Annual Report 2013 -14

TIFR Centre for Interdisciplinary Sciences

Professor Sriram Ramaswamy (Centre Director)

Highlights

Active liquid crystals

Active matter refers to collections of interacting self-driven energy-dissipating particles. Obvious realizations include motor-filament complexes inside living cells, collections of organisms on all scales from microns to kilometers, and chemical or mechanical imitators of motility. Spatial organization in active systems is at the forefront of research in nonequilibrium and biological physics today. A particular case of interest is active striped phases, for which we constructed a hydrodynamic theory whose striking predictions included novel instabilities, enhanced order in 2 and 3 dimensions and reentrant Kosterlitz-Thouless melting to an active nematic in 2 dimensions (published in Phys Rev Letters, with T Adhyapak, PhD student, now postdoc at TU Berlin, and J Toner, Univ of Oregon). Important new developments include: the possibility of time-periodic states, i.e., broken time-translation invariance, in active liquid crystals (Phys Rev Lett 2013, with S Fürthauer, postdoctoral fellow); theory and experiment on spontaneous rotation of the nucleus of living cells (Sci Rep 2014, with A Maitra, PhD student, in collaboration with Shivashankar's group at NUS, SIngapore); theory of the cortex of living cells as capillary condensation of an active fluid (EPJE 2013, collaboration with groups at Institut Curie and Univ of Saarbruecken).

The growth of glassy order

We extended the classic "mode-coupling" approach to the glass transition to the case of non-stationary states, allowing us to characterize the way glassiness grows. This is important both conceptually and as a further test of our theoretical understanding of the glass transition. Our predictions on the growth kinetics of a certain three-density correlator accounts remarkably well for old and hitherto not understood numerical observations (published in Phys Rev Letters, with S K Nandi, PhD student, now postdoc at Saclay).

Large deviations in yielding gels

We developed a simple statistical-mechanical theory of the strange phenomenon of negative strain rate fluctuations seen in experiments on surfactant gels, within which we find remarkable properties of the large-deviation

function (LDF) for the velocity, including a non-quadratic form near yielding, and a steady-state fluctuation relation (FR) at small driving. Crucially, our approach suggests that large fluctuations and motion in a direction opposite to an imposed force are likely to occur in a wider class of systems near yielding (published in J Stat Mech: Theory and Applications, with S K Nandi, PhD student, B Chakraborty, Brandeis and A K Sood, IISc).

Staff List:

a) **TCIS Students:** Harsh Soni, Suropriya Saha, Ananyo Maitra (the first two are supported as JRFs at TCIS, TIFR; all three will submit their PhD these to IISc in the next two months)

b) **External Students:** Sabiha Sachdeva and Ranjan Krishna Modak (based at IISc where their primary supervisors are working)
Postdoc: Sebastian Fuerthauer, very successful 6-month stay, now at NYU.

National and International Involvement (Professional and Academic) Memberships of editorial, academic and national committees, Office bearership of professional societies, etc.

Fellow of Indian Academy of Sciences since 1996, and Fellow of INSA since 2003.
Member, Editorial Boards of: *Annual Review of Condensed Matter Physics* since 2011, *Advances in Physics* since 2007, *European Physical Journal E* since 2009, *Journal of Statistical Mechanics: Theory and Experiment* since 2003; member, Advisory Board of *Soft Matter* since 2008. Higgs Centre, University of Edinburgh, March 2013 (research collaboration with M E Cates and group).

Invited Talks in Conferences and Meetings (Speaker, Title, Occasion, Place, Date)

- Organizer (jointly with M C Marchetti, Syracuse Univ, C Schmidt, Goettingen and I Couzin, Princeton) of Program on Active Matter, Cytoskeleton, Cells, Tissues and Flocks, Kavli Institute for Theoretical Physics, Univ of California, Santa Barbara, Jan-May 2014 .

- Invited lecture at the March meeting of the Condensed Matter Division of the American Physical Society, Denver, March 2014

- Invited lecture at Conference on Frontiers of Soft Matter Physics: from Non-equilibrium Dynamics to Active Matter, Hong Kong University of Science and Technology, 13 17 Jan 2014

- Invited lecture at Symposium on Complex Systems : From Physics to Biology 15-16 Oct 2013, JNU, New Delhi.
- Invited lecturer, I-CAMP'13 summer school, programme on the Mathematics of Liquid Crystals, Isaac Newton Institute, Cambridge University, June 2013
- Invited member, programme on Mathematical Modelling and Analysis of Complex Fluids and Active Media in Evolving Domains, Isaac Newton Institute, Cambridge University, June 2013
- Prof. Sivaramakrishnan Chandrasekhar Memorial Lecture, Centre for Soft Matter Research, Bangalore, June 2013

Publications:

1) Suropriya Saha, S Ramaswamy, Nonequilibrium noise in electrophoresis: the microion wind, Phys Rev E, 89, 032307, (2014).

2) A Kumar, A Maitra, M Sumit, S Ramaswamy, G V Shivashankar, Actomyosin contractility rotates the cell nucleus, Sci. Rep. 4, 3781, (2014); DOI:10.1038/srep03781 (2014); arXiv:1302.6052

3) S. Fuerthauer and S. Ramaswamy, Phase-Synchronized State of Oriented Active Fluids, arXiv:1307.5705; Phys Rev Lett, 111, 238102, (2013).

4) E Bertin, H Chate, F Ginelli, S Mishra, A Peshkov, S Ramaswamy, Mesoscopic theory for fluctuating active nematics, New J. Phys. 15, 085032, (2013); arXiv:1305.0772

5) J.-F. Joanny, K. Kruse, J. Prost, S. Ramaswamy, The actin cortex as an active wetting layer, Eur. Phys. J. E., 36, 52, (2013); arXiv:1302.5025

6) S K Nandi, B Chakraborty, A K Sood and S Ramaswamy, Yielding and large deviations in micellar gels: a model, J. Stat. Mech. P02027, (2013); arXiv:1210.1987

7) T.C. Adhyapak, S. Ramaswamy, and John Toner, Live Soap: Order, Fluctuations and Instabilities in Active Smectics, Phys. Rev. Lett. 110, 118102, (2013); http://arxiv.org/abs/1204.2708

8) M.C. Marchetti, J.-F. Joanny, S. Ramaswamy, T.B. Liverpool, J. Prost, M. Rao, R.A. Simha, Hydrodynamics of soft active matter, Rev. Mod. Phys. 85, 1143-1189, (2013). http://arxiv.org/abs/1207.2929

Graduate Courses

- **Advanced Statistical Mechanics** (Aug 2013 semester, jointly with S Karmakar)
- **Soft Condensed Matter** (Jan 2014 semester, jointly with S Sastry).

Professor Surajit Sengupta

Highlights

Non-monotonic crossover from single-file to regular diffusion in micro-channels

It was found, both experimentally and in computer simulations that the dynamics of colloidal particles confined within a narrow channel depends in a complex fashion on the width of the channel. When the width is a commensurate multiple of the typical ordering length of the colloids, the particles diffuse in a single-file manner for a very long time, ultimately crossing over to regular diffusion. The crossover time decreases rapidly as the width is tuned away from commensuration. The experiments were performed in the group of P. Leiderer in the University of Konstanz in Germany and the computations involved collaboration between Surajit Sengupta of TCIS, Hyderabad and the group of P. Nielaba, Konstanz, Germany. The paper was published in Scientific Reports, an online journal of the Nature Publishing Group.

