

## Generation and Property of Pair-Ion Plasma using Fullerene

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Pair plasmas consist of positive- and negative-charged particles with an equal mass. Parity in temporal and spatial scale of both the particles behavior is a special property which is quite different from that of ordinary plasmas. Pair plasmas consisting of electrons and positrons have experimentally been produced. However, the identification of the basic properties and collective modes in the positron-electron plasmas is very difficult because the annihilation time is short compared with the plasma period and the plasma density is too low. Therefore our attention is concentrated on the stable generation of a pair-ion plasma consisting of positive and negative ions with an equal mass and the collective-mode identification, where fullerenes are used as an ion source.

When a hollow electron beam with 100 eV is injected to a fullerene vapor under a uniform magnetic field, positive ions are produced by electron impact ionization and electrons with low energy (less 10 eV) are produced then. Negative ions are produced by electron attachment of these low-energy electrons. The electrons and ions are radially separated by a magnetic-filtering effect. Only positive and negative ions are expected to exist in the midmost of the hollow plasma, passing through an annular hole toward downstream. The electron-free pair-ion plasma generation is attained here.

The density of the pair-ion plasma passing through the inside of a cylindrical electrode can be controlled by applying a bias voltage to the electrode. Since longitudinal-electrostatic modes are excited when sinusoidal voltages are applied, the dispersion relations of the modes can be investigated in detail. There appear three modes which are an ion acoustic wave (IAW) and an ion plasma wave (IPW), both of which are predicted in the two-fluid theory, and an unprecedented intermediate-frequency wave (IFW) which behaves like a backward wave. The properties of the modes and the phase lag between the density fluctuations of positive and negative ions will be discussed.