Sakuntala Chatterjee

Associate Professor
Theoretical Sciences
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Guidance of Students/Post-Docs/Scientists

a) Ph.D. Students

1. Shobhan Dev Mandal; Bacterial chemotaxis; Under progress
2. Deepsikha Das; Nonequibrium systems with periodic drive; Under progress; Punyabrata Pradhan, SNBNCBS (Co-supervisor)

Publications

a) In journals

1. Shobhan Dev Mandal and **Sakuntala Chatterjee**, *Effect of receptor clustering on chemotactic performance of E. coli: Sensing versus adaptation*, Physical Review E, Letters 103, L030401, 2021

Talks / Seminars Delivered in reputed conference / institutions

1. Invited talk in an online International conference "Statistical Biological Physics: From Single Molecule to Cell"; Dec 7-18,2020; Online
2. Invited seminar at ICTS Bangalore.

Administrative duties

1. Served in many internal committees of the centre

Extramural Projects (DST, CSIR, DAE, UNDP, etc.)

1. Theoretical investigation of run-and-tumble motion in a noisy environment; SERB Matrics; 3 years; PI

Outreach program organized / participated

1. Organized virtual lab visits and online talks for young girl students from East Midnapore schools to encourage them to choose STEM field in their future career. This initiative was under Vigyan Jyoti scheme of DST.

Areas of Research

Nonequilibrium statistical physics, biological systems

Sensing vs adaptation in bacterial chemotaxis: With the advent of sophisticated techniques to measure single-cell response in experiments, an important question has emerged: how the behavior of a cell is affected by the fluctuations present at the intracellular biochemical reaction network. We address this question within the framework of E.coli chemotaxis, one of the best characterized systems in biology. The chemotaxis describes the migration tendency of the Escherichia coli cell towards the region of higher nutrient concentration. In the underlying reaction network, methylation is the slowest step. Any fluctuation present at this step acts as a slow noise which cannot be integrated out in the downstream processes. As a result, methylation noise was

considered to be the most important source of biochemical noise for E.coli chemotaxis. Recent experiments have recorded strong fluctuation in the chemoreceptor activity even in the absence of methylation. It was shown that the cooperativity of the receptors which gives rise to clustering tendency among the neighboring receptors, is an important source of noise. We ask the question: how this newly found noise source is ralated to the chemotactic performance of the cell. Our numerical simulations within a detailed theoretical model shows that there is an optimum size of the receptor cluster at which the cell shows most efficient chemotaxis. We explain this surprising result from the competition between sensing and adaptation, which are two principal modules of the reaction network.

Plan of Future Work Including Project

1. A detailed study of bacterial chemotaxis in presence of external and internal noise
2. Understanding the effect of periodic drive in systems out of equilibrium