Abstract Submitted
for the DFD05 Meeting of
The American Physical Society

High Reynolds number turbulent pipe flow RONGRONG ZHAO, ALEXANDER SMITS — Fully developed turbulent pipe is measured using a crossed-wire probe. Streamwise and wall-normal turbulence components are obtained over a Reynolds number range from 1.1×10^5 to 9.8×10^6. Inner and outer scaling are applied to the broadband turbulence intensity and spectra. The results are evaluated in terms of Perry's attached eddy model prediction (for example, k^{-1} law), and whether Townsend's 'inactive' and 'active' motions are interactive or not. Streamwise turbulence intensity measurements were compared to the earlier work of Morrison and found to be consistent to the previous one. For v'_{rms}, a constant region is found for the region $200 \leq y^+ \leq 0.1R^+$ in inner and outer scaling for Reynolds numbers up to 1.0×106. An increase in v'_{rms} is observed closer to the wall at about $y^+ \sim 100$, and is suggestive of the first maxima of streamwise turbulence intensity profile reported in Morrison *et al.* (2004). This result is new, and is not expected from Townsend's 'active' and 'inactive' motion distinction and Perry's attached eddy model, may signal the existence of interaction between 'active' and 'inactive' motions, which will lead to the incomplete similarity argued in Morrison *et al.* (2004). The wall-normal spectra are carefully examined, especially in the mean flow overlap region (where the logarithmic law applies). Collapse is found for the energy containing part with inner scaling, but for the low wave number region, a y/R dependence is observed which also indicates an influence from the outer flow.

Rongrong Zhao

Date submitted: 11 Aug 2005 Electronic form version 1.4