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Inertial Range Scaling in Rotations of Long Rods in Turbulence[1]

GREG VOTH, SHIMA PARSA[2], Wesleyan University — We measure the rotational statistics of neutrally buoyant rods with lengths $2.8 < l/\eta < 72.9$ in turbulence. For particles with length in the inertial range, we derive a scaling relationship for the mean square rotation rate, $\langle \dot{p}_i \dot{p}_i \rangle \propto l^{-4/3}$ and show that measurements approach this scaling. Deviations from the proposed scaling are explained as the effect of dissipation range scales. The correlation time of the Lagrangian autocorrelation of rod rotation rate scales as the turn over time of eddies of the size of the rod. Measuring rotational dynamics of single long rods provides a new way to access the dynamics of turbulence at fixed spatial scale in a frame advected with the flow.

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[2]Currently at SEAS, Harvard University.

Greg Voth
Wesleyan University

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