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２流体プラズマの各流体の巨視的モードの自己ポテンシャル依存性
Dependence of Macroscopic modes on Self-Potential of Two-fluid Plasmas

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A two-fluid plasma model is one of extended magnetohydrodynamics (MHD) models and widely used for explaining macroscopic plasma phenomena that cannot be explained by the conventional one-fluid MHD. In the two-fluid plasma model, velocity fields of ion and electron (e^-) fluids are determined by corresponding each fluid equation of motion. However, such a two-fluid plasma state has not ever been verified in laboratory experiments. To investigate the two-fluid plasma state experimentally, we have experimented the state by using pure lithium ion (Li^+) [1] and e^- plasmas. These plasmas can be confined not only independently but also simultaneously [2] in the BX-U linear trap [3].

They are non-neutral plasmas because of their charge non-neutrality. Thus, they can relax into corresponding rotating thermal equilibria. They last longer than 10 sec. In addition, they azimuthally rigid-rotate in opposite direction each other, owing to their different charge polarity. These allow to conduct experiments with exact initial conditions of the Li^+ and e^- plasmas and control the ratio of the ion density (n_i) to the electron one (n_e).

In the BX-U, a uniform magnetic field in the axial (z) direction confines both Li^+ and e^- plasmas radially. They are trapped [4, 5] in the corresponding positive and negative potential wells in the BX-U, respectively. Figure 1 shows when the Li^+ and e^- plasmas are experimentally superimposed each other. Regarding diagnostics, a micro-channel plate (MCP) followed by phosphor screen [6] is installed in the most downstream region of the BX-U. When either Li^+ or e^- fluid enters the MCP, the phosphor screen emits light. This is taken as an image by a high-speed camera that is placed outside the vacuum vessel. After analyzing the images, changes in two-dimensional shape of both Li^+ and e^- fluids are recognized after the elapse of two-fluid plasma state as shown in Fig. 1(b) where the ratio of n_e to n_i is in the range between 4 and 13. In this meeting, we will show initial results for the case of $n_e > n_i$.

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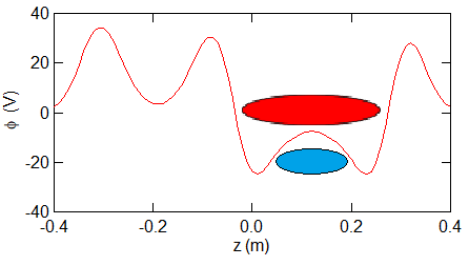

FIG. 1 Schematic of experimental superimposition of the Li^+ plasma on the e^- plasma in a nested trap of the BX-U linear trap.

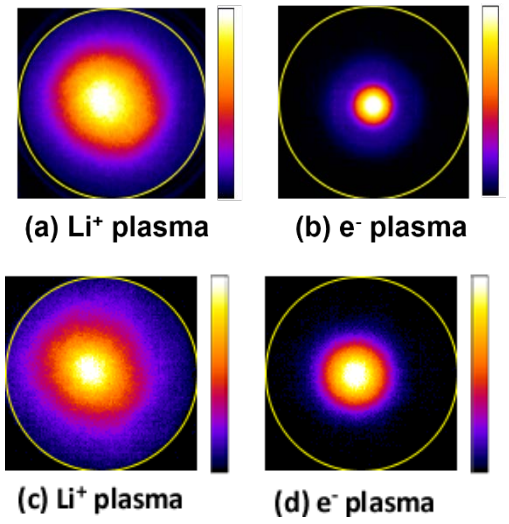

FIG. 2 Typical sets of images of Li^+ and e^- plasmas before and after the superimposition.