Effect of gravity on acceleration statistics of inertial particles in homogeneous isotropic turbulence: A numerical investigation

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Understanding the dynamics of inertial particles in a turbulent fluid has received attention in particle-laden community. The topic has a wide range of application both in theoretical physics (proto-planetary dust) as well as in the environment and industry (sediment transport, cloud formation, spray nozzles, numerical weather prediction, etc). Acceleration statistics of inertial particles in the presence of turbulence have been studied quite extensively mainly to understand the nature of the forces acting on particles. This has in turn led to the development of theoretical understanding to model the inertial particle dynamics. To this end, over the past years, most of the research is focused on studying the effect of turbulent Reynolds number (R_λ) and particle Stokes number (St) on acceleration of particles. Usually the effect of gravity has been neglected in the past studies in order to reduce the parameter space of the problem. This is while almost all natural phenomena take place in a gravitational field. Therefore, via direct numerical simulation (DNS) of turbulence, in this talk we will explore the effects of gravity on particle acceleration statistics. We will focus on the results from DNS of 256^3 flow simulation with $O(10^6)$ droplets in the context of cloud physics (droplet radii ranging from 10 to 60 micron).

In this research, we will extend the parameter space of the particle acceleration statistics to include dimensionless sedimentation (S_v). By including gravity, we hope to to gain a better quantitative understanding of particle-turbulent interaction and to realistically reproduce the conditions pertinent to warm rain formation.

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