Abstract Submitted
for the DFD09 Meeting of
The American Physical Society

Split energy cascade in turbulent flows DARIO VINCENZI, CNRS UMR 6621, Laboratoire J.-A. Dieudonne, Universite de Nice Sophia Antipolis, ANTONIO CELANI, Institut Pasteur, Paris, France, STEFANO MUSACCHIO, Dipartimento di Fisica Generale, Università di Torino, Italy, SYLVAIN RUBENTHALER, Laboratoire J.-A. Dieudonne, Universite de Nice Sophia Antipolis, France — Hydrodynamic turbulence exhibits a remarkable dependence on the space dimension. This property manifests for instance in the direction of the kinetic-energy cascade, which is direct in 3D and inverse in 2D. A passive scalar transported by a turbulent flow shows an analogous behavior. In isotropic flows, the variance of the scalar field cascades either downwards or upwards depending on the dimension, the degree of compressibility, and the scaling exponent of the carrier flow. We undertake a geometrical approach to investigate the dependence of turbulence and turbulent transport on the space dimensionality. We first consider a system that is fully under analytical control, i.e. a passive scalar transported by a Gaussian short-correlated flow on a cylindrical surface, where the radius can be inflated or collapsed at will. For any finite radius, the variance cascade splits into a direct branch and an inverse one. This behavior is intimately connected to the existence of a non-degenerate invariant measure for the fluid-particle separations. Direct numerical simulations of the Navier-Stokes equations show that also the kinetic-energy cascade splits when the aspect ratio of the flow is less than one.

Dario Vincenzi
CNRS UMR 6621, Laboratoire J.-A. Dieudonné,
Université de Nice Sophia Antipolis

Date submitted: 11 Aug 2009 Electronic form version 1.4