Abstract Submitted
for the DPP12 Meeting of
The American Physical Society

LES models for incompressible magnetohydrodynamics derived from the variational multiscale formulation[1] DAVID SONDAK, ASSAD OBERAI, Rensselaer Polytechnic Institute — Novel large eddy simulation (LES) models are developed for incompressible magnetohydrodynamics (MHD). These models include the application of the variational multiscale formulation (VMS) of LES to the equations of incompressible MHD, a new residual-based eddy viscosity model (RBEVM,) and a mixed LES model that combines the strengths of both of these models. The new models result in a consistent numerical method that is relatively simple to implement. A dynamic procedure for determining model coefficients is no longer required. The new LES models are tested on a decaying Taylor-Green vortex generalized to MHD and benchmarked against classical and state-of-the art LES turbulence models as well as direct numerical simulations (DNS). These new models are able to account for the essential MHD physics which is demonstrated via comparisons of energy spectra. We also compare the performance of our models to a DNS simulation by A. Pouquet et al., for which the ratio of DNS modes to LES modes is 262,144. Additionally, we extend these models to a finite element setting in which boundary conditions play a role. A classic problem on which we test these models is turbulent channel flow, which in the case of MHD, is called Hartmann flow.

[1]Research supported by an award from the Department of Energy Office of Science Graduate Fellowship Program under contract number DE-AC05-06OR23100.

David Sondak
Rensselaer Polytechnic Institute

Date submitted: 10 Jul 2012 Electronic form version 1.4