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Personal

Born on June 16 1974.

Indian Citizen

Married, three children

Education

Ph. D. (Physics), The Institute of Mathematical Sciences, Chennai, India 2010.
Thesis Title: Problems in the Statics and Dynamics of Nematic Liquid Crystals
Thesis Advisors: Prof. Gautam I. Menon and Prof. Sudeshna Sinha
Successfully defended on 26th July 2011

Marks in Course Work for Ph. D (2003-2004)
Semester-1 Classical Mechanics (10/10), Classical Electromagnetism (8/10), Quantum Mechanics (9/10), Mathematilcal Physics (8/10)

Semester-2 Statistical Mechanics (8/10), Quantum Field Theory (7/10), Condensed Matter Physics (10/10), Particle Physics (8/10)

M. Sc. (Physics), Lucknow University, Lucknow India , 2002

B. Sc. (Physics, Mathematics, Computer Science), Shia Degree College, Lucknow, India, 1998.

Intermediate (Physics, Chemistry, Mathematics), (Uttar Pradesh Board), Shia Inter College, Lucknow, India, 1991.

High School (Mathematics, Science, Biology), (Uttar Pradesh Board), Shia Inter College, Lucknow, India, 1991.

Achievements:

Qualified in the national-level CSIR-UGC National Eligibility Test for Lectureship (December 2002)

Selected in the Joint Entrance Screening Test for Graduate Research in India (Qualified in the 99^{th} percentile)

Selected for the "Workshop on Driven States in Soft and Biological Matter" (18-28 April 2006) at the International Centre for Theoretical Physics, Trieste, Italy.

Workshops/Conferences/School Attended

3rd Soft Matter Young Investigators Meeting 17 - 20 December 2015, Pondicherry, India.

2nd Soft Matter Young Investigators Meeting 18 - 20 December 2014, Pondicherry, India.

Contemporary Issues in Condensed Matter Science, 30 Jan. -1 Feb. 2012, Department of Physics, Indian Institute of Science, Bangalore.

Dynamics of Phase Transitions, 28-30 November, 2011, Jawaharlal Nehru Centre for Advanced Scientific Research, Benggaluru, India.

SPS March Meeting on Soft Matter Physics, 4 - 5 March, 2010, School of Physical Sciences, Jawaharlal Nehru University, New Delhi - 110067, India.

SERC School-cum-Symposium on Rheology of Complex Fluids, January 4-9, 2010, Indian Institute of Technology Madras, Chennai, India.

Disorder, Complexity and Biology II, Banaras Hindu University, Varanasi, India (Jan '09)

Indo-Belgian Symposium on the Statistical Physics Of Small Systems, IIT, Chennai, India (Nov '08)

SERC School on Non Linear Dynamics and Pattern Formation, IACS, Kolkata, India (Dec '06)

Workshop on Driven States in Soft and Biological Matter (18-28 April 2006) Miramare, Trieste, Italy.

Computational Approaches to Materials Science, JNCASR, Bangalore, India (Jan '06)

Discussion Meeting on Non - Equilibrium Statistical Mechanics, CFL, Bangalore, India (Dec '05)

Advanced Graduate School in Statistical and Condensed Matter Physics, Centre for Condensed Matter Theory, Department of Physics, Indian Institute of Science. Bangalore, India (January 15 – April 29, 2005)

Workshop on Hydrodynamics, Department of Mathematics, Indian Institute of Science, Bangalore(Dec, 2004)

Skills

12 years of research-level experience in Statistical Mechanics, Condensed Matter Physics and Dynamical Systems, in particular in the physics of liquid crystals.

Comfortable with Programming in C, Mathematica and Matlab

Teaching experience at the school, undergraduate and graduate levels

Employment

Post Doctoral Fellow, Department of Physics, Indian Institute of Science, Bangalore, India, July 2010 May 2012 .
At present I am designated as an Assistant Professor in the department of Physics, Shiv Nadar University.

Teaching

I enjoy teaching physics and have taught regulerly bachelors and master levels at SNU . Students have the freedom to explore and think about problems in new ways. As teachers, we have the opportunity to guide students' discoveries and learn a great deal in the process . I believe that interaction with students will also help me in pushing my research forward, as a consequence of fresh ideas that the student will bring. As one learn a great deal about a subject in the process of organising it for presentation, I would enjoy developing well-designed courses and associated materials. I am open to teaching most courses in an MSc/BSc syllabus, including regular mathematical methods, condensed matter, statistical mechanics, quantum and classical mechanics courses, in addition to more specialized courses in condensed matter physics and statistical mechanics.

Research

My research studies several problems in the static and dynamic properties of nematic liquid crystals [1,2,3,4]. Liquid crystals are an exceedingly well-characterized soft matter system, important both for technological applications as well as for the remarkable variety of physical behaviour they exhibit. Predictions for the behaviour of these systems can be systematically checked against experiments, providing a stringent test for theoretical work.

In first order phase transitions, where bulk phases can coexist, the properties of the interface between these phases is a problem of great interest to the condensed matter physicist. In liquid crystalline systems, where order parameters can be tensorial, such interfaces are particularly interesting because the interface can have properties very different from the coexisting bulk phases.

