Dispersion relations for the symmetric and anti-symmetric Hasegawa surface waves in a plasma slab containing collisional electrons and flowing ions

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Surface wave propagation on the interface between plasmas and a vacuum has drawn much attention because of interests in bounded plasmas and applications in various technical areas of plasma technologies and sciences. Since the actual plasmas in laboratory and space plasmas have boundaries and often take the structure of slab or planar geometry, waves propagating in a slab are of great importance. The slab plasma would support two modes of surface waves called symmetric and anti-symmetric modes, specified with respect to their parallel electric field components which are symmetric or antisymmetric with respect to the slab axis. In this work, the dispersion relations for the symmetric and anti-symmetric modes of electrostatic Hasegawa surface wave propagating in a cold dusty plasma slab whose constituents are collisional electrons, collisional streaming ions and dust grains are derived. We find that there are high- and low-frequency branches for both symmetric and anti-symmetric modes in the plasma slab. The real frequency of the wave is found to decrease as the ion collision frequency is increases for both modes. In the case of low-frequency branch, the phase velocity of the Hasegawa surface wave in a slab is always faster (slower) than that in a semi-bounded plasma for symmetric mode (anti-symmetric mode). We also found that the Hasegawa surface waves can be damped by the collisional dissipation. However, the characteristic of damping is quite different for the two modes: the magnitude of damping rate for symmetric (anti-symmetric) mode increases (decreases) as the slab thickness decrease.