Abstract Submitted
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Phase relationships and amplitude modulation in wall turbulence[1] BEVERLEY MCKEON, California Institute of Technology, DANIEL CHUNG, University of Melbourne — We present a framework for predicting the interactions between the large-scale motion and the underlying stress fluctuations in wall turbulence, or the apparent amplitude modulation effect described by, e.g., Mathis et al (Phys. Fluids, 2011). The dynamical equations for stress fluctuations are obtained from a scale decomposition of the governing equations which can be shown to be consistent with the resolvent analysis of McKeon & Sharma (2010). The spatial phase shift between the large-scale motion and stress fluctuations is revealed as being related to critical layer behavior identified therein. Consistent with experiments, the analysis predicts that the zero-crossing height of the amplitude modulation statistic, and corresponding $\pi/2$ lead of the small scales with respect to the large scale identified via cross-correlation techniques, coincides with the wall-normal location of the peak large-scale energetic activity. Simple approximations in the logarithmic region of the mean velocity link the behavior of the amplitude modulation statistic to the wall-normal profiles of the background (mean) turbulent stresses.

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Beverley McKeon
California Institute of Technology

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