3rd Asia-Pacific Conference on Plasma Physics, 4-8,11.2019, Hefei, China

# Phase transitions in gravitational dusty plasmas

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The dust present in molecular clouds is generally charged due to the presence of Hydrogen plasma. In the paper we construct equilibrium of dust cloud where the self-gravity of dust is balanced by the total dust pressure which in weak coupling limit is the sum of kinetic and electrostatic pressure. The former scales linearly while later scales quadratically with dust number density. We construct these equilibria analytically where the equilibrium problem can be solved using the mean field approximation and also through MD simulations[1]. There is good agreement between the mean field solutions and MD solutions. In the second part of paper we show the existence of first order phase transition. We construct a sequence of equilibria for given temperature of the dust. What show that for high values of temperature we get diffuse equilibria. If the temperature is below a critical value, there is spontaneous transition to an equilibrium with high density core and a diffuse envelop. The transition from diffuse equilibrium to core-halo equilibrium is accompanied by phase co-existence where initially small dust droplets are formed which coalesce to give a high density core. These results are applied to analyse the collapse of dust in HII region of GMC.

References
1. Manish Shukla and K. Avinash, Phys.Plasmas 26, 013701 (2019)