Abstract Submitted
for the DFD19 Meeting of
The American Physical Society

Non-equilibrium Turbulent/non Turbulent Interface velocity scaling in turbulent planar jets GIOACCHINO CAFIERO, Politecnico di Torino, JOHN CHRISTOS VASSILICOS, Imperial College London — We investigate the turbulent/non-turbulent interface (TNTI) of a turbulent planar jet using stereo-PIV and HWA. Following Zhou & Vassilicos (JFM 2017) we derive an expression for the entrainment velocity $\frac{d}{dx}\langle\int_{A_T} udydz\rangle = \mathcal{L}\ v_n$, where x is the streamwise coordinate, u is the streamwise velocity, $\mathcal{A}_\mathcal{T}$ is the area of the turbulent region in a plane orthogonal to the mean flow, and $\mathcal{L}$ is the length of the TNTI in this plane. $\mathcal{L}$ can be expressed as $\mathcal{L}\sim \delta(\eta_I/\delta)^{1-D}$, where $\delta(x)$ is the jet width at x, $\eta_I \sim \nu/v_n$ (Corrsin 1955) is a characteristic interface thickness and D is the line interface's fractal dimension. Non-equilibrium dissipation self-similar jet theory (Cafiero & Vassilicos PRSA 2019) predicts that v_n/v_η (where v_η is the Kolmogorov velocity) is a decreasing function of x, which is at odds with the classical Corrsin scaling $v_n \sim v_\eta$. Our experimental results confirm Corrsin's $\eta_I \sim \nu/v_n$ but also show that v_n/v_η is indeed a decreasing function of x. Our measurements support the scaling $v_n \sim v_\lambda$ ($=\nu/\lambda$, being λ the Taylor scale) predicted by our theory.

Gioacchino Cafiero
Politecnico di Torino

Date submitted: 09 Oct 2019 Electronic form version 1.4