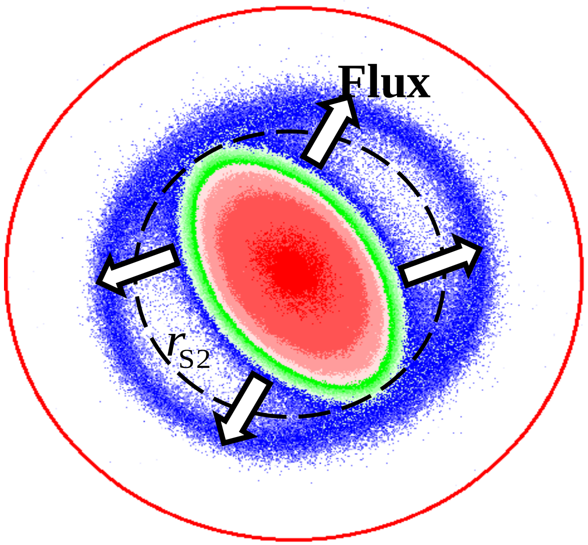
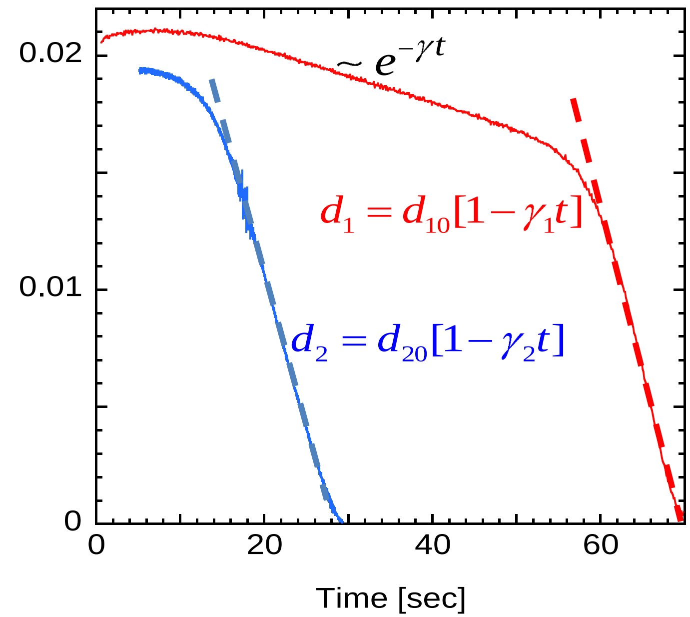
O'Neil /Driscoll /Dubin/UCSD

Algebraic Diocotron Mode Damping, aka Vortex Symmetrization



Diocotron modes are **E**×**B**-drift surface waves on magnetized electron plasma columns, and are isomorphic to Kelvin waves on vortices in 2D Euler flows. The image at left shows the measured vorticity (colors) in a large $m_\theta = 2$ (elliptical) wave. *Exponential* Landau damping (inviscid vortex symmetrization) occurs when vorticity interacts with the wave at the resonant radius r_{S2}, typically ceasing when a nonlinear "cat's eye" structure (blue) forms.

Recent experiments [1] and theory [2] elucidate a new *algebraic* damping process caused by a weak *flux of vorticity* through the resonant radius r_S. This occurs for the $m_\theta = 1$ (displacement) mode also. The plot shows measured wave amplitudes d_1 and d_2, each damping algebraically (as $1 - \gamma_m t$) once the (controlled) flux reaches r_S. This damping is fast, and it continues to zero amplitudes. Thus, even weak viscosity (causing negligible direct damping) which generates a weak outward *flux* will cause strong *algebraic damping*. The theory applies also to vortex symmetrization in 2D geophysical flows, and provides a new perspective on traditional plasma Landau damping [2].



1. A.A. Kabantsev et al., *Phys. Rev. Lett.*, **112**, 115003 (2014)
2. C.Y. Chim & T.M. O'Neil, *Phys. Plasmas*, **23**, 050801 (2016)