Abstract Submitted
for the DFD15 Meeting of
The American Physical Society

Finite Reynolds number properties of a turbulent channel flow similarity solution[1] JOSEPH KLEWICKI, University of New Hampshire/University of Melbourne, MARTIN OBERLACK, Darmstadt Technical University — Finite Reynolds number behaviors of the asymptotically logarithmic mean velocity profile in fully developed turbulent channel flow are investigated. This is accomplished by exploiting invariance properties admitted by the appropriately simplified form of the mean momentum equation. These properties underlie the existence of a similarity solution over an interior inertial domain. This similarity solution, which was originally demonstrated by numerically integrating the relevant nonlinear equation, is consistent with the emergence of a logarithmic mean velocity profile as the Reynolds number becomes large. It is now shown that the governing nonlinear equation has an analytical solution that contains both linear and logarithmic terms, but with the coefficient on the linear term decaying to zero with Reynolds number. Existing DNS are used to elucidate Reynolds number dependent properties of this finite Reynolds number form of the similarity solution. Correspondences between these properties and those indicated by finite Reynolds number corrections to the classical overlap layer formulation for the mean velocity profile are described and discussed.

[1]Support of the 2014 Mathematics of Turbulence program at the Institute for Pure and Applied Mathematics, UCLA, is gratefully acknowledged

Joseph Klewicki
University of New Hampshire/University of Melbourne

Date submitted: 30 Jul 2015 Electronic form version 1.4