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Pressure Fluctuations in Two-dimensional Turbulence YONGGUN JUN, Department of Physics of Complex Systems, Weizmann Institute of Science, X.L. WU, Department of Physics, University of Pittsburgh — We investigate pressure fluctuations in two-dimensional (2D) turbulence driven electromagnetically in a freely suspended soap film. The reduced probability distribution function (PDF), $P(p/\sigma_p)$, is found to be universal for different Reynolds numbers and consists of asymmetrical exponential wings, where $\sigma_p \equiv \langle p^2 \rangle^{1/2}$ is the standard deviation. The calculated pressure skewness $S_p = \langle p^3 \rangle / \sigma_p^3 \simeq -0.5$ is significantly smaller than predictions by simple 2D models (Holzer and Siggia, Phys. Fluids A5, 2525 (1993)) but surprisingly close to 3D calculations using a random velocity field with a Kolmogorov energy spectrum $E(k) \propto k^{-5/3}$. The pressure spectrum $E_{pp}(k)$ scales approximately as $E_{pp}(k) \propto k^{-7/3}$ in the energy inverse-cascade subrange and k^{-5} in the enstrophy cascade subrange. These observations suggest that pressure fluctuations is essentially a large-scale phenomenon and the presence of an enstrophy cascade has no effect on the tails of $P(p/\sigma_p)$.

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