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The Two-Flow Interactions in Dusty Plasma

Ying-Dong Jia, Christopher T. Russell, Hairong Lai, and Hanying Wei
UCLA, IGPP, los angeles, United States (yingdong@ucla.edu)

Charged dust has been found in many places in space. The number density of such fine particles often well exceeds one per Debye sphere. Thus, such interactions can be treated as a dusty plasma problem. The most common interaction in such dusty plasma is the evolution of a dust cloud in a plasma flow. In this study we investigate the behavior of two massive fluids: regular ions and charged dust. For simplification, we temporarily ignore the charging process of dust particles. The mass of charged dust can be 10^3 amu to grams, but we only model the lighter ones because the behavior of grains more massive than 10^5 are similar. For completeness, we also model a light "dust" fluid composed of particles from 1 to 1000 amu, representing interactions with two ion components. A multi-fluid code is used to simulate the large scale structure of such interactions, and compare cases when the "dust" fluid is composed of particles of mass 1, 10, 137, 800, 3000, 10^4, 10^5 amu. In addition, the behavior of varying dust density is also compared. Three-D magnetic structures are formed by such interactions, and waves can be seen in light-particle cases. Two well-documented events are used to constrain our numerical study: the AMPTE Barium (137 amu) release, and an interplanetary field enhancement (IFE) event observed by 5 spacecraft simultaneously. The IFE is best modeled by nano-dust of about 10^4 amu carrying one proton charge in the solar wind.