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GRANULAR SHEAR-FLOW INSTABILITY IN THE EPSTEIN REGIME UNDER MICROGRAVITY CONDITIONS

Abstract

Stability analysis of two-fluid disc models has advanced our understanding of planetesimal formation, where particles in a gas stream create shearing layers and shear-flow instabilities, leading to turbulence. In extraterrestrial environments, the gas is so rarefied that drag forces operate in the Epstein flow regime. Recreating such conditions on Earth is challenging due to gravitational sedimentation of the solid particles. Using particle image velocimetry in a microgravity environment, we experimentally demonstrate the onset of granular shear flow instability in a dilute dust-gas mixture, characterized by a periodic velocity field. This is the first direct measurement of such a phenomenon under conditions analogous to those in planet-forming discs, including similar Knudsen number, Reynolds number, and particle density.