Confinement Time Exceeding One Second in a Toroidal Electron Plasma

M.R. STONEKING, J.P. MARLER, BAO HA, J.C. SMONIEWSKI,
Lawrence University — Pure electron plasmas \(n = 2 \times 10^7 \text{ cm}^{-3}, a = 1.27 \text{ cm}, R_p = 17.4 \text{ cm}\) are confined for times exceeding one second in a new toroidal device, the Lawrence Non-neutral Torus II. The plasma is trapped in a 270\(^\circ\) toroidal arc by application of gate potentials to sections of a sectored gold-plated toroidal boundary \((b = 3.81 \text{ cm}, R_0 = 18 \text{ cm})\). At base vacuum pressures below \(10^{-8} \text{ torr}\) and magnetic field strengths approaching 700 gauss, the \(m = 1\) diocotron mode is excited by applying several cycles of rf near the resonant frequency to a section of the wall. The \(m = 1\) frequency, which is approximately proportional to the trapped charge, decays on a three second timescale, a confinement time that exceeds by at least an order of magnitude the confinement observed in all other toroidal traps for non-neutral plasmas. Numerical simulations that include toroidal effects are employed to accurately extract plasma charge and \(m = 1\) mode amplitude from the experimental data. Future work will include attempts to withdraw the electron source in order to study confinement in a full torus. This work is supported DOE-NSF Grant 0317412.

Matthew Stoneking
Lawrence University

Date submitted: 20 Jul 2007

Electronic form version 1.4