arvind	Contextuality in a deterministic quantum theory	PhD at QuIC - Ecole Polytechnique de Bruxelles
MS11004	Biplob Kumar Nandy	Dr. Kamal Priya Singh	Altosecond pules generation and measurment	PhD at ICFO Institute of Photonic Sciences Barcelona, Spain
MS11010	Joydeep Chakravarthy	Prof. C. S. Aulakh	Stability of vacua in the minimal supersymmetric standard model	PhD at ICTS-TIFR
MS11011	Love Grover	Dr. Manimala Mitra	Neutrino mass in B-L model and left right symmetric model	PhD at IISER Mohali
MS11012	Garima Singh	Dr. Abhishek Chaudhuri	Active Matter	
MS11016	Kishor Bharti	Prof. Arvind	Quantum correlations and its applications	PhD at NUS, Singapore

The BS-MS Alumni

Rgst. No.	Name	Supervisor	Thesis title	Present status
MS11017	Vivek Sagar	Prof. Somdatta Sinha	Transient dynamics and long term incoherence in coupled system	PhD at NorthWestern
MS11019	Rajendra Singh Bhati	Prof. Arvind	On the spontaneous localization process of many particle system	PhD at IISER Mohali
MS11021	Prashansa Gupta	Prof. Jasjeet Singh Bagla	Wide field imaging	PhD at York University, Montreal
MS11022	Diksha Jain	Dr. H.K. Jassal	Randall-sundrum model and cosmology	PhD at SISSA
MS11026	Abhinav Kala	Prof. Charanjit Singh Aulakh		PhD at TIFR
MS11030	Akhil Francis	Prof. M. M Gupta	CP violation in quark and leptonic sectors	PhD at North Carolina State University
MS11043	Gaikwad Akshay Ramdas	Dr. Kavita Dorai	Characterizing quantum processes using NMR	PhD at IISER Mohali
MS11044	Manvendra Singh	Dr. Manimala Mitra	Higgs phenomenology of minimal left right symmetric models and neutrinos masses in beyond standard models	
MS11058	Gyanendra Yadav	Dr. Kamal Priya Singh	Generation of orbital angular momenntum of light and its application in opto fluidics	
MS11080	Manvendra Pratap Rajvanshi	Prof. Jasjeet Singh Bagla	Modeling evolution of spherical over densities in cosmology	PhD at IISER Mohali
MS11015	Devwrat Dube	Dr. V.Rajesh	The evolving contours of scintific temper in india	

The BS-MS Alumni

Rgst. No.	Name	Supervisor	Thesis title	Present status
MS11051	Biswajit Panda	Dr. K.P.Singh	Nano newton force spectroscopy of silk	
MS11066	Harikrishnan P. S.	Dr. Abishek Chaudhuri	Interface Dynamics	
MS11067	Vivek Singh	Dr. Ananth Venkatesan	A Proposed Fluxtronic Capacitor	
MS12003	Gaurav Saxena	Prof. Arvind	Entanglement and Non-localiity for Continous Variable Systems	PhD at IISER Mohali
MS12009	Kanishk Jain	Prof. Sudeshna Sinha	Synchronized populations resist persistent infection	PhD at Emory University
MS12012	Amit Devra	Dr. Kavita Dorai	Genetic algorithms for NMR pulse design for QC	PhD at IISER Mohali
MS12016	Aditya Vyas	Dr. Sanjeev Kumar	Manipulating electronic band structure via magntic background	MBA at Delhi School of Business
MS12018	Abhijeet Roy	Dr. P.Balanarayan	Information entropies of bose einetein condensates in an oscillating trap	PhD at ICTS-TIFR
MS12021	Rahul Bansal	Prof. Sudeshna Sinha	Computational intelligence systems in weather forecast	Working at Druplets Technologies Pvt. Ltd.
MS12022	Bharti Yadav	Dr. Abishek Chaudhuri	Active Polymer Dynamics	
MS12028	Shivam	Dr. Abishek Chaudhuri	Active Fluids	
MS12042	Parul Janagal	Dr. Samir K. Biswas	Modelling micro gradient magnetic field distribution with FEM	
MS12046	Shivali Sokhi	Dr. Kamal P. Singh	Pieo-Newton silk based force sensor	PhD at IISER Mohali
MS12054	Anjali krishnan	Dr. Satyajit Jena	Higher moment of multiplicity distribution in heavy Ion-Collision	PhD at IISER Mohali

