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Electrically driving large magnetic Reynolds number flows on the Madison plasma dynamo experiment DAVID WEISBERG, JOHN WALLACE, ETHAN PETERSON, DOUGLASS ENDREZZI, CARY B. FOREST, University of Wisconsin - Madison, VICTOR DESANGLES, ENS de Lyon — Electrically-driven plasma flows, predicted to excite a large-scale dynamo instability, have been generated in the Madison plasma dynamo experiment (MPDX), at the Wisconsin Plasma Astrophysics Laboratory. Numerical simulations show that certain topologies of these simply-connected flows may be optimal for creating a plasma dynamo and predict critical thresholds as low as $Rm_{crit} = \mu_0 \sigma L V = 250$. MPDX plasmas are shown to exceed this critical Rm, generating large ($L = 1.4\,\mathrm{m}$), warm ($T_e > 10\,\mathrm{eV}$), unmagnetized ($M_A > 1$) plasmas where $Rm < 600$. Plasma flow is driven using ten thermally emissive LaB_6 cathodes which generate a $J \times B$ torque in Helium plasmas. Detailed Mach probe measurements of plasma velocity for two flow topologies will be presented: edge-localized drive using the multi-cusp boundary field, and volumetric drive using an axial Helmholtz field. Radial velocity profiles show that edge-driven flow is established via ion viscosity but is limited by a volumetric neutral drag force ($\chi \sim 1/(\nu \tau_{in})$), and measurements of velocity shear compare favorably to Braginskii transport theory. Volumetric flow drive is shown to produce stronger velocity shear, and is characterized by the radial potential gradient as determined by global charge balance.

David Weisberg
University of Wisconsin - Madison

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