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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, θ) 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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