Abstract Submitted
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Resolving the 3D velocity field inside a Roughness Sublayer in a turbulent channel flow using HPIV[1] SIDDHARTH TALAPATRA, JOSEPH KATZ, Johns Hopkins University — Microscopic holographic PIV is used to measure the 3D velocity field within the roughness sublayer of a turbulent channel flow at Re_τ of 3400. Recording holograms through a rough surface is facilitated by matching the optical refractive index of the rough wall with that of the working fluid, a concentrated solution of NaI in water. The pyramidal roughness height is k=0.45mm, the sample volume size is $3.2\times1.8\times1.8mm^3$, the long dimension being in the streamwise direction, and the wall-normal range is -0.33< y/k <3.67, where y=0 is located at the roughness peak. The flow is locally seeded with 2μm particles, and in the current data, 5000 particles are tracked per hologram pair. The resulting unstructured vectors are interpolated onto a regular 3D grid to obtain vectors with a spacing of 60μm or 8.5 wall units. The data show that aty/k <0.5, there is a preferred channeling of the flow along paths that circumvent the pyramid crest lines. Planar vorticity distribution from different perspectives as well as 3D isosurfaces show that the near wall region is flooded by quasi-streamwise vortices that are aligned at shallow angles and have a typical streamwise extent of 1-2k.

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Joseph Katz
Johns Hopkins University

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