Abstract Submitted
for the DFD13 Meeting of
The American Physical Society

Lilly mechanism versus Zigzag instability in the destabilisation of a stratified turbulent flow initially uniform on the vertical JEAN-MARC CHOMAZ, LadHyX, CNRS-École Polytechnique, Palaiseau, France, CRISTOBAL ARRATIA, EPFL, Lausanne, Suisse — It is now well established that strongly stratified turbulence involves a direct inhomogeneous cascade where the vertical scale is given by the buoyancy length scale as predicted by the Billant & Chomaz (2001) scaling (BCS). But the role of the so-called zigzag instability (ZZI) in imposing this scaling remains an open question, in particular because Lilly's arguments (similar to the toroidal cascade) do not involve vertical transport as ZZI does. The argument also predicts the occurrence of vertical scales much smaller than the horizontal scale. By performing transient energy growth of perturbations around an evolving, or even turbulent, flow that is vertically uniform we demonstrate that, except for flows made of well separated vortices, the layering of the flow results from the 2D perturbation mode associated to the leading Lyapunov exponent (measuring the sensitivity to initial condition of the 2D base flow) and not from the zigzag modes coming from neutral 2D mode associated with rotation and translation. The generic route to stratified turbulence seems then to be following a Lyapunov-Lilly avenue and not the zigzag winding road. Still, no matter which mechanism involved, the BCS scaling applies to the optimal gain explaining the anisotropy of stratified turbulence.

Jean-Marc Chomaz
LadHyX, CNRS-École Polytechnique

Date submitted: 01 Aug 2013 Electronic form version 1.4