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Probability Distribution Functions for a Rapidly Rotating Turbulent Flow: Experiment and Theory

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We have made velocity measurements on a quasi-two-dimensional turbulent flow in a rapidly rotating annulus (Reynolds number 20000, Rossby number (0.1). The probability distribution function (PDF) for velocity increments measured over a wide range of distances between measurement points is non-Gaussian, but the PDF is self-similar (independent of the distance between measurement points). The non-Gaussian PDF for the velocity increments is described well by a form deduced from nonextensive statistics. Using conservation of potential enstrophy and energy, we obtain a PDF for the vorticity by maximizing a nonextensive entropy function. The resultant PDF is in better accord with the measurements than the PDF derived assuming extensive entropy.

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