

MONDAY

COLLOQUIUM

Exploring the 'dynamics' range of optical tweezers in mesoscopic matter: from inducing exotic rotations in water to driving activity in air

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27 Jan 2025 (Monday) | 16:00 Hrs (Tea / Coffee 15:45 Hrs) | Venue: TIFRH Auditorium

Optical tweezers offer unmatched versatility in driving exotic dynamics in mesoscopic matter immersed in fluids. In this talk, I shall describe some of our experiments on mesoscopic colloidal particles trapped in water and air, where we observe rather exotic dynamics in the trapped particles. In water, we use effects of the spin-orbit interaction of light induced due to tight focusing in tweezers, and tuned by the presence of a refractive index stratified medium in the light path, to obtain simultaneous rotation and revolution in trapped highly birefringent microscopic particles. Indeed, the entire system of spinning and revolving particles is reminiscent of planetary motion at mesoscopic scales. In air, we trap highly asymmetric and absorbing Carbon microparticles utilising photophoretic forces. Intriguingly, we observe coupled motion in the axial and radial directions, leading to the position probability distribution being of a bimodal nature - with diffusive behaviour in the radial and active-like behaviour in the axial direction. The degree of activity can also be controlled by the laser power. A two-dimensional Langevin model incorporating stochastic forces along the axial direction replicates the observed behaviours, showing agreement with experiments. This is, to the best of our knowledge, the first observation of simultaneous active and diffusive-like behaviour of particles trapped in optical tweezers.