Dynamics of soft matter in micro channels:

The dynamics of plastically deformed solids, confined within micro-channels, was investigated using large scale computer simulations. Various regimes, including jamming, plug flow and plastic deformation was identified and the role of defects during this process was highlighted. In a separate investigation within the same theme, the diffusion of individual colloidal particles confined within micro-channels was investigated and was shown to have interesting cross-overs from single file to normal diffusion as a function of the width of the channel. These results were confirmed using laboratory experiments.

Thermodynamic anomalies in network formers:

Network forming materials like water, Si, silicate glasses as well as gels made out of patchy colloidal particles, show a number of thermodynamic anomalies like density maxima, pressure minima, anomalies in the compressibility etc. Many of these anomalies arise from local network structures formed in the liquid state. Many materials, chemical and biological processes depend on this network forming ability. In a set of computer simulations we investigated whether network formation may be influenced by manipulating external periodic fields or by the use of a template. Our results were understood in terms of a mean field calculation of a suitably constructed lattice model.

Staff List:

TCIS student: Debabrata Sinha. 2nd year

External Students:

1. Chandana Mondal (submitted her thesis on Feb. 2014 to Calcutta University)
2. Nirmalendu Ganai (registered with Calcutta University, will submit this year)
3. Saswati Ganguly (registered with Calcutta University, will submit next year)

Publications: (after 31st March 2013)

1. Saswati Ganguly, Surajit Sengupta, Peter Sollich, Madan Rao, *Non-affine displacements in crystalline solids in the harmonic limit*, Phys. Rev. E, **87**, 042801 (2013).
2. Debabrata Sinha, Surajit Sengupta, Chandan Dasgupta, Oriol T. Valls, *Out of equilibrium plasticity dynamics and the annealing of supersolidity in solid 4He*, J. Phys.: Condens. Matter **25**, 295601(2013).
3. Nirmalendu Ganai, Arnab Saha, and Surajit Sengupta, *Colloidal particles in a drying suspension: A phase field crystal approach*, Eur. Phys. J. E **36**:90, (2013).
4. Chandana Mondal, Ali Hossain Khan, Bidisa Das, Somobrata Acharya and Surajit Sengupta, *Origin of Chains of Au-PbS Nano-Dumbbells in Space*, Scientific Reports (Nature Publishing Group) **3**, 2612 (2013).
5. Arya Paul, Sengupta Surajit, Madan Rao, *Non-affine fields in solid-solid transformations: the structure and stability of a product droplet*, Journal of Physics: Condensed Matter **26**, 015007 (2013).
6. Nirmalendu Ganai, Surajit Sengupta and Gautam I. Menon, *Chromosome positioning from activity-based segregation*, Nucleic Acids Research, DOI: 10.1093/nar/gkt1417 (2014).
7. Sumanta Mukherjee, Arnab Saha, Pralay K. Santra, Surajit Sengupta and D. D. Sarma, *Beyond the coffee ring": Re-entrant ordering in an evaporation driven self-assembly in colloidal suspension on a substrate*, J. Phys. Chem. B, **118**, 2559 (2014).

Most significant publication in this period:

Nirmalendu Ganai, Surajit Sengupta and Gautam I. Menon, *Chromosome positioning from activity-based segregation*, Nucleic Acids Research, DOI: 10.1093/nar/gkt1417 (2014).

This has been discussed in the Telegraph and The Hindu newspapers:

- (http://www.telegraphindia.com/1140310/jsp/knowhow/story_18062547.jsp#.Uxz60lC3SBY) and in Hindu !!
- (http://www.thehindu.com/sci-tech/science/chromosome-organisation-explained- by-using-a-physics-model/article5805556.ece)

Graduate Courses

Electrodynamics I (August, 2013) Introduction to Physics and Chemistry at TIS, together with 2 other lecturers. (August, 2013)

Dr. Prasad Perlekar

Highlights

We have studied the competition between domain coarsening in a symmetric binary mixture below critical temperature and turbulent fluctuations. We find that the coarsening process is arrested in the presence of turbulence. The physics of the process shares remarkable similarities with the behavior of diluted turbulent emulsions and the arrest length scale can be estimated with an argument similar to the one proposed by Kolmogorov and Hinze for the maximal stability diameter of droplets in turbulence. Although, in the absence of flow, the microscopic diffusion constant is negative, turbulence does effectively arrest the inverse cascade of concentration fluctuations by making the low wavelength diffusion constant positive for scales above the Hinze length.

Staff List

Visiting Scientist/Postdocs:

- Dr. S.K. Malapaka, Postdoctoral Visiting Fellow, 09 December 2013 - 09 March 2014.
  Current status: Postdoctoral fellow at University of Tor Vergata, Rome, Italy.

Conference organisation:
Was part in the organising committee of Perspectives in Nonlinear Dynamics, 2013 meeting that was jointly organised by TCIS and UoH.

Publications

1. P. Perlekar, R. Benzi, D.R. Nelson, F. Toschi, Cumulative compressibility effects on slow reactive dynamics in turbulent flows, Journal of Turbulence, 14, 161, (2013).

2. S. Srivastava, P. Perlekar, J. H. M. T. Boonkkamp, N. Verma, F. Toschi, Axisymmetric multiphase lattice Boltzmann method, Physical Review E, 88, 13309, (2013).

3. P. Perlekar, R. Benzi, H.J. H. Clercx, D.R. Nelson, F. Toschi, Spinodal Decomposition in Homogeneous and Isotropic Turbulence, Physical Review Letters, 112, 014502, (2014).

4. S. Ravichandran, P. Perlekar, R. Govindarajan, Attracting fixed points for heavy particles in the vicinity of a vortex pair, Physics of Fluids, 24, 013303, (2014).

Graduate Courses

1. August-December 2013, Advanced Computational Physics
2. January-March 2014, Advanced Dynamics (1/3 course)

Professor P. K. Madhu

Staff List

Post-Docs: G. Rajalakshmi and Kaustubh Mote. Raji has been looking at the procurement/installation of the optical pumping set up required to do hyperpolarisation NMR spectroscopy with noble gases. Dr. Mote has joined on March 20, and will be working on the synthesis of membrane proteins and their structural characterisation with solid-state NMR.

Conference Organised by the School / Deptt. / Group (Title, Place, Date, Short Description)

NMR Meets Biology: An Interaction Week, Feb. 21-27, 2014, Candolim, Goa (in association with University of Leipzig, Germany, and University of Aarhus, Denmark.

Publications

1. B. Sarkar, V. S. Mithu, B. Chandra, A. Mandal, M. Chandrakesan, D. Bhowmik, P. K. Madhu, S. Maiti, Significant Structural Differences between Transient Amyloid- Oligomers and Less-Toxic Fibrils in Regions Known to Harbor Familial Alzheimers Mutations, Angew. Chem. Int. Ed. DOI: 10.1002/anie.201402636, (2014). (This can be cited as the most significant in this list.)

