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Janus spectra: cascades without local isotropy[1] CHIEN-CHIA LIU, RORY CERBUS, PINAKI CHAKRABORTY, Okinawa Institute of Science and Technology — Two-dimensional turbulent flows host two disparate cascades: of enstrophy and of energy. The phenomenological theory of turbulence, which provides the theoretical underpinning of these cascades, assumes local isotropy. This assumption has been amply verified via computational, experimental and field data amassed to date. Local isotropy mandates that the streamwise (u) and transverse (v) velocity fluctuations partake in the same cascade; consequently, the attendant spectral exponents (α_u and α_v) of the turbulent energy spectra are the same, $\alpha_u = \alpha_v$. Here we report experiments in soap-film flows where α_u corresponds to the energy cascade, but concurrently α_v corresponds to the enstrophy cascade, as if two mutually independent turbulent fields of disparate dynamics were concurrently active within the flow. This species of turbulent energy spectra, which we term the Janus spectra, has never been observed or predicted theoretically. Remarkably, the tools of phenomenological theory can be invoked to elucidate this manifestly anisotropic flow.

[1]Okinawa Institute of Science and Technology

Pinaki Chakraborty
Okinawa Institute of Science and Technology

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