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Basic plasma experiment in DC plasma device - Landau damping of ion acoustic waves DCプラズマ装置におけるイオン音波の基礎実験

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Landau damping of ion acoustic wave (IAW) in a DC plasma device is studied. The ion acoustic wave is generated by an excitation grid and the wave amplitude is observed in space by spatially distributed probes. Plasma parameters are in the range of 10^9 cm^{-3} for the density and a few electron volts for the electron temperature. When the hydrogen impurities are added to argon plasmas the ion acoustic wave damps due to the increase of the particles with velocities close to the phase velocity of IAW.

1. Basic experiments at educational environment

Wave-particle interaction [1,2] plays an important role in regulating microscopic and macroscopic instabilities in collision-less plasmas. In this work, Landau damping of ion acoustic wave in a DC plasma device is studied. We aim at education and training of the graduate students [3]. In Ref.[3], the ion acoustic wave is generated by an excitation grid (with a real frequency "ω_1") and the Landau damping is observed in space by spatially distributed probes. The background argon pressure is set to order of m torr. Plasma parameters are in the range of ~10^9 cm^{-3} for the density and a few electron volts for the electron temperature. Damping of ion acoustic waves with and without hydrogen impurities are investigated. When the hydrogen impurities are added to argon plasmas, the wave damps significantly (since the number of the particles with velocities close to the phase velocity of IAW increase, see Fig.1).

2.Discussions

The DC plasma device consists of a metal vacuum vessel of a cylindrical shape. Relatively inexpensive experimental setting are considered (see e.g. Ref.[4], the *Soup-pot experiment* uses permanent magnets to create cusp fields in improving confinement) at our educational environment. Landau damping in itself is a reversible process in the absence of collisions. Now, we consider whether we can generate plasma echoes (which is feasible in the DC plasma setting) by exciting the "ω_2" wave at the second excitation grid. Possible effects of Coulomb collisions on plasma echoes [6,7] (both by increasing the ion densities and the neutrals), which can significantly alter the distribution function, and thus the damping process, are also discussed.

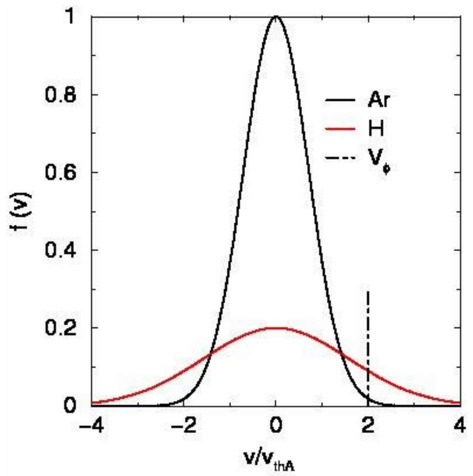

Fig.1. A conceptual diagram of the velocity distribution of argon plasmas and hydrogen plasmas. Due to a large population of hydrogen plasmas at "$v=v_{thA}$", damping can be enhanced significantly.

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