2. V. S. Mithu, B. Sarkar, D. Bhowmik, A. K. Das, M. Chandrakesan, S. Maiti, P. K. Madhu, Curcumin alters the salt-bridge containing turn region in amyloid beta 1-42 aggregates, J. Biol. Chem. (2014) (in press).

3. P. K. Madhu, Heteronuclear spin decoupling in soild-state nuclear magnetic resonance: Overview and outlook, Isr. J. Chem. 54, 25-38, (2014).

4. V. S. Mithu, K. O. Tan, P. K. Madhu, Selective inversion of 1H resonances in solid-state nuclear magnetic resonance: Use of Double-DANTE pulse sequence, J. Magn. Reson. 237, 11-16, (2013).

Graduate Courses

Courses Taught: P. K. Madhu, NMR: Principles and Applications, January -April 2014, TIFR colaba. Rajalakshmi, Experimental Physics Course, January-April 2014, TCIS Hyderabad.

Professor Rama Govindarajan

Highlights

- Vortex merger is an important mechanism for the inverse cascade of energy in turbulent flow. It was shown that merger can be delayed and even prevented by background density stratification.
- A drop of liquid moving down an inclined plate was shown to roll or slide in a ratio depending only on a shape factor and not on many other parameters.
- The film flowing down an inclined plate was shown to be very sensitive to Froude number Fr when Fr 1. In this regime, shallow water theory ws shown not to give the correct answers.

Staff List

Students (all in their fourth year)

1. S Ravichandran
2. Sharath Jose
3. Mamta Raju Jotkar
4. Suraj Singh: Research Assistant
5. Bharath Srinivasan: Project Assistant under CEFIPRA

Conference Organised by the School / Deptt. / Group (Title, Place, Date, Short Description)

TCIS and UoH co-organised the International Conference on Perspectives in Non-linear Dynamics (PNLD2013) http://uohherald.commuoh.in/international-conference-on-perspectives-in-nonlinear-dynamics-inaugurated-at-uoh/

Publications:

1. Rama Govindarajan & Kirti Chandra Sahu, Instabilities in viscosity-stratified flows. Annual Review of Fluid Mechanics. 46: 331-353, (2014).
2. S Ravichandran, Prasad Perlekar and Rama Govindarajan, Attracting fixed points for heavy particles in the vicinity of a vortex pair. Physics of Fluids, 26, 013303 (2014).

3. R Usha, Outi Tammisola, & Rama Govindarajan, Linear stability of miscible two-fluid flow down an incline. Physics of Fluids, 25, 104102, (2013).

4. Harish Dixit & Rama Govindarajan, Effect of density stratification on vortex merger. Physics of Fluids, 25, 016601, (2013).

5. Sumesh P Thampi, R. Adhikari, and Rama Govindarajan, Do liquid drops roll or slide on inclined surfaces? Langmuir, 29, 33393346, (2013).

6. Mamta R Jotkar, Jose Miguel Perez Perez, Vassilis Theolis, Rama Govindarajan, A unied framework for global instability mechanisms in the plane channel, diverging channel and backward-facing step ow, AIAA Paper 2013-2463, (2013).

7. Juan A. Tendero, Pedro Paredes, Miquel Rouraz, Rama Govindarajan, Vassilios Theofilis, BiGlobal and Point Vortex Methods for the Instability Analysis of Wakes, AIAA Paper 2013-2820, (2013).

Graduate Courses

- Mathematical Methods (Autumn 2013)
- Advanced Continuum Mechanics (co-teaching, Spring 2014)
- Continuum Mechanics (co-taught, 2013 Spring): this course was credited by students of TCIS and UoH.

Professor Srikanth Sastry

Staff List

- Vinutha H A - 6th semester, registered for Ph. D
- Anshul Deep Singh Paramar - 6th semester, registered for Ph D
- Jyoti Prasad Banerjee - 4th semester. Doing course work + project research (with Abhishek Dhar, ICTS, currently).

Conference Organised by the School / Deptt. / Group (Title, Place, Date, Short Description)

- Symposium on Fragility, January 5 - 8, 2014 [Organizers: Rajesh Ganapathy, Kenneth Kelton, A. Lindsay Greer, Srikanth Sastry; Venue: JNCASR, Bangalore]
- Workshop on Soft Matter Self Assembly and Dynamics, January 9-10th 2014 [Organizers: Surajit Dhara, V S S Sastry, Narayanan Menon, Srikanth Sastry, Venue University of Hyderabad, Hyderabad]

Publications:

1. Vishwas V Vasisht and Srikanth Sastry, Liquid-Liquid Phase Transition in Supercooled Silicon, (Review Article) Adv. Chem. Phys. vol. 152, p. 463 (2013).
2. Davide Fiocco, Giuseppe Foffi, Srikanth Sastry, Oscillatory athermal quasi-static deformation of a model glass, Phys. Rev. E. 88, 020301(R) (2013).
3. Shiladitya Sengupta, Thomas B. Schrder, and Srikanth Sastry, "Implication of the density-temperature scaling for the fragility in the Kob-Andersen model" E. P. J. E 36 141 (2013).
4. Davide Fiocco, Giuseppe Foffi, Srikanth Sastry, Persistent memory in athermal systems with deformable energy landscapes. Phys. Rev. Lett. 112, 025702 (2014).
5. Shiladitya Sengupta, Vishwas V. Vasisht and Srikanth Sastry, Diffusivity anomaly in the modified Stilliner-Weber liquid J. Chem. Phys. 140, 044503 (2014).
6. L. Di Michele, D. Fiocco, F. Varrato, S. Sastry, E. Eiser and G. Foffi, Aggregation dynamics, structure, and mechanical properties of bigels, Soft Matter, DOI: 10.1039/C3SM52558A (2014).

7. Smarajit Karmakar, Chandan Dasgupta, Srikanth Sastry, Growing Length Scales and their Relation to Time Scales in Glass-forming Liquids, (Review Article) Ann. Rev. Condens. Matt. Phys. 5:25584 (2014).

Book: Fragility of Glass-forming Liquids, edited by A. Lindsay Greer, Kenneth F Kelton and Srikanth Sastry (2014)

Graduate Courses

Soft Matter and Biological Physics [with Sriram Ramaswamy]

Dr. Smarajit Karmakar

Highlights

I. BREAKDOWN OF THE STOKES-EINSTEIN RELATION IN TWO, THREE AND FOUR DIMENSIONS

The breakdown of the Stokes-Einstein (SE) relation between diffusivity and viscosity at low temperatures is con-sidered to be one of the hallmarks of glassy dynamics in liquids. Theoretical analyses relate this breakdown with the presence of heterogeneous dynamics, and by extension, with the fragility of glass formers. We perform an investigation of the breakdown of the SE relation in 2,3 and 4 dimensions, in order to understand these interrelations. Results from simulations of model glass formers show that the degree of the breakdown of the SE relation decreases with increasing spatial dimensionality. The breakdown itself can be rationalized via the difference between the activation free energies for diffusivity and viscocity or relaxation times in the Adam-Gibbs relation. The fragility of the studied liquids is found to increase with spatial dimensionality, contrary to the expectation based on the association of fragility with heterogeneous dynamics. We calculate various measures of heterogeneity of dynamics and find no clear correlation between the degree of the SE breakdown and the heterogeneity of dynamics.
Authors : Shiladitya Sengupta (JNCASR, Bangalore and TIFR-H, Hyderabad), Smarajit Karmakar, Chandan Dasgupta (IISc, Bangalore), Srikanth Sastry (JNCASR, Bangalore and TIFR-H, Hyderabad)
Publication: Breakdown of the Stokes-Einstein relation in two, three, and four dimensions - Shiladitya Sengupta, Smarajit Karmakar, Chandan Dasgupta, and Srikanth Sastry, J. Chem. Phys. 138, 12A548 (2013).

