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A novel bridging relation connecting Eulerian and Lagrangian statistics MICHAEL WILCZEK, CRISTIAN LALESCU, Max Planck Institute for Dynamics and Self-Organization — The complexity of fully developed turbulent flows can be perceived either from an Eulerian or a Lagrangian point of view. The Eulerian frame is particularly suited for characterizing the spatial structure of turbulence. Following tracer particles, i.e. adopting the Lagrangian perspective, adds temporal information. Understanding the relationship between Eulerian and Lagrangian properties of turbulence is important for a range of problems, including turbulent mixing and transport as well as uncovering the origin of Lagrangian intermittency. The key challenge in relating Eulerian and Lagrangian statistics lies in the fact that Lagrangian tracers sample the flow spatio-temporally in a non-trivial manner: while tracer particles disperse, the flow field evolves in time. Here we present a novel bridging relation which captures both of these effects in an effective Lagrangian dispersion, relating the statistics of instantaneous Eulerian to temporal Lagrangian velocity fluctuations. We discuss the derivation of the bridging relation along with the properties of the effective Lagrangian dispersion. Furthermore, we benchmark our predictions against high-resolution direct numerical simulations of homogeneous and isotropic turbulence.

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