

Radial Compression of a Non-neutral Plasma in a Non-uniform Magnetic Field of a Cusp Trap

H. Saitoh^{1*}, A. Mohri¹, Y. Enomoto^{1,2}, Y. Kanai¹, and Y. Yamazaki^{1,2}
 MUSASHI group of ASACUSA collaboration

¹Atomic Physics Laboratory, RIKEN, Saitama 351-0198, Japan

²Graduate School of Arts and Sciences, University of Tokyo, Komaba 277-8561, Japan

Spectroscopic comparison of antihydrogen and hydrogen atoms is one of the best candidates for the stringent tests of the CPT symmetry, and intensive studies are being carried out by using Antiproton Decelerator at CERN [1, 2]. The ASACUSA collaboration has constructed a superconducting cusp trap for the formation, trapping, and extraction of antihydrogen atoms [3], where a quadrupole magnetic field is generated by a pair of anti-Helmholtz coils [4]. The cusp configuration is considerably advantageous for the extraction of spin-polarized and ground-state antihydrogen beams that are ideal for the spectroscopic measurements of hyperfine structures of the ground state of antihydrogen [3]. For the effective generation of antihydrogen atoms, it is essential to form high density and stable plasmas of antiproton and positrons. In this study, we applied a rotating electric field to an electron plasma in the inhomogeneous cusp magnetic field, and demonstrated the effective radial compression of a non-neutral plasma in a broad frequency range [5]. The compression rate depended on the rotating frequencies and had a broad peak extending on both sides of a longitudinal (1,0) mode frequency. The similar procedure can in principle be applied to positron and antiproton plasmas. Radial compression of these plasmas is one of necessary means for the future experiments to synthesize antihydrogen atoms in the cusp trap.

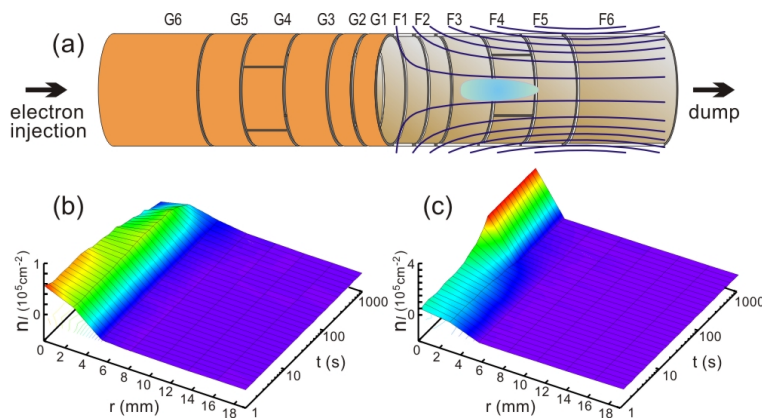


Figure: (a) Trap geometry including electrodes and magnetic field lines. Temporal evolutions of line-integrated density profile measured by a Faraday cup (b) when rotating wall is not applied and (c) when applied.

[*] Present address: *Graduate School of Frontier Sciences, University of Tokyo, Chiba 277-8561, Japan.*

[1] M. Amoretti *et al.*, *Nature* **419**, 456 (2002).

[2] G. Gabrielse *et al.*, *Phys. Rev. Lett.* **89**, 213401 (2002).

[3] A. Mohri and Y. Yamazaki, *EuroPhys. Lett.* **63**, 207 (2003).

[4] A. Mohri *et al.*, *Jpn. J. Appl. Phys.* **37**, L1553 (1998).

[5] H. Saitoh, A. Mohri, Y. Enomoto, Y. Kanai, Y. Yamazaki, accepted to *Phys. Rev. A*.