II. RANDOM PINNING GLASS MODEL

Glass transition where viscosity of liquids increases dramatically upon decrease of temperature without any major change in structural properties, remains one of the most challenging problems in condensed matter physics in spite of tremendous research efforts in last decades. On the other hand disordered freezing of spins in a magnetic materials with decreasing temperature, the so-called spin glass transition, is relatively better understood. Previously found similarity between some spin glass models with the structural glasses inspired development of theories of structural glasses based on the scenario of spin glass transition. This scenario though looks very appealing is still far from being well established. One of the main differences between standard spin systems to molecular systems is the absence of quenched disorder and the presence of translational invariance: it is often assumed that this differ-

ence is not relevant, but this conjecture still needs to be established. The quantities, which are well defined and characterized for spin models, are not easily calculable for molecular glasses due to the lack of quenched disorder which breaks the translational invariance in the system and the characterization of the similarity between the spin and the structural glass transition remained an elusive subject. In this study we introduced a model structural glass with built in quenched disorder which alleviates this main difference between the spin and molecular glasses thereby helping us to compare these two systems: the possibility of producing a good thermalization at rather low temperatures is one of the advantages of this model. Authors : Smarajit Karmakar (TIFR-H and Departimento di Fisica, Universita di Roma La Sapienza ,Roma, Italy) and Giorgio Parisi (Departimento di Fisica, Universita di Roma La Sapienza ,Roma, Italy)
Publication : Random Pinning Glass Model - Smarajit Karmakar and Giorgio Parisi, Proc. Nat. Acard. Sci (USA) 110, 2752 (2013). Note : This work is partially done in TCIS.

III. IDENTITY OF THE LENGTH SCALE CHARACTERIZING THE GLASS TRANSITION FROM DIFFERENT APPROACHES

The dramatic dynamic slowing down associated with the glass transition indicates the existence of a static length scale that should grow rapidly when temperature decreases. It turned out that the definition and calculation of such a length scale is subtle and non-trivial. Recently there were two such definitions that seem to fit the bill, that were based on very different insights regarding the relevant physics. One approach is based on the point to set correlation 2 technique and the other on the scale where the lowest eigenvalue of the Hessian matrix becomes sensitive to disorder. In this work we present evidence that the two approaches result in the same identical length scale. The two methods are complementary in being relevant for higher and lower temperature regimes respectively. Authors : Giulio Biroli (CEA Saclay, France), Smarajit Karmakar and Itamar Procaccia (Weizmann Institute of Sciences, Israel)
Publication : Comparison of Static Length Scale Characterizing the Glass Transition - Giulio Biroli, Smarajit Karmakar and Itamar Procaccia, Phys. Rev. Lett. 111, 165701 (2013).

IV. DISTRIBUTION OF DIFFUSION CONSTANTS AND STOKES-EINSTEIN VIOLATION IN SUPERCOOLED LIQUIDS

It is widely believed that the breakdown of the Stokes-Einstein relation between the translational diffusivity and the shear viscosity in supercooled liquids is due to the development of dynamic heterogeneity i.e. the pres-

ence of both slow and fast moving particles in the system. In this study we directly calculate the distribution of the diffusivity for a model system for different temperatures in the supercooled regime. We find that with decreasing temperature, the distribution evolves from Gaussian to bimodal indicating that on the time scale of the _ relaxation time, mobile (liquid like) and less mobile (solid like) particles in the system can be unambiguously identified. We also show that less mobile particles obey the Stokes-Einstein relation even in the supercooled regime and it is the mobile particles which show strong violation of the Stokes-Einstein relation. Finally, we show that the degree of violation of the Stokes-Einstein relation can be tuned by introducing randomly pinned particles in the system.

Authors : Shiladitya Sengupta (JNCASR, Bangalore and TIFR-H, Hyderabad) and Smarajit Karmakar
Publication : Distribution of Diffusion Constants and Stokes-Einstein Violation in supercooled liquids - Shiladitya Sengupta and Smarajit Karmakar arXiv:1301.1181 (J. Chem. Phys. 2014).

Staff List

1. Jeetu S Babu, Post Doctoral Fellow from NIT, Calicut, Kerela
2. Monoj Adhikari, Project Assistant Fellow from Visva Bharati, West Bengal

Invited Talks in Conferences and Meetings (Speaker, Title, Occasion, Place, Date)

1. Soft Matter Young Investigators Meeting January 5 - January 7, 2014 Pondicherry
2. Soft Matter Workshop: 9 - 10 January, Hyderabad
3. Indian Statistical Physics Community Meeting 1 - 3 February 2014, Bangalore

Publicactions:

1. Shiladitya Sengupta, Smarajit Karmakar, Chandan Dasgupta, and Srikanth Sastry, Breakdown of the Stokes-Einstein relation in two, three, and four dimensions - J. Chem. Phys. 138, 12A548 (2013).
2. Smarajit Karmakar and Giorgio Parisi, Random Pinning Glass Model - Proc. Nat. Acard. Sci (USA) 110, 2752 (2013).
3. Giulio Biroli, Smarajit Karmakar and Itamar Procaccia, Comparison of Static Length Scale Characterizing the Glass Transition - Phys. Rev. Lett. 111, 165701 (2013).

4. Smarajit Karmakar, Chandan Dasgupta and Srikanth Sastry, Growing Length Scales at the Glass Transition - Annual Review of Condensed Matter Physics 5, 1 (2013)

5. Shiladitya Sengupta and Smarajit Karmakar Distribution of Diffusion Constants and Stokes-Einstein Violation in supercooled liquids - arXiv:1301.1181 [J. Chem. Phys. (2014)].

Graduate Courses

August - December 2013

a Advanced Stat Mech (jointly with Prof. Sriram Ramaswamy)

b Numerical Methods - I

January - April 2014

a Numerical Methods - II

Professor Narayanan Menon

Highlights

I have started building a soft-matter and nonequilibrium physics laboratory in the transit building of TCIS. With students at TCIS, I have started three exploratory activities: (i) sedimentation in the Stokes regime of objects with open geometries, (ii) contact mechanics of collisions between fluid-immersed objects and (iii) instabilities of linear arrays of falling non spherical particles. The first two projects are with the theoretical collaboration of Prof Rama Govindarajan, and the third with Prof Sriram Ramaswamy. With a postdoc, Joel Marthelot, I am studying the dynamics of flexible filaments at a fluid-fluid interface.

Staff List

I work with TCIS PhD students S. Ganga Prasath, Sumit Birwa and Pankaj Popli. Postdoc: Joel Marthelot from ESPCI working under a Raman-Charpak Fellowship. I continue to supervise students and a postdoc at the University of Massachusetts, from which institution I am on leave.

National and International Involvement (Professional and Academic):

Editor (one of many) of Journal of Statistical Mechanics.

