Abstract Submitted
for the DPP12 Meeting of
The American Physical Society

Global simulations of dynamo in flowing plasmas – applications to laboratory and astrophysical plasmas FATIMA EBRAHIMI, A. BHATTACHARJEE, University of New Hampshire — The alpha dynamo effect is numerically examined for magnetically- and flow-driven turbulence. It has been shown that the alpha effect can be rigorously written in the form of a total divergence of the helicity flux from fluctuations and dissipative terms (Bhattacharjee and Hameiri 1986). For the first time, we have confirmed this functional form from direct numerical simulations of the magneto-rotational instability (MRI) as well as reconnecting instabilities. When turbulence is dominated by tearing modes, the total divergence term is shown to be related to "hyperresistivity." In plasmas unstable to the MRI, we demonstrate that the same total divergence form leads to a very different dynamo. We compute this MRI-driven turbulent dynamo, and show from global simulations that it differs from the Vishniac-Cho form (V&C 2001), used in recent astrophysical dynamo studies. Indeed, their form is found to be subdominant to other contributions to the total divergence form, which depend upon the source of free energy for the instability. These numerical calculations of the total divergence form of the turbulent helicity flux are fundamental for understanding the role of boundary conditions on the dynamo problem in laboratory as well as astrophysical plasmas. Supported by DOE and NSF.

Fatima Ebrahimi
University of New Hampshire

Date submitted: 18 Jul 2012 Electronic form version 1.4