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Electron Plasma Heating due to Collisional Separatrix Crossings[1]

K.A. THOMPSON, A.A. KABANTSEV, C.F. DRISCOLL, UCSD — We observe heating of a pure electron plasma as it undergoes forced sloshing through an electrostatic squeeze potential. Our preliminary measurements show that separatrix induced heating is much larger than bulk viscous heating in the low collisionality regime and the scaling of the heating rate is consistent with theoretical predictions. The cylindrical plasma column is confined in a Penning-Malmberg trap where a θ-symmetric squeeze is applied to the axial midplane of the column. This squeeze creates a velocity separatrix that divides the phase space into regions of trapped and passing particles. Oscillating the confinement end potentials of the trap forces the plasma a distance, δL, through the squeeze potential. During the compression and expansion of the trapped particle orbits there is collisional separatrix heating, which is caused by particle diffusion across the separatrix, as well as bulk viscous heating. The heating rate is measured via changes in frequency of the $m_\theta = 1$ Diocotron mode. We use sloshing frequencies, f_{sl}, that are greater than the collision rate, ν_c , and smaller than the axial bounce frequency in order to minimize bulk viscous heating. For the low collisionality regime, the heating rate due to collisional separatrix crossings is predicted to scale as $dT/dt \propto T(\delta L/L)^2\ (f_{sl}\nu_c)^{1/2}$ which is in agreement with our results as well as results from recent experiments in pure ion plasmas (F. Anderegg, et al., BAPS.2016.DPPP.P10.114)

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