Abstract Submitted
for the DFD13 Meeting of
The American Physical Society

Numerical simulations of high Rayleigh, Prandtl and Schmidt number flows using multiple space/time resolutions ROBERTO VERZICCO, Università di Roma Tor Vergata, Dipartimento di Ingegneria Industriale, RODOLFO OSTILLA MONICO, ERWIN P. VAN DER POEL, DETLEF LOHSE, University of Twente, Physics of Fluids, PHYSICS OF FLUIDS TEAM — The numerical simulation of passive and active scalars in turbulence becomes more challenging as their diffusivity decreases. In fact, for large Prandtl or Schmidt numbers the Batchelor scale η_T is smaller than the Kolmogorov scale η and, being mesh size taylored to the smallest of the two, the momentum equation is integrated in space and time using unnecessary fine resolutions. This strongly penalizes the computation because, while the scalar dynamics is described by a single equation, the momentum evolves according to a vectorial equation and an elliptic equation for the pressure. Contrary to the intuition, it has observed that even in the case of a flow at Pr=0.7 the resolution needed for the scalar is larger than that of the momentum since the absence of pressure in the equation of the former keeps localized steep gradients. Motivated by the above observation here we show a novel numerical procedure that decouples the space and time resolutions of momentum and temperature and allows to use a refined mesh only for the quantities that need it. We show that, provided every quantity is adequately resolved, the conservation properties of the schemes are retained and at least an order of magnitude reduction of the computational effort is achieved.

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Date submitted: 31 Jul 2013 Electronic form version 1.4