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Inertial Particles in Turbulent Flows and the Clustering Instability of Interstellar Dust

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The dynamics of dust grains in turbulent flows plays an important role in many astrophysical processes. I will review the problem of the formation of planetesimals (precursors of full-fledged planets) in turbulent circumstellar disks. I will then discuss some fundamental aspects of the physics of heavy particles in turbulent flows, and specifically the phenomenon of small scale clustering, an effect verified by laboratory experiments and in situ terrestrial cloud sampling. I will present results of large numerical simulations of particle-laden compressible turbulence, including statistics of clustering and of particle velocity differences.