The growth of $m=3$ perturbations in elliptical vortices

The growth of $m=4$ and $m=6$ modes with and without a circular boundary.

**References**


**Experimental methods**

Electron vortices are pure electron plasma columns trapped within hollow conducting cylinders [2]. Negative potentials on the end-electrodes provide axial confinement, and a uniform axial magnetic field provide radial confinement. A rapid small amplitude motion averages over $z$ variations, allowing a 2D description of the system. The flow of the electrons is well described by 2D-Boussinesq dynamics, with an equation of motion which is isomorphic to the 2D Euler equations for a inviscid fluid of uniform density within a circular boundary. The vorticity of the electron flow is proportional to the electron line density which is directly measured in the experiment. Electron vortices have simple free-slip boundary conditions and low dissipation rates compared to vortices in conventional fluids.

**Computational methods**

The vortex methods have a long and respected history as a naturally adaptive method for computing vorticity dominated flows. These to impose represent the vorticity field of a fluid as a linear combination of moving, localized basis functions. Each basis function can be interpreted as a small patch of vorticity which influences all the other basis function (see a numeration at top left). It is an easy to impose new base functions on the fluid, in particular at the top right (bilinear patches). The use of a new basis function, such as those shown at top right, eliminates redundancy and introduces new base functions. The simulation growth rates agree well with the rates predicted by Love for a Kirchhoff vortex in an open domain. The experiment is different in that there is a circular boundary, and the vorticity profile is not initially steep. The simulation growth rates agree well with the rates predicted by Love for a Kirchhoff vortex in an open domain. The experiment is different in that there is a circular boundary, and the vorticity profile is not initially steep.