Abstract Submitted
for the DFD11 Meeting of
The American Physical Society

Resonant instability in two-dimensional vortex arrays PAOLO LUZZATTO-FEGIZ, Woods Hole Oceanographic Institution, CHARLES H.K. WILLIAMSON, Cornell University — In this work, we examine conditions for the development of an oscillatory instability in two-dimensional vortex arrays. By building on the theory of Krein signatures for Hamiltonian systems, and considering constraints owing to impulse conservation, we show that a resonant instability (developing through coalescence of two eigenvalues) cannot occur for one or two vortices. We illustrate this deduction by examining available linear stability results for one or two vortices. Our work indicates that a resonant instability may, however, occur for three or more vortices. For these more complex flows, we propose a simple model, based on an elliptical vortex representation, to detect the onset of an oscillatory instability. We provide an example in support of our theory by examining three co-rotating vortices, for which we also perform a linear stability analysis. The stability boundary in our model is in good agreement with the full stability calculation. In addition, we show that eigenmodes associated with an overall rotation or an overall displacement of the vortices always have eigenvalues equal to zero and $\pm i\Omega$, respectively, where Ω is the angular velocity of the array. These results, for overall rotation and displacement modes, can also be used to immediately check the accuracy of a detailed stability calculation.

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Date submitted: 16 Sep 2011 Electronic form version 1.4