Abstract Submitted
for the DFD12 Meeting of
The American Physical Society

A new theory for the streamwise turbulent fluctuations in pipe flow MARCUS HULTMARK, Princeton University — A new theory for the streamwise turbulent fluctuations, in fully developed pipe flow, is proposed. The new theory, which is based on the near asymptotic analysis introduced by George & Castillo 1997, introduces a sensitivity function for the fluctuations, which is related to the increase of the non-dimensionalized fluctuations with Reynolds number. The theory predicts that the fluctuations will experience a logarithmic behavior if the sensitivity function is constant in a region in space and that the magnitude of the constant will correspond to the slope of the logarithm. The theory extends the similarities between the mean flow and the streamwise turbulence fluctuations, as observed in experimental high Reynolds number data, to also include the theoretical derivation. Experimental data show that a mesolayer, similar to that introduced by Wosnik et al. 2000, exists for the fluctuations for $300 > y^+ > 800$, which coincides with the mesolayer for the mean velocities. In the mesolayer, the flow is still affected by viscosity, which acts to decrease the fluctuations and to form an outer peak in the fluctuation profile.

Marcus Hultmark
Princeton University

Date submitted: 30 Jul 2012 Electronic form version 1.4