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Is vortex stretching the main cause of the turbulent energy cascade? ANDREW BRAGG, Duke University, MAURIZIO CARBONE, Polytechnic University of Turin — While the dominant idea is that in 3D turbulence, the energy cascade occurs through the process of vortex stretching, evidence for this is debated. In the framework of the Karman-Howarth equation, we derive a new result for the average flux of kinetic energy between two points in the flow. The result shows that vortex stretching is in fact not the main contributor to the average energy cascade; the main contributor is the self-amplification of the strain-rate field. We emphasize the need to correctly distinguish and not conflate the roles of vortex stretching and strain-self amplification in order to correctly understand the physics of the cascade, and also resolve a paradox regarding the differing role of vortex stretching on the mechanisms of the energy cascade and energy dissipation rate. Direct numerical simulations are used to confirm the results, as well as provide further results and insights on vortex stretching and strain-self amplification at different scales in the flow. Interestingly, the results imply that while vortex stretching plays a sub-leading role in the average cascade, it may play a leading order role during large fluctuations of the energy cascade about its average behavior.

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