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## Experiments of superimposing $\text{Li}^+$ plasma on $e^-$ plasma for producing two-fluid plasmas on BX-U linear trap

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Two-fluid plasmas are one of extended magnetohydrodynamics (MHD) models and are recently used for explaining phenomena that cannot be explained by the conventional MHD. In two-fluid plasmas, velocity fields of ion and electron ( $e^-$ ) fluids are independent each other. However, no such two-fluid state has not been clearly observed in laboratory experiments. Also, the related two-fluid effect on especially the better confinement of ions and the suppression of several fluid instabilities is not clearly confirmed experimentally.

To investigate the two-plasma state and the related two-fluid effects, we have used nonneutral plasmas. Usually, a nonneutral plasma consists of either pure ion or  $e^-$ , and its confinement time is much better than that of neutral plasmas. In BX-U linear trap [1], we confine lithium ion ( $\text{Li}^+$ ) [2] and  $e^-$  fluids not only independently but also simultaneously [3]. In the BX-U, a uniform magnetic field in the axial direction confines particles radially, and both positive and negative potential wells separately trap the  $\text{Li}^+$  and the  $e^-$  fluids, respectively. Regarding diagnostics, a micro-channel plate (MCP) followed by a phosphor screen [4] is installed in the most downstream region of the BX-U and a high-speed camera is set outside. When charged particles are injected into the MCP, the phosphor screen emits light. From images of this luminescence, we analyze two-dimensional distributions of both fluids. To capture both images of  $\text{Li}^+$  and  $e^-$  plasmas successively, we built an electric circuit by which the high voltage applied to the MCP is switched [5]. With this method, we continuously take photographs of the luminescence caused by the  $\text{Li}^+$  and  $e^-$  fluids.

To produce the two-fluid state, we superimpose  $\text{Li}^+$  and  $e^-$  fluids. In Fig. 1, we show preliminary images that are taken after the cases where (a) only a  $\text{Li}^+$  fluid is confined, (b) only an  $e^-$  fluid is confined, and (c) both  $\text{Li}^+$  and  $e^-$  fluids are superimposed. For these,  $\text{Li}^+$  and  $e^-$  fluids are continuously injected in this order in the trap [6], as shown in Fig. 2. Details of the data on superimposing the two fluids will be presented in the conference.

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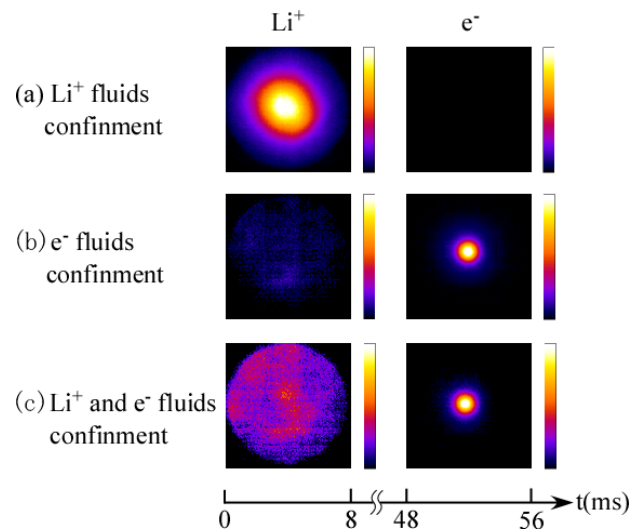


Figure 1. Typical images of luminescence obtained after (a) only a  $\text{Li}^+$  fluid is confined, (b) only an  $e^-$  fluid is confined and (c) both  $\text{Li}^+$  and  $e^-$  fluids are superimposed in a nested trap of the BX-U.

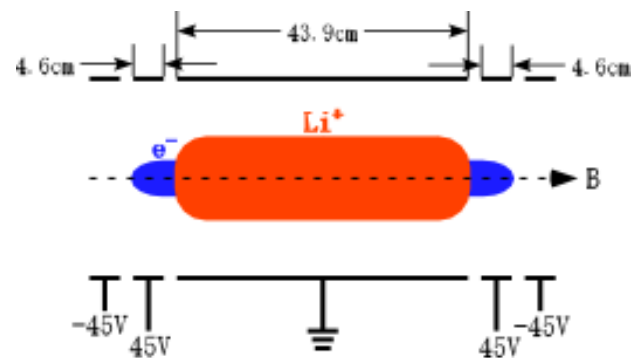


Figure 2. Schematic of the nested trap in the BX-U.