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## Research Interests

- Soft matter and Biological Physics

## Brief Summary of Research

The research work of Prof. P. B. Sunil Kumar (PBSK) is now focused on Lipid membranes and semiflexible polymers. His major emphasis in research has been to employ computer simulation techniques to investigate the properties of these systems in its equilibrium, non-equilibrium and active steady states. In a set of paper recently s PSSK and demonstrated that many key processes involved in the structural organization of membrane nematogens can result from from the cooperative thermodynamic behavior of the membrane curving proteins coupled to the flexible membrane. PBSK have studied the steady state shape of closed vesicles to active fission and fusion and showed they can give rise to a variety of equilibrium and steady state shapes that have striking similarity of the of the intercellular compartments. Elasticity of a biological cell, how force transmits through the interior of a cell and the collective action of polymers and molecular motors to generate propulsion other areas that PBSK and group have been interested in. They were able to show that active filaments, consisting of linked nanoscopic objects that can self propel, can exhibit periodic beating motion as the result of long range hydrodynamic interactions.

Designing materials with specific properties and understanding how they behave under different processing conditions is a core issue in materials manufacturing. The models and techniques involved in such a study need to cover many orders of magnitude in length and time scales. Developing such multi-scale models with capability to predict properties of the materials both at the molecular level and at macroscopic level is an area PBSK in currently interested in.

## Recent Publications (Full list of publications: [www.vinodap.co.nf/publications.html](http://www.vinodap.co.nf/publications.html))

- N. Ramakrishnana, P. B. Sunil Kumar and Ravi Radhakrishnan, “**Mesoscale computational studies of membrane bilayer remodeling by curvature-inducing proteins**”  
Physics Reports Volume: 543 Page: 1-60, 2014
- Alexander D. Olinger, Eric J. Spangler, P. B. Sunil Kumar, Mohamed Laradji, “**Membrane-mediated aggregation of anisotropically curved nanoparticles**”,  
Faraday Discussions, 2016, Volume: 186 Page: 265, 2016
- Raj Kumar Manna a and P. B. Sunil Kumar, “Emergent topological phenomena in active polymeric fluids”, Soft matter Volume:15 (3), Page: 477-486, 2019.
- Madhusmita Tripathy, P. B. Sunil Kumar, Abhijit P. Deshpande, “**Molecular Structuring and Percolation Transition in Hydrated Sulfonated Poly(ether ether ketone) Membranes**”  
The Journal of Physical Chemistry B, Volume: 121 Page: 4873 2017