Abstract Submitted
for the APR13 Meeting of
The American Physical Society

Flux-freezing breakdown observed in high-conductivity magnetohydrodynamic turbulence[1] C. LALESCU, G. EYINK, K. KANOV, R. BURNS, C. MENEVEAU, A. SZALAY, The Johns Hopkins University, E. VISHNIAC, University of Saskatchewan, H. ALUIE, Los Alamos National Laboratory, K. BÜRGER, Technische Universität München — Alfven's principle of "frozen-in" magnetic field lines for ideal plasmas explains diverse astrophysical phenomena, e.g. how protostars shed excess angular momentum. But frozen-in lines also preclude rapid changes in magnetic topology observed at high conductivities, e.g. in solar flares. Microphysical processes at scales below the ion gyroradius are a proposed explanation but it is unclear how these lead to rapid reconnection of astrophysical flux structures very much larger. We propose instead that turbulent Richardson advection brings field-lines implosively together to gyroradius separations from distances far apart. Here we report analysis of a simulation of MHD turbulence at high-conductivity that exhibits Richardson dispersion. This effect of advection by rough velocities leads to line-motions that are completely indeterministic or "spontaneously stochastic," as predicted in analytical studies. The turbulent breakdown of standard flux-freezing at scales greater than the ion gyroradius can explain fast reconnection of large-scale flux structures, e.g. post-CME side-lobe magnetic fields reconnecting to an arcade of flare loops. The thick current sheet observed between flare arcade and CME is explained quantitatively by the stochastic flux-freezing due to turbulence.

[1]The JHU group was supported the NSF grants CDI-II: CMMI 0941530 and OCI-108849, and JHU's IDIES; EV was supported by NSERCC. R. Westermann of TUM contributed to the visualisation tool, and we thank A. Lazarian of UWM for discussions of the science.

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Date submitted: 15 Jan 2013 Electronic form version 1.4