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**Structures and nonlocal interactions in fluids and MHD** ANNICK POUQUET, PABLO MININNI, ALEXANDROS ALEXAKIS, NCAR — Direct numerical simulations of three-dimensional Navier-Stokes and magnetohydrodynamic (MHD) turbulence (with grids of up to $1536^3$ points in MHD) are analyzed to study the formation and role of small scale structures and the degree to which nonlinear terms are nonlocal, i.e. involving widely separated scales. A sharp Fourier filter is used, and both decaying and forced flows are studied, with periodic boundary conditions. In the fluid case, roughly 20% of interactions correspond to the small scales exchanging energy with the forcing scale of the flow, leading to a slow recovery of symmetries in the small scales and giving credence to models involving entrainment by a large-scale flow (Phys. Rev. Lett. **95**, 264503, 2005). In MHD, the transfer itself has strong non-local components (Phys. Rev. E **72**, 046301 and 046302, 2005), with the implication that, as soon as one exits the linear phase of exponential growth of small scales in the form of vorticity and current sheets, a plethora of structures form, with a self-similar in time growth of the maxima of current and vorticity $\sim t^3$, with a $k^{-3}$ energy spectrum at those early times and with later, a constant rate of energy dissipation. These results will be illustrated on several flows. We also show that the current and vorticity sheets are spatially co-located and that, at the highest resolution, Kelvin-Helmoltz instabilities develop leading to roll-up of the sheets whereas at lower Reynolds numbers, the sheets simply fold after having been stretched.

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