Experimental Measurements of Elliptical Electron Vortices\(^1\) M.T. AZIZ, W. SHI, X. WANG, T.B. MITCHELL, Dept. of Physics and Astronomy, U. Delaware, Newark DE — In the 2D \(E \times B\) approximation, a magnetized electron column is a vortex evolving in \((r, \theta)\) according to the Euler equation. We trap pure electron plasmas within hollow conducting cylinders in a uniform axial magnetic field, and subsequently measure the density \(n(r, \theta, t)\) by dumping the electrons onto a biased phosphor screen and measuring the light intensity. Diocotron/Kelvin modes, which are \(\cos(m, \theta)\) surface modes with no axial dependence, can be grown with a variety of techniques. We are able to access a new regime of very large amplitude modes through the use of precisely shaped applied impulses. Vortices with large amplitude modes have been found to be susceptible to a variety of processes which contribute to axisymmetrization, including resonant wave-fluid interactions, resonant beat wave-fluid interactions, and filamentation. We have explored the stability of very elliptical vortices with aspects ratios of up to \(a/b \sim 6\). We find that these vortices are additionally subject to instabilities of \(m = 2, 3\) and \(4\) surface modes similar to those predicted in 1893 for Kirchhoff elliptical vortices with \(a/b > 3\). Interestingly, the instability is observed on vortices with aspect ratios well below 3, and the effect may play a more important role in axisymmetrization than previously thought.

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