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Optimization of flows in the Madison Dynamo Experiment N.Z. TAYLOR, C.B. FOREST, N.S. HAEHN, E.J. KAPLAN, R.D. KENDRICK, C.A. PARADA, C.R. WEBER, University of Wisconsin-Madison, M.D. NORNBERG, PPPL, E.J. SPENCE, ETH Zurich — In the Madison Dynamo Experiment two counter-rotating impellers in a one meter-diameter sphere drive turbulent flows of liquid sodium. One goal of the experiment is to observe the spontaneous onset of a large scale dynamo in the presence of background turbulence. The time-averaged flows created by the impellers are expected to be dynamos (assuming that the time-averaged flows are laminar). The role of the fluctuations is expected to increase the threshold for self-excitation. To observe a dynamo in the experiment, two sets of optimizations are being implemented. First, the mean-flow is being optimized using a combination of a Computational Fluid Dynamics (CFD) simulation of the experiment coupled with an eigenmode code. The CFD simulation predicts the velocity field due to the addition of vanes mounted on the outer wall to change the overall pitch of the mean flow. The vane pitch has been optimized by minimizing the critical magnetic Reynolds number. The second optimization is to reduce the overall turbulent fluctuation amplitude by introducing an equatorial baffle to partially separate the two hemispheres of the experiment. These optimizations are in the process of being tested in a water version of the experiment and are being implemented in the sodium experiment.

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