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The inertial subrange in turbulent pipe flow: centre line[1]
JONATHAN MORRISON, Department of Aeronautics, Imperial College London, MARGIT VALLIKIVI, GE Global Research, Munich, ALEXANDER SMITS, MAE, Princeton University — The inertial subrange scaling of the axial velocity component is examined for the centre line of turbulent pipe flow for Reynolds numbers in the range $249 \leq Re_\lambda \leq 986$. Measurements were performed in the Princeton/ONR Superpipe using NSTAP probes of length, $\ell = 30$ μm or 60 μm, with temporal resolution up to 300 kHz. Estimates of the dissipation rate, ϵ, are made by both integration of the one-dimensional dissipation spectra and the third-order moment of the structure function. It is noticeable that neither dissipation estimate provides values of $A = \frac{\epsilon}{u_\tau^3/R}$ that asymptote to a constant: rather A increases almost linearly with Re_λ. We show that complete similarity of the inertial range spectra is not evident: there is little support for K41, and effects of Reynolds number are not well represented by Kolmogorov's "extended similarity hypothesis," K62. The second-order moment of the structure function does not show a constant value, even when compensated by K62. Direct effects of viscosity appear at the centre line where correction of the "4/5ths" constant for finite Reynolds number (Lundgren 2002) yields values of 0.80 ± 0.01

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