Invited Talks in Conferences and Meetings (Speaker, Title, Occasion, Place, Date)

Several

Conference Organised by the School / Deptt. / Group (Title, Place, Date, Short Description)

Co-organized the "Workshop on Soft Matter, Self Assembly and Dynamics" from January 9 -10th 2014 at the University of Hyderabad, with U of H Prof. S Dhara.

Non DAE Research Projects (Investigators, Title, Funding Agency, Duration)

None through TCIS

Graduate Courses

Classical Mechanics, Aug to Dec 2013

Professor Shubha Tewari

Highlights

0.0.1 Jamming in granular hopper flow

To look for signatures of an impending jam, we have been exploring the behaviour of variables such as velocity, stress, and vorticity and their correlations in 2D, gravity-driven granular flow as the opening size at the base of the hopper decreases. TCIS student Sumit Birwa is writing a 3D version of this event-driven simulation, and plans to study the nature of structures that create a jam at the opening.

0.0.2 Foam flow in a diverging channel

The instabilities that arise when an incompressible liquid flows through a widening channel of fixed angle and infinite length are well-known. We are looking at how a foam flowing through the same geometry behaves. This is being studied both via experiment and simulation by TCIS student Shubhadeep Pal in collaboration with Prof. Rama Govindarajan.

Staff List

TCIS students Sumit Birwa and Shubhadeep Pal are doing projects with me.

Talks in Conferences and Meetings (Speaker, Title, Occasion, Place, Date)

Talk at Mumbai-Pune Soft Matter meeting, held at IISER Pune on 17 August 2013. Title: "Partnering Outreach with Research and Education"

Graduate Courses

1. Statistical Mechanics I
2. Scientific Communication

Taught (in collaboration with Surajit Sengupta, M. Krishnamurthy, V. Chandrasekhar) a course titled 'Introduction to the Physical and Chemical Sciences" for integrated MA students at the Tata Institute for Social Sciences, Hyderabad.

Popular Science Articles/ Lectures

Outreach Activities

1. Initiated a new discussion series for the general public called "Sawaal-Jawaab: Conversations on Science". The sessions are held once a month at a public venue, Lamakaan in Banjara Hills, and we have had 5 talks so far. The list is:

    - "Flocks, herds, swarms: the Physics of moving in groups" by Sriram Ramaswamy.
    - "Lord of the Rings: the Rise of Carbon" by V. Chandrasekhar.
    - "Clone Wars: the Science behind the Stem Cell Debate" by D. Balasubramanian.
    - "Blueprint to bricks: DNA as a building block" by Yamuna Krishnan.
    - "After the Higgs" by Rohini Godbole.

2. Ongoing collaboration with IEEE and IBM to create an exhibit on nanotechnology at the Birla Science museum in Hyderabad.

Professor K.V.R. Chary

Staff List

Ph.D. Students:

- Ms. Susmitha (2008...) JRFSRF of ICMR working for her Ph.D (BHU, Varanasi). She is presently involved in a project entitled, "Thermo-sensory and Ca^{2+}, Mg^{2+} ATPase functions elicited by a putative archeal $\beta\gamma$-crystallin".

- Mr. Himanshu Singh (2011...) A graduate student from Department of Chemical Sciences working for his Ph.D. He is presently involved in a project entitled, "Structural Characterization of S55A Mutant of UVI31+ from *'Chlamydomonas reinhardtii'* and also studying NMR in Plant metabolism.

- Ms. Deepshika Agarwal (2012...) A graduate student from Department of Chemical Sciences working for her Ph.D. She is presently involved in a project entitled, "Post-Translational Modification in Proteins: *In-Vivo* and *In-Vitro* Studies".

Post-doctoral Fellows:

- Dr. Sunita Patel is involved in MD simulations of intrinsically disordered proteins.

- Dr. Manish Shukla is involved in studying in-cell metabolic changes of C. reinhardtii during mixotrophic and heterotrophic conditions.

Other students:

- Guided an Indian Academy of Sciences summer students.

Publications:

1. Sunita Patel, Atul Srivastava, Venkatraman Ramanujam and Kandala V R Chary, Conformational Propensities and Dynamics of a $\beta\gamma - crystallin$, an Intrinsically Disordered Protein, PCCP (2014, in press).

2. Himanshu Singh, Deepshika Varma, Basuthkar J Rao, Kandala V R Chary, ^{1}H,^{13}C and ^{15}N NMR assignments of Mg^{2+} bound form of UV inducible transcript protein (UVI31+) from *Chlamydomonas reinhardtii*. Biomol NMR Assignments (2014), in press.

3. Himanshu Singh, Manish Shukla, Basuthkar J Rao, Kandala V R Chary, Flagella as a Novel Alignment Media for the Measurement of Residual Dipolar Couplings in Proteins, Chem Comm., 2013, 49(97), 11403-05.

4. Ashok K. Rout, Sunita Patel, Somlata Gupta, Manish Shukla, Deepa Saraswathi, Alok Bhattacharya and Kandala V. R. Chary, Functional manipulation of a calcium binding protein from *E. histolytica* guided by paramagnetic NMR, J. Biol. Chem., 2013, 288, 22893-22898.

Professor V. Chandrasekhar

Highlights

Molecular Materials

- We have been involved in the of molecular systems that can show molecular magnetism.
- We have designed strategies for preparing complex molecular entities containing homo-(3d and 4f) and heterometallic (3d-4f) systems (Figure 1).
- Some of these compounds have been shown to possess single-molecule magnet properties.

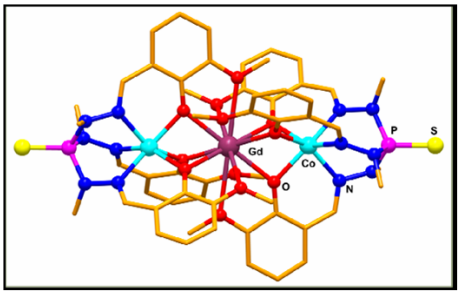

Figure 1: A heterometallic trinuclear Co2Gd complex

We have worked on cyclometalated Ir(III) compounds with particular emphasis on hetero-bridged dinuclear derivatives with a view to improve their photophysical properties. In these systems we were able to prepare a family of compounds whose emission properties could be modulated from green to red.

Molecular and Supramolecular Chemistry

Utilizing multi-topic ligands such as organophosphonates and organophosphates we have been able to assemble exotic molecular aggregates, The nuclearity of the molecular systems can be varied by a changing the steric bulk of the ligands as well as introducing ancillary nitrogen ligands (Figure 2).

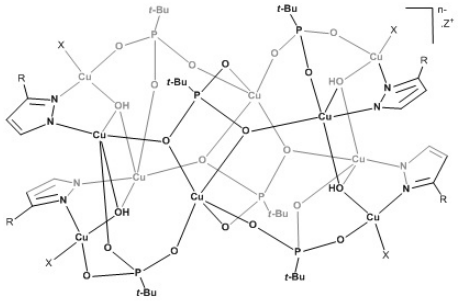

Figure 2: A decanuclear Cu(II) phosphonate containing pyrazole ligands.

