Modeling Kinematic Dynamos in 2 and 3D

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The purpose of this project was to utilize a new program written by Nick Featherstone to analyze how magnetic fields behave in velocity fields and observe the properties of numerical diffusion. Simulations were run in both two and three dimensions. Flows that were used in previous papers were looked at for code verification and to characterize the numerical diffusion for a two dimensional flow. Afterwards three dimensional flows were used to produce complex field generation as well as analyze numerical diffusion. We were able to show that the numerical diffusion could be characterized for both two and three dimensional flows and that it followed a pattern. The numerical diffusion roughly doubled as the number of grid points along an edge was cut in half. This was true in both the two and three dimensional flows. In addition we saw that the numerical diffusion also depended on the velocity field. It is important to note that while the value of the numerical diffusion changed for different velocity fields the numerical diffusion would still follow the same rule with respect to changing the grid spacing. Finally we were also able to show that the code could handle complex velocity flows that might be present in the sun and for one of these flows we rendered a movie of the magnetic energy and field lines for this flow over the course of 20,000 iterations.