My research considers the properties of the interface between isotopic and uniaxial nematic systems within the frame work of the Ginzburg-Landau- de Gennes theory of liquid crystals. I have found solutions to the equations describing the interface which provide a far better parametrization of interface properties than previous work, both for the special case of planar anchoring as well as for more general anchoring conditions[2]. My results compare very well with results obtained from density functional theory, but are entirely analytic in nature, as opposed to those calculations. As a result they also provide useful physical intuition. I have also developed a novel variational approach to the study of interfaces with an arbitrary anchoring condition, providing very new results for this problem and clarifying several open questions regarding the properties of the interface[3]. The analysis is combined with a variety of efficient numerical methods, including a spectral expansion method for the solution of the equations of nematodynamics and a variety of minimization techniques in the variational calculation[2,3].

The rheological properties of soft matter have attracted much attention recently, since these systems exhibit chaotic behaviour even though the Reynolds numbers are negligibly small. Such chaos is a consequence of constitutive, and not convective, non-linearity. A time series analysis of the stress-strain-rate curve shows signs of low dimensional chaos. Recent measurements indicate that this chaos has complex spatio-temporal properties. A number of theoretical attempts have been made to understand this phenomenon. These attempts have used either approximations in which the order parameter is considered to be constant in space or, more recently, consider only a one-dimensional variation, solving the appropriate partial differential equations describing the coupling of a shear flow to the nematic order.

Our approach to this problem uses coupled map lattices (CML's), motivated by the success of the application of CML's in representing systems with spatio-temporal chaos. I have developed a map which accurately reproduces the result of the uniform order parameter case[1]. This map is constructed using quaternion variables. Coupling maps such as these spatially, in both one and two dimensions, yields a va-

riety of simple and complex spatio-temporal states, including uniform, periodic and chaotic ones. I have performed a detailed characterization of these states, thus studying the emergence of low-dimensional chaos in model spatio-temporal systems devised to mimic sheared nematics[4]. This is the first theoretical study of rheological chaos in soft matter systems which uses coupled map lattices.
I worked on an indo-european project, Modeling of Nano-Scaled Advanced Materials Intelligently (**MONAMI**). I was testing and comparing the existing theories of nonequilibrium statistical mechanics or dynamics of the approach to the thermodynamical equilibrium. One such theory is Dynamical Density Functional Theory. The Dynamical Density Functional Theory (DDFT) aims to write the equations for time evolution of fluid density incorporating the results of equilibrium DFT. Here we are interested mainly in the DDFT equations given for the time evolution of the coarse grained density $\overline{\rho}(\mathbf{r},t)$. Equilibrium solution of the Fokker-Planck equation corresponding to dynamical equations of $\overline{\rho}(\mathbf{r},t)$ leads to the conclusion that the statistical weight of equilibrium distribution goes as $\sim \exp(-\beta\mathcal{F}[\overline{\rho}])$, where $\mathcal{F}[\overline{\rho}]$ is the density functional being used in equilibrium DFT. We check the validity of these equations by comparing the results of Monte Carlo simulation using $\mathcal{F}[\overline{\rho}]$ as the Hamiltonian and MD simulation of hard spheres. These simulations have been performed with and without external periodic field. We find that in both cases the results are not in favor of DDFT, while equilibrium DFT gives very satisfactory results. I have also worked on Phase Field Model. We are very soon putting our work to be published.

Publications

Journal Articles

1 **Spatial modulation of the composition of a binary liquid near a repulsive wall.**
Shibu Saw, S. M. Kamil, and Chandan Dasgupta
*Phys. Rev. E***91**, 052406(2015) (**With SNU Affiliation**).

2 **A Coupled Map Lattice Model of Rheological Chaos.**
S.M. Kamil, Gautam I. Menon and Sudeshna Sinha
Chaos,**20**, 043123 (2010)
(http://arxiv.org/abs/1005.2041)

3 **The isotropic-nematic interface with an oblique anchoring condition.**
S. M. Kamil, A. K. Bhattacharjee, R. Adhikari and Gautam I. Menon
The Journal of Chemical Physics, **131**, 174701(2009)
(http://arxiv.org/abs/0908.2517)

4 **Biaxiality at the Isotropic-Nematic Interface with Planar Anchoring.**
S. M. Kamil, A. K. Bhattacharjee, R. Adhikari and Gautam I. Menon
Phys. Rev. E **80**, 041705(2009)
(http://arxiv.org/abs/0906.2899)

5 **Regular and Chaotic States in a Local Map description of Nematic Liquid Crystals**,
S.M. Kamil, Sudeshna Sinha and Gautam I. Menon,
Physical Review E **78**, 011706(2008).
(arXiv:0801.3876v2)

References

1. Prof. Gautam I. Menon Email: menon@imsc.res.in
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CIT Campus,

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2. Prof. Sudeshna Sinha Email: sudeshna@imsc.res.in
The Institute of Mathematical Sciences,
CIT Campus,
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Chennai 600 113 INDIA

3. Prof. Ronojoy Adhikari Email: rjoy@imsc.res.in
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4. Prof. Chandan Dasgupta Email: cdgupta@physics.iisc.ernet.in
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