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Energy injection into two-dimensional turbulence: a scaling regime controlled by drag[1] YUE-KIN TSANG, WILLIAM YOUNG, Scripps Institution of Oceanography, University of California, San Diego — The energy injection rate ε is the most important single statistical quantity characterizing two-dimensional turbulence, and it plays a central role in Kraichnan's theory of inverse energy cascade. In most experiments and meteorological applications, ε is not known a priori, as the fluid is driven by a body force rather than by prescribing ε. It is therefore important to understand the dependence of ε on the external control parameters of a system. Drag is an important physical effect in many quasi-two-dimensional systems. Hence, we consider two-dimensional turbulence driven by steady sinusoidal body force at small scale, with linear drag of damping time scale μ^{-1} as the main dissipative mechanism. We present numerical results that reveal a new scaling regime in which $\varepsilon \sim \mu^{1/3}$. A theoretical model in which the directly forced mode is randomly swept by the large scale motion across the stationary sinusoidal forcing pattern is used to explain the observations.

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