Abstract Submitted
for the DFD12 Meeting of
The American Physical Society

A bypass transition in the Lamb-Oseen vortex LUIGI BISANTI, PIERRE BRANCHER, CHRISTOPHE AIRIAU, IMFT — Transient energy growth in the short-time linear dynamics of a Lamb-Oseen monopole is a potential mechanism for nonlinear bypass transition, a phenomenon already observed in both experiments and numerical simulations. In the present study, we investigate this scenario by means of a nonlinear optimal perturbation approach, i.e. by looking for the initial perturbation whose evolution satisfies the fully nonlinear Navier-Stokes equations and maximizes the energy gain at a given time horizon. Preliminary two-dimensional results show that, for small initial amplitudes, the optimal perturbation and growth mechanisms observed in the linear regime are recovered. More particularly, the time evolution of the $m = 2$ optimal perturbation leads to an elliptical core deformation of the monopole, which suggests a potential bypass scenario driven by the non-linear dynamics. This is confirmed by computations for larger initial perturbation amplitudes: the optimal perturbation is similar to that of the linear regime but a subcritical bifurcation to a quasi-steady, high-energy, rotating tripole is observed.

Pierre Brancher
IMFT

Date submitted: 23 Jul 2012 Electronic form version 1.4