Abstract Submitted
for the DFD05 Meeting of
The American Physical Society

Zigzag instability of vortex arrays in a stratified fluid PAUL BILLANT, AXEL DELONCLE, JEAN-MARC CHOMAZ, LadHyX, CNRS-Ecole Polytechnique, 91128 Palaiseau, France — We investigate the three-dimensional linear stability of classical vortex configurations (Von Karman street, double symmetric row) in a strongly stratified fluid. By means of an asymptotic theory in the limit of long-vertical wavelength and well-separated vortices, we demonstrate that both the Von Karman street and a double symmetric row of columnar vertical vortices are unstable to the zigzag instability. This instability corresponds to a bending of the vortices with almost no internal deformation and ultimately slices the flow into horizontal layers. The most unstable wavelength is found to be proportional to bF_h, where b is the separation distance between the vortices and F_h the horizontal Froude number ($Fh = \Gamma/\pi a^2 N$ with Γ the circulation of the vortices, a their core radius and N the Brunt-Väisälä frequency). The maximum growth rate is independent of the intensity of the stratification and only proportional to the strain $S = \Gamma/2\pi b^2$. These results may explain the formation of layers observed in stratified turbulence.

Jean-Marc Chomaz
LadHyX, CNRS-Ecole Polytechnique, 91128 Palaiseau, France

Date submitted: 15 Aug 2005 Electronic form version 1.4