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Mutually independent cascades in anisotropic soap-film turbulence CHIEN-CHIA LIU, GUSTAVO GIOIA, PINAKI CHAKRABORTY, Okinawa Institute of Science and Technology — Computational, experimental and field data amassed to date indicate that in 2D turbulence the spectrum of longitudinal velocity fluctuations, $E_{11}(k_1)$, and the spectrum of transverse velocity fluctuations, $E_{22}(k_1)$, correspond always to the same cascade, consistent with isotropy, so that $E_{11}(k_1) \propto k^{-\alpha}$ and $E_{22}(k_1) \propto k^{-\alpha}$, where the "spectral exponent" α is either 5/3 (for the inverse-energy cascade) or 3 (for the enstrophy cascade). Here, we carry out experiments on turbulent 2D soap-film flows in which $E_{11}(k_1) \propto k^{-5/3}$ and $E_{22}(k_1) \propto k^{-3}$, as if two mutually independent cascades were concurrently active within the same flow. To our knowledge, this species of spectrum has never been observed or predicted theoretically. Our finding might open up new vistas in the understanding of turbulence.

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