Abstract Submitted
for the DFD19 Meeting of
The American Physical Society

Roughness effects on scalar transport[1] ZVI HANTSIS, UGO PIOMELLI, Queen's University — The momentum transport in wall-bounded flows has been studied extensively, for both smooth and rough surface; passive-scalar transport has also been the focus of experimental and numerical investigations. The mechanisms that govern scalar transport in the presence of roughness, however, are less well-known. For smooth walls, the similarity between their respective transport equations results in an analogy between the velocity and scalar (Reynolds analogy), that relates the velocity and scalar statistics. For rough walls, however, such analogy fails. We perform Direct Numerical Simulations of passive-scalar transport with $Pr = 0.7-1.4$ in a fully-developed turbulent channel with smooth and rough walls at $Re_\tau \approx 1,650$. The downward shift of the mean scalar log-layer is smaller than that of the velocity, and depends on the Prandtl number. While the $\overline{u'u'}$ fluctuations (in wall units) decrease significantly, the scalar ones are less affected. For the budget of $\overline{\theta'\theta'}$, scalar dissipation is the only significant sink and is roughly equal to the sum of the two significant sinks of $\overline{u'u'}$: dissipation and pressure work. The form-induced velocity affect the budget of $\overline{\theta'\theta'}$ more than that of $\overline{u'u'}$.

[1]This research was supported by NSERC

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Date submitted: 27 Jul 2019 Electronic form version 1.4