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Measurements of axial bounce motion of lithium ion plasmas on BX-U linear trap

K. Akaike, H. Himura, S. Yamada, K. Furukawa, T. Kato, S. Masamune

Kyoto Institute of Technology, Department of Electronics, Kyoto 606-8585, JAPAN

S. Okada

Osaka University, Suita, Osaka 565-0871, JAPAN

To investigate two-fluid plasma effects in laboratory experiments, Li^+ ion and e^- plasmas are produced independently and confined simultaneously [1] in the BX-U linear trap [2-5]. A Li^+ ion beam is injected into a positive potential well to produce the Li^+ ion plasma. When the voltage of the upstream potential barrier is increased, some of the injected ions overcome the downstream potential barrier. Such ion leakages were observed in another experiment [6], however, detail of the ion leakages have not been explained.

Our recent study shows that such ion leakages are caused by two physical mechanisms. And, one of these seems to be closely related to the axial bounce motion of the ion plasmas, which is driven by the closure of the upstream potential barrier.

To detect the axial bounce motion experimentally, we employ a highly sensitive current amplifier that is connected to an electrode to measure the image current induced by the axial bounce motion of the ions. Figure 2(a), (b), and (c) show the time evolution of the upstream potential barrier, the measured noise obtained from a vacuum baseline shot, and the measured current during a plasma test shot. Ion plasmas are confined between 250 and 500 μs. Clear oscillation can be recognized when the ion plasma is confined. In this case, the measured current peak-to-peak amplitude is about 40 nA and the oscillation frequency is ~ 29 kHz. These values depend on experimental parameters. Details of these measurements will be presented in the conference.

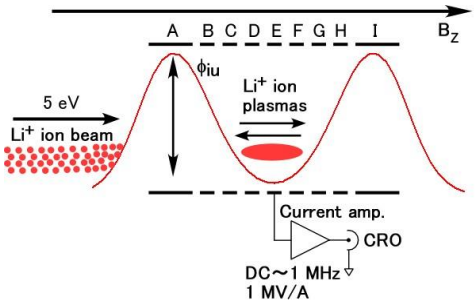

Figure 1. Setup for measuring axial bounce motions of Li^+ ion plasmas.

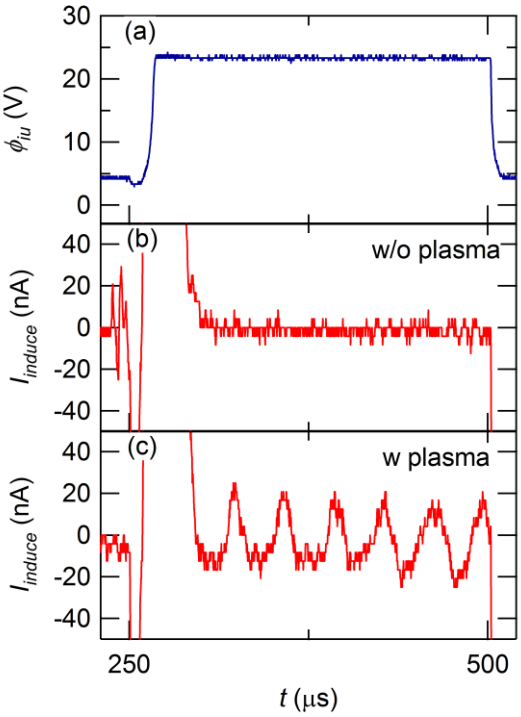

Figure 2. Typical time dependences of (a) the voltage applied to the upstream potential barrier, (b) measured noise obtained from a vacuum shot, and (c) the image current of Li^+ ion plasmas.

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