Conference Organised by the School / Deptt. / Group (Title, Place, Date, Short Description)

- April 27, 2013 : Chemistry Symposium, Venue TCIS Hyderabad

Publicactions:

1. V. Chandrasekhar, R. Suriya Narayanan, Metalation studies of 3-and 4-pyridyloxycyclophosphazenes: metallamacrocycles to coordination polymers Dalton Trans. 2013, 6619-6632

2. V. Chandrasekhar, R. K. Metre, R. Suriya Narayanan, Lipophilic bismuth phosphates: a molecular tetradecanuclear cage and a 1D-coordination polymer. Synthesis, structure and conversion to BiPO4 Dalton Trans. 2013, 8709-8716

3. V. Chandrasekhar, D. Sahoo, R. Suriya Narayanan, R.J. Butcher, F. Lloret, E. Pardo A Hexaicosametallic Copper(II) Phosphonate Dalton Trans. 2013, 42, 8192-96

4. V. Chandrasekhar, A. Chakraborty, E. C. Sanudo. Ferrocene-based compartmental ligand for the assembly of neutral Zn-II/Ln(III) heterometallic complexes Dalton Trans. 2013, 42, 13436-13443

5. V. Chandrasekhar, D. Sahoo,R. K. Metre Isomorphic Co(II) and Zn(II) phosphonates: co-crystal formation of $[\{M_2(\eta 1\text{-DMPzH})_4(Cl_3CPO_3)M(\eta 1\text{-DMPzH})_2Cl_2\}_2](toluene)_2(M = Co(II) and Zn(II))$ $CrystEngComm, 2013, 15, 7419 - 7422$

6. V. Chandrasekhar, P. Bag, B. Murugesapandian. A phosphorus-based compartmental ligand, (S)P[N(Me)N=CH−C_6H_3−2−O−3−OMe]$_3$ (LH_3) enables the assembly of luminescent heterobimetallic linear $L_2Zn_2Ln^+[Ln = Gd, Tb, NdandEu]complexesDaltonTrans.2013, 42, 15447 - 15456$

7. V. Chandrasekhar, A. Dey, S. Das, M. Rouzires, R. Cle rac Syntheses, structures, and magnetic properties of a family of heterometallic heptanuclear [Cu5Ln2] (Ln = Y(III), Lu(III), Dy(III), Ho(III), Er(III), and Yb(III)) complexes: observation of SMM behavior for the Dy(III) and Ho(III) analogues. Inorg. Chem. 2013, 52, 2588-98

8. V. Chandrasekhar, A. Kumar, M. D. Pandey, R. K. Metre Telluroxane-supported coordination ligands: Synthetic and structural aspects Polyhedron (Special Alfred Werner Issue) 2013, 52, 1362-68

9. V. Chandrasekhar, C. Mohapatra, R. Banerjee, A. Mallick Synthesis, structure, and H2/CO2 adsorption in a three-dimensional 4-connected triorganotin coordination polymer with a lvt [corrected] topology. Inorg. Chem. 2013, 52, 3579-81

10. V. Chandrasekhar, S. Kundu, J. Kumar, S. Verma, K. Gopal, A. Chaturbedi, K.Subramaniam Supramolecular signatures of adenine-containing organostannoxane assemblies Crystal Growth and Design 2013, 13, 1665-1775

11. O. Reu, A. Palii, S. Ostrovsky, W. Wallace, O. Zaharko, V. Chandrasekhar, R. Clerac, S. Klokishner Experimental Characterization and Theoretical Modeling of a Linear [$Co^{II}{}_2Tb^{III}$]$SingleMoleculeMagnett.$ $J.Phy.Chem.C2013, 117, 6880 - 6888$

12. V. Chandrasekhar, P. Bag, E. Colacio Octanuclear Ln(III)8(Ln = Gd, Tb, Dy, Ho) macrocyclic complexes in a cyclooctadiene-like conformation: Manifestation of slow relaxation of magnetization in the Dy(III) derivative Inorg. Chem. 2013, 52, 4562-70

13. V. Chandrasekhar, A. Dey, A. J. Mota E. Colacio Slow magnetic relaxation in Co(III)-Co(II) mixed-valence dinuclear complexes with a Co(II)O5X (X = Cl, Br, NO3) distorted-octahedral coordination sphere. Inorg. Chem. 2013, 52, 4554-61

14. V. Chandrasekhar, P. Bag, M. Speldrich, J. Van Leusen, P. Kgerler Synthesis, structure, and magnetic properties of a new family of tetra-nuclear Mn2 IIILn2(Ln = Dy, Gd, Tb, Ho) clusters with an arch-type topology: Single-molecule magnetism behavior in the dysprosium and terbium analogues Inorg. Chem. 52, 5035-44

15. V. Chandrasekhar, J. Goura, A. Duthie Molecular indium(III) phosphonates possessing ring and cage structures. synthesis and structural characteri-

zation of [In2(t-BuPO3H)4(phen)2Cl2] and [In3(C5H9PO3)2(C5H9PO3H)4 (phen)3]·$NO3 \cdot 3.5H2O.Inorg.Chem.2013, 52, 4819 - 24$

16. V. Chandrasekhar, S. Hossain, S. Das, S. Biswas, J. P. Sutter Rhombus-Shaped Tetranuclear [Ln(4)] Complexes [Ln = Dy(III) and Ho(III)]: Synthesis, Structure, and SMM Behavior Inorg. Chem. 2013, 52, 6346-6353

17. V. Chandrasekhar, R. K. Metre,S. Biswas Stabilizing the [RSn($\mu 2-O)SnR$] $MotifthroughIntramolecularN\rightarrow$Sn Coordination. Synthesis and Characterization of $[(RSn)_2(\mu_2-O)(\mu_2-FcCOO)_2(\eta-FcCOO)_2]\cdot THFand(RSn)2(\mu_2-O)[(t-BuO)_2PO_2]_2Cl_2 \cdot THF \cdot 2H_2O(R = 2-(Phenylazo)phenyl)$ $Organometallics, 2013, 32, 3419 - 3422$

18. V. Chandrasekhar, R. Suriya Narayanan Organostannoxane-supported Pd(0) nanoparticles as an efficient catalytic system for alkyne dimerization Ind. J. Chem. Sec. A. 2013, 52, 1066-1071

19. V. Chandrasekhar, S. Das, A. Dey, S. Hossain, F. Lloret, E. Pardo Synthesis, Structure, and Magnetic Properties of a Family of Heterometallic Pentanuclear [Co4Ln] (Ln = GdIII, DyIII, TbIII, and HoIII) Assemblies Eur. J. Inorg. Chem. 2013, 4506-4514

20. V. Chandrasekhar, C. Mohapatra,R. K. Metre Reactions of (E)-5-(Pyridin-4-yl-methyleneamino)isophthalic Acid (LH_2) with Triorganotin Oxides and Chloride. Formation of One-Dimensional- and Two-Dimensional-Coordination Polymers Crystal Growth and Design 2013, 13, 4607-4614

21. V. Chandrasekhar, S. Das, A. Dey, Atanu; S. Hossain, J. P. SutterTetranuclear Lanthanide (III) Complexes Containing Dimeric Subunits: Single-Molecule Magnet Behavior for the Dy4 Analogue Inorg. Chem. 2013, 52,11956-11965

22. V. Chandrasekhar, C. Mohapatra 2D-Coordination Polymer Containing Interconnected 82-Membered Organotin Macrocycles Crystal Growth and Design 2013, 13, 4655-4658

