Abstract Submitted
for the DFD08 Meeting of
The American Physical Society

Refined Analysis of the Mean Momentum Balance in Rough-Wall Turbulent Boundary Layers FARAZ MEHDI, JOSEPH KLEWICKI, CHRISTOPHER WHITE, University of New Hampshire — Determining the dominant terms in the mean momentum balance (MMB) as a function of position within a turbulent flow reveals the important dynamical mechanisms, and can form the basis for multiscale analysis. Little is known regarding the combined influences of roughness and Reynolds number on behavior of the MMB in turbulent boundary layers. Previous analyses reveal that this is especially the case in and near the roughness sublayer where the data scatter is significant. A semi-theoretical method for reducing the effect of this scatter on the empirical determination of the MMB is described. The efficacy of this method is demonstrated via its capacity to recover the existence of a near-wall stress gradient balance layer that by simple physical considerations is known to exist. Refined MMB analyses augment previous preliminary results based on the location of the Reynolds stress peaks for different δ^+ and k_s^+. Contrary to prevalent notions regarding rough-wall layers, the present results strongly suggest the importance of the viscous force in, and in some cases, above the roughness sublayer, and that relative to the establishment of the mean momentum field there is a significant coupling between the combined effects of roughness and Reynolds number. The support of the NSF (CTS0555223, grant monitor William Schultz) and the ONR (N000140810836, grant monitor Ronald Joslin) is gratefully acknowledged.

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Date submitted: 31 Jul 2008 Electronic form version 1.4