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The k^{-2} spectrum in decaying magnetohydrodynamic turbulence[1]

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We investigate the origins of the k^{-2} spectrum in a decaying Taylor-Green magnetohydrodynamic flow with zero large scale magnetic flux. So far a possible candidate for this scaling exponent has been the weak turbulence phenomenology. From our numerical simulations, we observe that current sheets in this flow are formed in regions of magnetic discontinuities. Based on this observation and by studying the influence of the current sheets on the energy spectrum, using a filtering technique, we demonstrate that magnetic discontinuities are responsible for the -2 power law scaling of the energy spectra in this flow. We also show that initial strong correlations between the velocity and the magnetic field exhibit a k^{-2} spectrum at the peak of dissipation of decaying MHD turbulence. Therefore, the presence of a clear k^{-2} spectrum due to strong current sheets could imply lack of universality in decaying MHD turbulence. However, our highest resolution simulations (2048^3) indicate that we have classes of universality at moderate Reynolds numbers and possibly a universal power law in the high Reynolds number limit.

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