23. V. Chandrasekhar, P. Bag, W. Kroener, K. Gieb, P. Muller Pentanuclear Heterometallic Ni2Ln3 (Ln = Gd, Dy, Tb, Ho) Assemblies. Single-Molecule Magnet Behavior and Multistep Relaxation in the Dysprosium Derivative Inorg. Chem. 2013, 52, 13078-13086

Professor M. Krishnamurthy

School of Natural Sciences / Nuclear and Atomic Physics / UP-HILL (Ultrashort Pulse High Intensity Laser Laboratory)

Highlights

Broad area Intense Field Physics / Studies on laser cluster interaction dynamics

i) Size limited mesoscopic laser plasma accelerators

Intense (>10^{18} W/cm2) ultrashort (<100 fs) lasers impinging on gaseous and solid targets produce plasmas which in turn generate and sustain extremely large electric fields (>100 GV/m) giving rise to highly compact accelerating structures for charged particles. Innovative target engineering, particularly for ion acceleration, assumes importance from the perspective of developing university-scale table top laser-plasma accelerators. Nanometric-scale atomic clusters or nanoparticles coated on a solid substrate as targets have been reported to generate multi-MeV ion beams even at moderate intensities accessible in most laboratories through commercial lasers. In this context, the study of targets comprising mesoscopic particles of sizes on the order of magnitude of the laser wavelength for laser plasma acceleration is an exciting yet sparsely explored domain, theoretically and experimentally. Mie-scattering and/or surface plasmon resonances are expected to induce local enhancement of the laser electric field, increasing the efficiency of hot electron generation, a precursor to particle acceleration. In this project we endeavoured to develop a novel source of nearly monodisperse microparticles to be delivered as an effusive jet into vacuum for laser plasma studies. The goal of the experiments planned with this source would be to extend our understanding of the physics behind laser interactions in the mesoscopic domain and also evaluate its potential for table top ion acceleration.

A prototype of the design has been fabricated. Easily available micrometric crystals of boric acid or talc with a narrow particle size distribution in the range of 10-20 um have been shown to aerosolized with no agglomeration. An imaging system to capture the particles emerging from the source and concomitant software has been developed for analysis of particle size distribution. In first experiments with 40 fs, 300 mJ laser pulses, Bremsstrahlung x-rays indicating an electron temperature of 15 keV have been observed. Issues relating to gas load management in the reaction chamber are currently being addressed and a second version of the source will soon be ready for further experiments.

(Ram Gopal, Aditya Kulkarni, S. Sivaramkrishnan, and M. Krishnamurthy)

(ii) Electron acceleration from methane cluster jets

Over the last decade laser plasma acceleration has made rapid strides in terms of providing high brightness, tunable, monochromatic energetic beams of electrons and ions. The promise of table top systems with applications in cancer therapy, isotope preparation, radiography and thermonuclear fusion, to name a few, has catapulted research in the field of high density, high field science to the forefront in many centers worldwide. Among the emerging areas of research is that of wake-fields of intense pulses propagating through plasmas which have shown to accelerate electrons to very high energies. Most electron acceleration schemes use gas jets to produce the target medium. Unlike gas monomers, clusters irradiated with intense light exhibit unique optical properties. Because of this, a laser pulse can be self-focused in a cluster medium at two-orders of magnitude lower peak power than the relativistic self-focusing threshold in gas monomers at similar densities. In a novel experiment in collaboration with groups from Rutherford Appleton Laboratories, UK and Imperial College, UK, we used gaseous clusters as a new type of target for laser driven electron acceleration.

For the first time, consistent electron beams with excellent beam divergences of 3.5 mrad x 1.5 mrad were observed from Methane cluster jets irradiated with 35 fs, 650 mJ laser pulses focused to intensities of 2.7 x 1018 W/cm2 in f/18 geometry. These beams were analyzed with a magnet spectrometer and found to have energies reaching 250 MeV. 2D Particle-in-cell simulations are underway to uncover the physics behind the interaction. Enhanced focusing as a result of the nonlinear polarization of the cluster jet could lead to higher intensities at the interaction region. This makes relativistic intensities achievable even with lasers of relatively moderate peak powers. In this pioneering experiment we have shown clusters to be an interesting medium from the perspective of developing university-scale table-top accelerators.

(P. P. Rajeev, Ram Gopal, Malay Dalui, and M. Krishnamurthy)

(iii) Reinstallation of a 0.5 Terawatt femtosecond laser system

To spearhead the first laser-plasma experiments at the transit campus of TIFR-Hyderabad, a 100 fs, 0.5 terawatt laser system was shipped from TIFR-Mumbai. The system consists of a MIRA-seed oscillator (50 fs, 76 MHz, 350 mW), which is amplified by a two stage amplifier using chirped pulse amplification (CPA) to 100 fs, 50 mJ, 10 Hz pulses. A small number of critical components, including a Ti: Sa crystal for the amplifier had to be

replaced on account of damage. The pump laser system had some damage to the electronic components which was also repaired in-house. The MIRA oscillator was brought to lasing and modelocked. The stretcher for the CPA was also aligned. The amplifier unit is presently being brought into operation.

(Ram Gopal, P. P. Rajeev, and M. Krishnamurthy)

(iv) Photoionization of clusters in intense few-cycle near infrared femtosecond pulses

At a central wavelength of 800 nm, an optical cycle has a period of 2.7 fs. Thus, laser pulses with a temporal full-width at half-maximum (FWHM) of 10 fs or less may be appropriately described as few-cycle pulses. Such pulses are so short that ionic motion during the interaction of these pulses with the target can be ruled out. These pulses provide an unprecedented opportunity to investigate clusters in a regime which is entirely dominated by electronic motion in the collective potential of the ions which remain motionless or frozen during the interaction with the pulse. In contrast, the photoionization dynamics of clusters in the NIR on sub- and few picosecond timescales is dominated by the motion of ions the expansion of the ionized aggregate leads to a strong resonant interaction between the driving laser field and the electronion system resulting in the so-called nanoplasma resonance.

To investigate this new regime, a new instrument has been set up, which includes a source of clusters and a skimmer to obtain a skimmed cluster jet in an ultra-high vacuum chamber. This chamber will be coupled with a few cycle laser source which is to be set up in the coming months at Hyderabad. The vacuum testing of the apparatus has been completed; detectors are being assembled and will be tested.

(Ram Gopal, S. Sivaramakrishnan, Kumara Raja and M. Krishnamurthy)

Staff List

Visiting Fellows:

Ram Gopal and S. Sivaramakrishnan

Junior Research Fellows:

Aditya Kulkarni

National and International Involvement (Professional and Academic) Memberships of editorial, academic and national committees, Office bearership of professional societies, etc.

