Abstract Submitted
for the DFD05 Meeting of
The American Physical Society

Intermittency and Direct Numerical Simulations KATEPALLI R. SREENIVASAN, International Centre for Theoretical Physics, JOERG SCHUMACHER, Marburg University, VICTOR YAKHOT, Boston University — The conventional wisdom in direct numerical simulations (DNS) is that the turbulent velocity field can be regarded as fully resolved if the linear dimension of the discretization grid is the Kolmogorov scale. It then follows that the computational work in DNS increases with the large-scale Reynolds number Re as Re^3. The arguments leading to this conclusion, which will be reviewed briefly, ignore the effects of small-scale intermittency. It will be shown that the effect of this intermittency is to establish scales that are smaller than the Kolmogorov scale, and that a full resolution of the velocity field requires computational power of the order Re^4. This places more severe computational demands on DNS of turbulence. A few results from simulations performed with a grid resolution that is substantially finer than the Kolmogorov scale will be discussed. The changes that manifest in the tails of the probability density function and the multifractal spectrum will be discussed. The results demonstrate that extreme events of the dissipation field indeed require superfine resolution below the Kolmogorov scale. Similar issues relate to the passive scalar field as well, and the DNS performed with grid resolution that is finer than the Batchelor scale are discussed. The conclusions for the scalar field are qualitatively similar to those for the velocity field.

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Date submitted: 04 Aug 2005 Electronic form version 1.4