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Testing a similarity theory for isotropic turbulence on DNS data.
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Using direct numerical simulations, we consider the issue of self-similarity in 3D incompressible isotropic turbulence. The starting point for our investigation is a similarity theory we have developed on the basis of high Reynolds number shell model calculations. Like Kolmogorov's 1941 theory, our theory calls for similarity across all scales in the inertial range. Unlike K41, our theory does not fail on account of intermittency, but is developed to blossom in that environment. To observe self-similarity, it is essential that the correct variables are used, otherwise one sees only intermittency. The correct variables are reasonably easy to spot for the shell model, but they are more difficult to identify for the full Navier-Stokes equations. Moreover, one has to overcome the fact that the DNS has lower Reynolds numbers than in the shell model simulations so that the inertial range is shorter. Using the technique ESS, we clear this obstacle with only a minor modification to the theory. The DNS data then collapse on the theoretical pdf at all scales.

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