Nonlinear Structures and Associated Dust Transport in Nonuniform Space and Laboratory Dusty Plasmas*

Padma K. Shukla

Institut für Theoretische Physik IV, Ruhr–Universität Bochum, D-44780 Bochum, Germany

Dastgeer Shaikh

Institute of Geophysics and Planetary Physics, University of California Riverside, CA 92507, USA

ABSTRACT

Dust and dusty plasmas are ubiquitous in nonuniform space environments and low-temperature laboratory discharges. Dusty plasmas are composed of electrons, ions, micron-sized charged dust particulates and neutrals. Our objective here is to present analytical and simulation studies of highly resolved dust fluid flows involving nonlinearly coupled incompressible surface dust vortex modes (SDVMs) and dust zonal flows (DZFs) in unmagnetized dusty plasmas containing equilibrium plasma pressure and dust charge density inhomogeneities. Our investigation is based on the Hasegawa-Shukla (H-S) equations (Phys. Lett. A **332**, 82, 2004) in which the dust vorticity and dust mass density are nonlinearly coupled. Computer simulations of the H-S equations reveal that large scale SDVMs emerge through nonlinear interactions with DZFs, and they suppress the dust particle transport across the density gradient. By contrast, DZFs posses short scale vortices with a higher turbulent transport. The relevance of our investigation to the role of coherent dust structures in space and laboratory plasmas is discussed.

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