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The interplay between universal scaling laws and vortex clustering in two-dimensional quantum turbulence AUDUN SKAUGEN, LUIZA ANGHELUTA, Univ of Oslo — The relationship between vortex dynamics and the turbulent energy spectrum is an active research topic in quantum turbulence of superfluids and Bose-Einstein condensates. The energy spectra in quantum turbulence exhibit a Kolmogorov -5/3 scaling law, analogous to classical turbulence. Recent developments show that in two-dimensional quantum flows, this energy spectrum corresponds to an inverse energy cascade, which is realized by clustering of like-signed quantized vortices. We investigate numerically the statistics of quantized vortices in two-dimensional quantum turbulence using the Gross-Pitaevskii equation. We find that a universal -5/3 scaling law in the turbulent energy spectrum is intimately connected with the vortex statistics, such as number fluctuations and velocity, which also show a similar scaling behavior. The -5/3 scaling law appearing in the power spectrum of the vortex number is consistent with a scenario of isolated vortices passively advected by a turbulent superfluid velocity, which is again generated by like-signed vortex clusters. The velocity probability distribution of clustered vortices is also sensitive to spatial correlations, and exhibits a power-law tail with a -5/3 exponent that we can predict analytically from the point vortex model.

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