The role of system-scale turbulence on MHD activity in the Madison Dynamo Experiment

The Madison Dynamo Experiment studies the onset conditions for magnetic field growth in a turbulent flow of liquid sodium and is investigating the turbulent electromotive force (EMF) $\varepsilon = \langle \vec{v} \times \vec{b} \rangle$. This work analyzes the influence of a recently installed equatorial baffle to reduce the largest scale turbulent eddies in the flow. The averaged magnetic fluctuations drop about 20%. A spherical harmonic decomposition of the magnetic field indicates a reduction of the largest scale magnetic fluctuations, consistent with an unmeasured reduction of the large-scale velocity fluctuations. Amplification of a transverse seed magnetic field (the expected dynamo eigenmode) show a gain of about 50%, in contrast to experiments without the baffle which had negligible gain. These observations may also indicate a reduction of the beta-effect. A two-axial velocity probe will provide velocity fluctuations by measuring potential differences in a uniform field of a small permanent magnet. In combination with Hall sensors detailed investigations of the local EMF are possible. This work is supported by the NSF/DOE partnership in plasma physics.

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