The BS-MS Alumni

Rgst. No.	Name	Supervisor	Thesis title	Present status
MS12065	Devika S.	Dr. Smriti Mahajan	UV emission of galaxies in the coma supercluster	JRF at IISER Mohali
MS12066	Sanjib Kumar Das	Dr. Sanjeev Kumar	Spin liquid phase in kitaev heisenberg model	PhD at IFW Dresden
MS12074	Karan Khurana	Dr. Kamal P. Singh	Extraction and optical characterization of bombys mori cocoons	
MS12081	T H Anishya	Dr. H. K. Jassal	Cosmology parameter from galaxy cluster data	
MS12106	Akanksha Gautam	Prof. Arvind & Dr. Kavita Dorai	State initialisation evolution of qubit system	PhD at IISER Mohali
MS12117	Haritha.R	Prof. Jasjeet Singh Bagla	Tidal inflnence on mass function of halos	
MS12118	Ashish Thampi	Dr. Vishal Bhardwaj	Study of X(3872) and X(3915) using the belle detector	
MS12123	Akshay Kumar	Dr. Kavita Dorai	Modal free analusis of relaxation parameters of NMR in various biomolecules	
MS12127	Vishnu P.K	Dr. Ketan M Patel	Lepton mixing discrete symmetry models & quark lepton complementary	PhD at IISER Mohali
MS12128	Jyoti Rani	Dr. Rajeev Kapri	Molecular dynamics simulation of polymers	
MS12129	Ashish Ranjan	Dr. Ritajyoti Bandyopadhyay	Understanding and modeling informal sector	
MS12131	Boddu Satya Spandana	Dr. Kavita Dorai	Evalution of NMR Relaxation parameters using model Free	

The MS Alumni

Registration Number	Name	Supervisor	Thesis title	Present status
MP12001	Imrankhan B Mulani	Prof. J. S. Bagla	Review of discrete newtonian cosmology	PhD at IISER Pune
MP12009	Ashish Thakur	Prof. M.M.Gupta	Quark Mass Matrices & Textures	
MP12014	S Srikanth	Dr. Dipanjan Chakraborty		
MP13010	Mrityunjay Pandey	Dr. Goutam Sheet	Electo-mechanical and electrical characterization of Cu2S-CdS nano structures using atomic force microscopy	
MP13016	Himanshu Dua	Dr. Rajeev Kapri	Dynamic Transitions Unzipping of an Adsorbed Polymer	
MP14005	Pratik Chattopadhyay	Dr. Ketan Patel	Gauge-hierarchy Problem, Seesaw Mechanisms and Discrete symmetries	PhD at Nottingham

The Ph.D Alumni

Name	Supervisor(s)	Thesis title	Present status
Amrita Kumari	Dr. Kavita Dorai	Struture and dynamics of Nanomaterials & Biomolecules insights from NMR spectroscopy	Post-Doctoral Fellow at University of Shanghai for Science and Technology, China
M. Nath Shukla	Dr. Kavita Dorai	NMR spectroscopic investigations of diffusion in mixtures of small molecules, fluorinated drugs and biometic in a membrane mimetic environment	Post-Doctoral Fellow at University of Glasgow, Scotland, U.K.
C. Jebarathinam	Prof. Sudeshna Sinha	Characterizing quantum correlation in the nonsignaling framework	Post-Doc at S N Bose Centre for Basic Sciences

The Ph.D Alumni

Name	Supervisor(s)	Thesis title	Present status
George Thomas	Dr. Ramandeep Singh Johal	Quantum thermodynamic machines: The rote of interaction and information	Post-Doctoral Fellow at IMSc Chennai, India
Debmalya Das	Prof. Arvind	Quantum state estimation using weak measurments and entanglement manipulation local filters	Postdoctoral Fellow at HRI, Allahabad
Preety	Dr. Ramandeep Singh Johal	Prior information in the inference of performance in constrained thermodynamic processes	Asst. Prof. At DAV College, Jalandhar, India
Bhupesh Kumar	Dr. Kamal P Singh	A study of torsional superelasticity fatigueless response and femtosecond pulses based micromachining of spider silks	Post-Doctoral Fellow at Bar Ellen University, Israel
Shruti Dogra	Dr. Kavita Dorai & Prof. Arvind	Novel aspects of multiqubit entanglement and qudit computing on an NMR quantum information processor	Visiting Research Fellow, University of Dortmund, Germany
Vivek Kohar	Prof. Sudeshna Sinha	Emergent patterns in nonlinear system and their application	Post-Doctoral Fellow at North Carolina State University, USA
Anshul Choudhary	Prof. Sudeshna Sinha	Dynamics on complex networks	Post-Doctoral Fellow at University of Oldenberg, Germany
Kanika	Dr. Sanjeev Kumar	Unconventional magnetic ordering in heisenberg and hubbard models	Teaching at Akal University
Gopal Verma	Dr. Kamal P Singh	Unravelling the Nano-Mechanical Effect of Photon Momentum at Fluid Interface Using Optical Techniques	Post-Doctoral fellow at
Sisram Rebari	Dr. Ananth Venkatesan	Low Temperature Dissipation Scenarios in Palladium Nano-mechanical Resonators	Teaching in a College

