

Shalabh Kumar Anand

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EDUCATION

Indian Institute of Science Education and Research Bhopal

PhD, Department of Physics

Thesis title: A Computer Simulation Study of Active Filaments and Anisotropic Microswimmers

Madhya Pradesh, India

January 2015 - September 2020

Banaras Hindu University

Master of Science, Department of Physics

Varanasi, India

July 2012 - June 2014

Banaras Hindu University

Bachelor of Science, Department of Physics

Varanasi, India

August 2009 - May 2012

Research Interests

I am interested in analytical as well as computational studies of soft matter systems. Out of which, active matter is the field I am currently working on. I employ computer simulations and theoretical models to study the physics of these out of equilibrium systems. My interests involve individual as well as collective behavior of active particles. Furthermore, I want to understand the collective richness of anisotropic chiral active particles. I am also interested in studying flow properties of suspensions of macromolecules and colloids. More specifically, my current interest can be divided in these subgroups:

Polymer Physics

Studying the properties of a polymer under different circumstances has a very long history. During the time, huge development has been done in its theoretical as well as experimental realisations. I employ theoretical models and computer simulations to study structure and dynamics of polymer chain under different physical conditions along with the presence of active forces.

Biological Physics

Studying the physical and mechanical properties of a Biological systems has seen a huge upsurge in last few years. During the time, huge development has been done in its theoretical as well as experimental realisations. I am interested in applying the theoretical models and computer simulations to study these complex systems (self-assembly of colloidal particles, protein aggregation, membranes, cells, tissues etc).

Active matter: Microswimmers and swarms

Study of active particles is in immense interest in last few decades. These particles show very different and emergent properties compared to particles in equilibrium. I study individual as well collective behaviour of anisotropic microswimmers, which also include the effect of fluid-flow on the system. I am also involved with a master's student in studying collective behaviour of isotropic active particles using quorum sensing rules. My research interest also involves theoretical study of a densely packed active particles.

Non-equilibrium Statistical Physics

The formulation of thermodynamic laws for the description of small-scale non-equilibrium systems in contact with heat and work reservoirs has deepened and extended our understanding of thermodynamics and its relation to microscopic laws in recent years. This novel connection has been made in various different contexts, including microscopic classical and quantum descriptions, mesoscopic descriptions embodied in stochastic thermodynamics. Study of fluctuation relations and heat dissipation in out-of-equilibrium systems also interests me.

Skills

During my PhD, I have worked mainly on active polymers. It includes conformational and dynamical behaviour of polymers under the influence of active forces. It also includes the behavioural study of dilute suspension of active polymers in the presence of hydrodynamic interactions in a confined environment in the presence of fluid flow. I use Brownian dynamics simulations as well as multi particle collision dynamics (MPCD) for hydrodynamic interactions among the particles. I heavily relied on my versatile programming skills to design high performance computing tools for workstations as well as for cluster computing environments.

Computer Proficiency

- Good level : FORTRAN, Linux, L^AT_EX, OpenMP
- Intermediate : C, C++, LAMMPS, HTML, CSS
- Basic level : Python, MPI

Communication Skills

- Hindi : Native speaker
- English : Oral(fair), Written(good)

Publications

7. Mimicking ciliary motion using active polymer chain model,
Shalabh K. Anand, Raghunath Chelakkot and Sunil P. Singh;
Manuscript under preparation.
6. Collective dynamics of microswimmers in a confined medium,
Shalabh K. Anand and Sunil P. Singh; Manuscript under preparation.
5. Phase separation of active colloidal suspension via quorum Sensing,
Francis Jose, **Shalabh K. Anand** and Sunil P. Singh; Soft Matter 2021.
4. Conformation and dynamics of a self-avoiding active flexible polymer,
Shalabh K. Anand and Sunil P. Singh; Phys. Rev. E, **101**, 030501 (Rapid), 2020.
3. Beating to rotational transition of a clamped active ribbon-like filament,
Shalabh K. Anand, Raghunath Chelakkot and Sunil P. Singh;
Soft Matter, 2019, **15**, 7926-7933.
2. Behavior of active filaments near solid-boundary under shear flow,
Shalabh K. Anand and Sunil P. Singh; Soft Matter **15**, 4008-4018, 2019.
1. Structure and dynamics of a self-propelled semiflexible filament,
Shalabh K. Anand and Sunil P. Singh; Phys. Rev. E **98**, 042501(2018).

Conferences & Seminars

Participation

- Bangalore School of Statistical Mechanics (7th edition) 2016, ICTS Bangalore (India)
- Statistical Physics of Soft Matter (SPSM 2015), Banaras Hindu University, Varanasi (India)
- Inhouse symposium November 2015, IISER Bhopal (India)

Contributed poster presentation

- COMPFlu 2019, IISER Bhopal (India)
- Winter School on Motile Active Matter: Nanomachines, Microswimmers, and Swarms, February 2019, Juelich, Germany
- Workshop on "Soft and Active Matter" 2018, University of Hyderabad (India)
- COMPFlu 2017 IIT Madras, Chennai(India)
- Collective Dynamics of-, on- and around filaments in living cells: motors, maps, tips and tracks 2017, ICTS Bangalore (India)

Contributed talk

- Inhouse symposium October 2018, IISER Bhopal (India)
- Inhouse symposium October 2017, IISER Bhopal (India)

References

Dr. Sunil Pratap Singh (PhD mentor)
Assistant Professor,
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Bhopal 462 066, Madhya Pradesh, India
Email: spsingh@iiserb.ac.in

Dr. Raghunath Chelakkot (Collaborator)
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