Abstract Submitted
for the DFD19 Meeting of
The American Physical Society

The energy budget at the outer peak of $\overline{u^2}$ in turbulent pipe flow.[1] JONATHAN MORRISON, JOSE FERNANDEZ VICENTE, Imperial College — We use the NSTAP data from the Princeton superpipe (Vallikivi PhD thesis 2014) to examine the spatial & spectral energy fluxes close to the outer peak in $\overline{u^2}$ in the range of Reynolds numbers, $2.1 \times 10^6 \leq Re_D \leq 6.0 \times 10^6$, for which the ratio of hot-wire length to Kolmogorov length scale is $l/\eta \approx 10$. Previous results (Hultmark *et al.* PRL, **108**, 2012) suggest that the outer peak emerges at $Re_D \approx 1.1 \times 10^6$, its position exhibiting a locus $y_m^+ = 0.23(Re^+)^{0.67}$. We note that this is close to the position of the well-known "mesolayer", which we have also described as the intermediate layer with scaling $(y_m^+ \propto \sqrt{Re_\tau}, u_m)$, where u_m is the rms velocity at $y = y_m$ (Diwan & Morrison, TSFP11 – see also the presentation in the session, "Turbulent Boundary Layers"). It is straightforward to show that the locus of u_m is close to that for the production, $P_m(\overline{u^2})$, where the local-equilibrium approximation approximately holds. Therefore, spectral dynamics are most Kolmogorov-like because spatial transport is minimal. We examine the inertial scaling of the axial velocity spectra and low-order structure functions to explain the importance of intermediate scaling.

[1]EPSRC Grant no. EP/I037938

Jonathan Morrison
Imperial College

Date submitted: 29 Jul 2019 Electronic form version 1.4