- Member, Technical program committee, 2014, Conference on Lasers and Electro-Optics,(CLEO) Applications and Technology 3 subcommittee San Jose, USA .
- Member, Technical program committee, International Conference on ultra intense lasers ICUIL 2014, Goa, India.
- Member, Local organizing committee, 2013 Laser plasma accelerator workshop, Goa, India

Visits

30 Apr 2013 05 May 2013 Jeju Island, S. Korea Conference
22 May 2013 29 May 2013 APS-DAMOP, Quebec Conference

Awards and Distinctions:

M. Krishnamurthy was elected Fellow of the Indian Academy of Sciences (2013).

Invited Talks (Speaker, Title, Occasion, Place, Date)

1. Accelerating neutral atoms to MeV energies, IISc Bangalore Colloquim at the Dept of Physics. (2014)
2. Provoking matter with intense laser light, talk given at the Advances in Light Matter Interaction From Ultra-high Power to Ultrafast to Ultrasmall Symposium at the Bombay Exhibition Center. Mumbai (2013)
3. Charge Microscopy of Nanometric Plasmas invited talk at Lasers Plasma Accelerator Workshop, Goa (2013)

4. Accelerating Neutral atoms on a Table top, invited talk at Lasers Plasma Accelerator Workshop, Goa (2013)

5. Accelerating neutral atoms on a Table top, oral presentation at APS-DAMOP Quebec, Canada (2013).

6. A plenary talk on Clusters charged with neutrality at the Advanced laser and their applications workshop, Jeju Island, Korea (2013).

Publications

1. S. R. Krishnan, R. Gopal, R. Rajeev, J. Jha, V. Sharma, M. Mudrich, R. Moshammer and M. Krishnamurthy, 1. Photoionization of clusters in intense few-cycle near infrared femtosecond pulses, Physical Chemistry Chemical Physics (2014).

2. Malay Dalui, Madhu Trivikram, Ram Gopal and M. Krishnamurthy, Probing strong field ionization of solids with a Thomson Parabola Spectrometer, Pramana 82 121 (2014).

3. R. Rajeev, Madhu Trivikram, K.P.M. Rishad, and M. Krishnamurthy, Electronic excitation as a mode of heat dissipation in laser-driven cluster plasmas, Physics of Plasma (letter) 20 120701(2013).

4. R. Rajeev, K.P.M. Rishad, J.Jha and M. Krishnamurthy, Anomalous ion charge distribution from cluster nanoplasmas, T. Madhu Trivikram, Phys. Rev. Lett. 111, 143401 (2013).

5. R. Rajeev, S. V. Raja, Madhu Trivikram, K.P.M. Rishad, V. Narayanan and M. Krishnamurthy, A simple measurement of the spatial cluster density profile from a supersonic jet, J. App. Phys. 114, 083112 (2013).

6. R. Rajeev, T. Madhu Trivikram, K.P.M. Rishad, and M.Krishnamurthy, Non-Maxwellian electron energy distribution from cluster nanoplasmas, Phys. Rev. A 87, 053201 (2013)

7. R. Rajeev, Madhu Trivikram, K.P.M. Rishad, V. Narayanan and M. Krishnamurthy, Generation of energetic negative ions from clusters using intense laser fields, New J. Phys, 15 43036 (2013).

8. R. Rajeev, Madhu Trivikram, K.P.M. Rishad, V. Narayanan E. Krishnakumar and M. Krishnamurthy, A compact laser driven plasma accelerator for MeV energetic neutral atoms, Nature Physics. 9 185 (2013).

FACULTY AT TCIS Hyderabad

List of Current Faculty:

1. Sriram Ramaswamy (SR), Director
2. Narayanan Menon (NM), Dean
3. K.V.R. Chary (KVR)
4. Rama Govindrajan (RG)
5. Anukul Jana (AJ)
6. Smarajit Karmakar (SK)
7. M. Krishnamurthy (MK)
8. P.K. Madhu (PKM)
9. Prasad Perlekar (PP)
10. Srikanth Sastry (SrSa)
11. Surajit Sengupta (SuSe)
12. Shubha Tewari (ST)

Visiting Faculty:

1. N. Hari Dass (NDH)
2. Subodh R. Shenoy (SRS)

New Faculty in 2013 - 2014:

- Physical Sciences: Narayanan Menon and Shubha Tewari, joined in August, 2013.
- Chemical Sciences: Anukul Jana, joined in March, 2014.

Alumni:

V. Chandrasekhar, moved January 2014 to NISER Bhubaneswar as a Director.

Summary of Publications from TCIS-Hyderabad April 2013-March 2014:

Scientific Journal Articles: 74

Phys. Rev. Lett. 6, Sci. Rep. 2, Phys Rev E 4, Nature Physics 1, Phys. Rev. A 1, Angew. Chem. Int. Ed. 1, New J. Phys. 2, J. App. Phys. 1, Eur. Phys. J. E. 3, J. Stat. Mech. 1, Rev. Mod. Phts. 1, J. Phys.: Condens. Matter 2, Nucleic Acids Res 1, J. Phy. Chem. B. 1, Journal of Turbulence 1, Phys Fluids 3, Phys Plasma 1, Pramana 1, J. Biol. Chem. 2, Isr. J. Chem. 1, J. Magn. Reson. 1, Annu. Rev. Fluid Mech. 1, Langmur 1, AIAA 2, Adv. Chem. Phys. 1, J. Chem. Phys. 3, Soft Matter 1, Ann. Rev. Condens. Matt. Phys. 1, Porc. Nat. Acard. Sci. (USA) 1, PCCP 1, Biomol NMR Assignments 1, Chem Comm 1, Inorg. Chem. 9, Dalton Trans. 5, CrystEngCommun. 1, Polyhedron 1, Crystal Growth and Design 3, J. Phy. Chem. C 1, Organometallics 1, Ind. J. Chem. Sec. A. 1, Eur. J. Inorg. Chem. 1

Book:

Fragility of Glass-forming Liquids, edited by A. Lindsay Greer, Kenneth F Kelton and Srikanth Sastry (2014).

Conferences/Workshops Organized by TCIS faculty:

- April 27, 2013 : Chemistry Symposium, Venue TCIS Hyderabad (VC)
- July 15-18, 2013: TCIS and UoH co-organised the International Conference on Perspectives in Non-linear Dynamics (PP + RG)
- January 5 - 8, 2014: Symposium on Fragility, [Organizers: Rajesh Ganapathy, Kenneth Kelton, A. Lindsay Greer, Srikanth Sastry; Venue: JNCASR, Bangalore] (SrS)
- January 9-10th 2014: Workshop on Soft Matter Self Assembly and Dynamics, [Organizers: Surajit Dhara, V S S Sastry, Narayanan Menon, Srikanth Sastry, Venue University of Hyderabad, Hyderabad] (NM + SrS)
- Feb. 21-27, 2014: NMR Meets Biology: An Interaction Week, Candolim, Goa (in association with University of Leipzig, Germany, and University of Aarhus, Denmark (PK)
- Jan-May 2014: Active Matter: Cytoskeleton, Cells, Tissues and Flocks, Kavli Institute for Theoretical Physics, Univ of California, Santa Barbara, Jan-May 2014 (jointly with M C Marchetti, Syracuse Univ, C Schmidt, Goettingen and I Couzin, Princeton) (SR)

Public outreach:

1. New monthly discussion series for the general public featuring eminent scientists: "Sawaal-Jawaab: Conversations on Science" initiated in October 2013.

2. Taught a course titled 'Introduction to the Physical and Chemical Sciences" for integrated MA students at the Tata Institute for Social Sciences, Hyderabad.

3. Ongoing collaboration with IEEE and IBM to create an exhibit on nanotechnology at the Birla Science museum in Hyderabad