Abstract Submitted
for the DPP06 Meeting of
The American Physical Society

Intermittent magnetic field excitations in the Madison Dynamo Experiment M.D. NORNBERG, E.J. SPENCE, C.M. JACOBSON, C.A. PARADA, R.D. KENDRICK, C.B. FOREST, University of Wisconsin-Madison — Determining the onset conditions for magnetic field growth in magnetohydrodynamics is fundamental to understanding how astrophysical dynamos such as the Earth, the Sun, and the galaxy self-generate magnetic fields. The role of turbulence in modifying these onset conditions is studied in the Madison Dynamo Experiment. A turbulent flow of liquid sodium, composed primarily of two counter-rotating helical vortices, is generated by impellers. Laser Doppler velocimetry measurements of the flow in an identical-scale water experiment demonstrate that the turbulence is isotropic, though not homogeneous, with particularly long-lived eddies in the shear layer between the two flow cells. The magnetic field induced when an axial field is applied shows intermittent periods of growth and has a spatial structure consistent with the fastest growing magnetic eigenmode predicted by a laminar kinematic dynamo model of the mean flow.[1] Turbulent fluctuations of the velocity field change the flow geometry such that the eigenmode growth rate is temporarily positive, thus generating the magnetic bursts. It is found from ensemble averaging that the bursts gain strength and frequency with increased impeller rotation rate, though they become shorter so that each burst remains a rare, random event.

[1]Nornberg *et al.*, Phys. Rev. Lett., in press (2006), physics/0606239.

Mark Nornberg
University of Wisconsin-Madison

Date submitted: 24 Jul 2006 Electronic form version 1.4