International Conference on "NMR at the Interface of Physics, Chemistry and Biology", November 29-30, 2010.

International Conference on Gravitation and Cosmology, December 14-18, 2015.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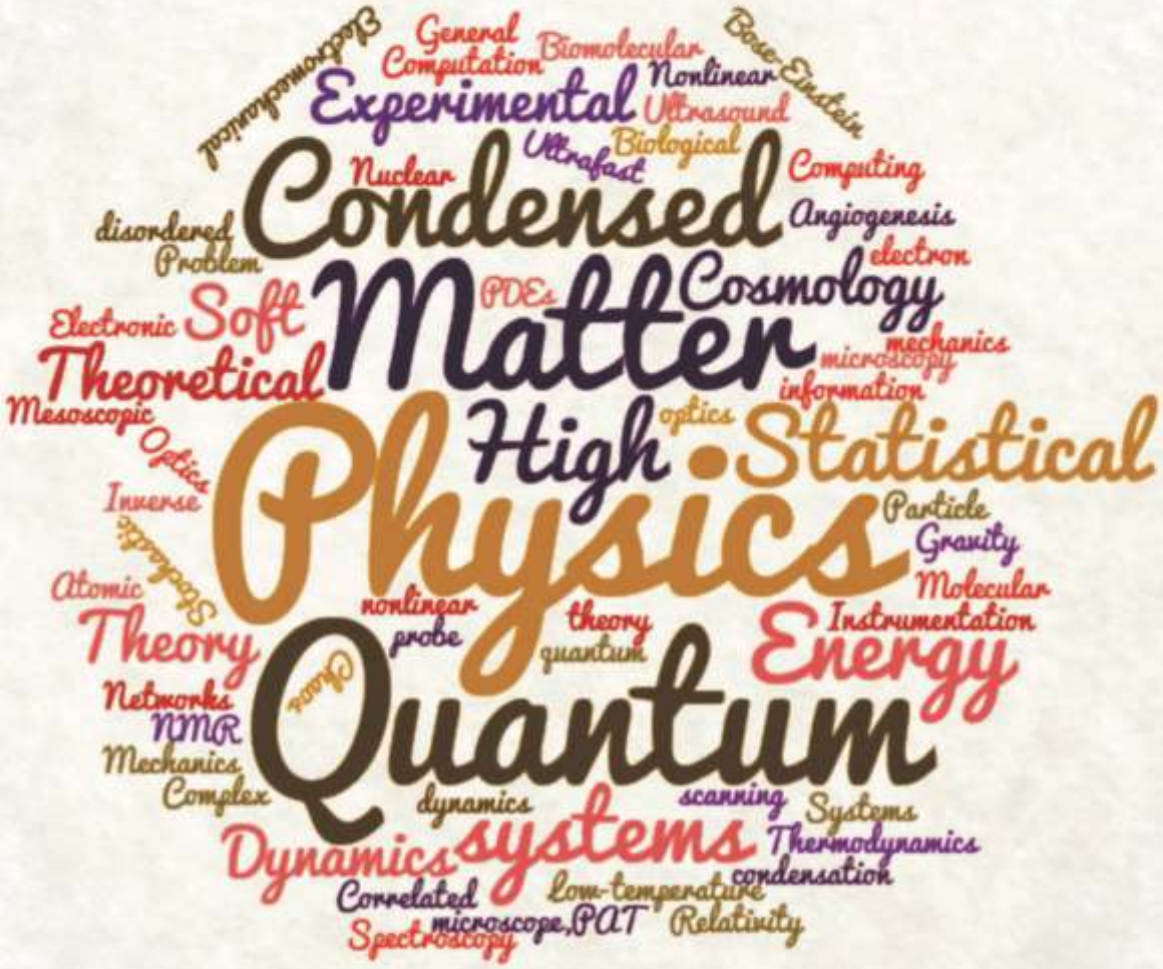

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