

Who are the partners in this team?

Katie Schram and Garrett King.

What are you and your partner proposing to do?

Study and visualize the small-scale dynamo motion that arises from magnetofluid environments. Of particular interest is the way spontaneous small-scale dynamos convert kinetic energy into magnetic energy in the fluid environment.

What area of E&M will you be conducting original calculations for?

We plan on carrying out calculations in magnetics and magnetohydrodynamics (MHD)- the study of plasma in the presence of electric and magnetic fields. MHD is an approximation based in a set of four equations that combine fluid dynamics with magnetic effects. The magnetic Reynolds number, similar to the Reynolds number for fluids, arises in MHD and is the governing parameter for the dynamos.

What source material are you drawing from?

We'll be drawing from Dr. O'Shea's research and the work his research group has done with Athena and Enzo. Many other publications on magnetodynamics and dynamo motion will also be incorporated. For preliminary reading, we have looked at the paper *The dynamics of unforced turbulence at high Reynolds number for Taylor-Green vortices generalized to MHD* by A. Pouquet et al. [Geophysical and Astrophysical Fluid Dynamics, 104(2,3), (2010)] and the textbook *Essential magnetohydrodynamics for astrophysics* by H.C. Spruit [arXiv:1301.5572v3]. Other papers found include *Dynamo action in the Taylor-Green vortex near threshold* by C. Nore et. al [Physics of Plasmas, 4(1), (1997)] and *MHD Simulations and Astrophysical Applications* by D. Gomez, P. Mininni, and P. Dmitruk [Advances in Space Research, 35(5), (2005)]. From these papers, we've found that a magnetic Reynolds number, similar to the Reynolds number for fluids, arises in MHD and is the governing parameter for the dynamos. Turbulent flows are associated with a high magnetic Reynolds number and Taylor-Green flows are a case of turbulent flow of particular interest in modelling the dynamos we propose to model. The Nore paper talks about how these dynamos lead to a long scale magnetic fields, which is an interesting concept that arises in studying this approximation.

What has been done so far and what are you going to do? It's ok if it's a solved problem, but you will need to reproduce what has been done and extend it beyond what your reference material offers.

This problem is solved up to the point of small-scale modeling - it becomes a problem for parallel supercomputing at that point. We hope to show some visualizations of the known conditions and show why these systems diverge so quickly. In addition to the computation, an explanation of what MHD is and where it is applicable could also be presented. In addition to these dynamos producing long term magnetic fields, other MHD systems could be mentioned to show the range of applications.