Energy transfers via triad interactions and phase dynamics in turbulent flows

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Turbulent flows are complex—their dynamics are chaotic, multi-scale, and out-of-equilibrium. This complexity arises from the nonlinear term in the equations of motion, which is responsible, among other things, for energy transfers across scales. Quantifying and understanding the behavior of these energy transfers is a central challenge in the study of turbulence. As such, many approaches have been developed to tackle this complex behavior. From the spectral perspective, triads of wavenumbers naturally arise from the Fourier transform of the nonlinear term, making up the building blocks of inter-scale energy transfers. Whether triads result in a nonzero energy transfer, and in what direction this transfer occurs, depends on both the energy as well as the phase of each mode in the triad. In this Mini Symposium, we highlight some of the latest results from this field, looking to bring together research on energy transfers through the lens of triads and phase dynamics.

