TIFR Centre for Interdisciplinary Sciences
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Seminar

The dynamics of finite-sized particles in turbulent airflows

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The dynamics of heavy particles in turbulent flows is of great natural and industrial importance. In this colloquium we will focus on some recent theoretical, numerical and experimental results in this area which is strongly motivated by a need to understand the microphysics of cloud formation.

In the first part of the talk, we show results from experiments and direct numerical simulations that validate the Stokes model and show that droplets suspended in a turbulent flow approach very close to each other with very intense velocities. This is due to the sling effect, which consists in the droplets detachment from the fluid motion before being vigorously thrown toward each other. These events produce fat tails in the probability distribution of velocity differences, which are related to fluid flow statistics in terms of an optimal sling size balancing the kinetic energy content of large turbulent eddies with the damping due to viscous drag.

We then focus on heavy particles suspended in a turbulent flow which settle faster than in a still fluid. This effect stems from a preferential sampling of the regions where the fluid flows downward and is quantified here as a function of the level of turbulence, of particle inertia, and of the ratio between gravity and turbulent accelerations. By using analytical methods and detailed, state-of-the-art numerical simulations, settling is shown to induce an effective horizontal two-dimensional dynamics that increases clustering and reduce relative velocities between particles. These two competing effects can either increase or decrease the geometrical collision rates between same-size particles and are crucial for realistic modeling of coalescing particles.

Thursday, August 28th 2014

11:30 AM (Tea/Coffee at 11:15 AM)

Seminar Hall, TCIS