Abstract Submitted
for the DFD07 Meeting of
The American Physical Society

Characterization of Implicit LES Methods ANDREW ASPDEN, Lawrence Berkeley National Laboratory — The broad range of time and length scales present in high Reynolds number turbulent flows is often prohibitively expensive for direct numerical simulations (DNS) to capture completely. Large eddy simulation (LES) attempts to circumvent this issue by filtering out the small scale motions in the flow, replacing their effects with a subgrid model. High-order finite-volume schemes can accurately capture the inviscid cascade of kinetic energy, and the inherent truncation error acts as an implicit subgrid model, forming a natural form of LES. However, the absence of a physical viscosity prohibits conventional characterization of these methods, specifically how kinetic energy is dissipated at the grid scale and how to define a relevant Reynolds number. Kolmogorov's 1941 papers achieve this characterization for real-world viscous fluids in terms of a universal equilibrium range determined uniquely by the rate of energy dissipation and physical viscosity. Analogously, this paper proposes than an ILES method can be characterized by a universal equilibrium range determined uniquely by the energy dissipation rate and computational cell width. Implicit LES simulations of maintained homogeneous isotropic turbulence are presented to support this proposal and highlight similarities and differences with real-world viscous fluids. Direct comparison with data from high resolution DNS calculations provides a basis for deriving an effective viscosity and an effective Kolmogorov length scale.

Andrew Aspden
Lawrence Berkeley National Laboratory

Date submitted: 03 Aug 2007

Electronic form version 1.4