Abstract Submitted
for the DPP14 Meeting of
The American Physical Society

Energy Dissipation in Magnetohydrodynamic Turbulence: Coherent Structures or Nanoflares? VLADIMIR ZHDANKIN, STANISLAV BOLDYREV, University of Wisconsin-Madison, JEAN CARLOS PEREZ, University of New Hampshire - Space Science Center, STEVEN TOBIAS, University of Leeds — Energy dissipation in magnetohydrodynamic (MHD) turbulence is known to be highly intermittent, occurring mainly in current sheets. However, the question remains whether the overall energy dissipation is dominated by small (dissipation-scale) structures or by large (inertial-range) structures. To systematically investigate this question, we develop and apply a procedure to identify and characterize dissipative structures in numerical simulations of reduced MHD. We find that the probability distribution of energy dissipation rates exhibits a power law tail with index very close to the critical value of -2.0, indicating that structures of all intensities contribute equally to the overall energy dissipation. We then measure the characteristic spatial scales of structures using two methods: one based on the linear scales across the structure and the other based on the Minkowski functionals, which rigorously characterize the morphology of any shape. We find that energy dissipation is dominated by coherent structures with lengths and widths uniformly distributed across the inertial range, while thicknesses lie deep within the dissipative regime. As the Reynolds number is increased, structures become thinner and more numerous, while the energy dissipation continues to occur mainly in large-scale coherent structures. The current sheets therefore exhibit features of both coherent structures and nanoflares.

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Date submitted: 10 Jul 2014 Electronic form version 1.4