Abstract Submitted
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An Eddy-Based Model and Measurements of the Ekman-induced Turbulent Transport of Momentum and Magnetic Flux in the Liquid Sodium a?-Dynamo Experiment: STIRLING COLGATE, LLNL and NMIMT, JIAHE SI, JOE MARTINIC, NMIMT, HUI LI, LLNL — The two coherent motions, rotational shear, the "w-effect," and pulsed unidirectional plume-driven helicity, the "a-effect," of the Liquid Sodium aw-Dynamo Experiment at NMIMT depends upon the two orthogonal instability-constrained, low turbulent flows. The stability of the w-effect is achieved by stable Couette flow, $dw/dr > 0$, (that of the "a-effect by the transient nature of the plumes.) The effective "w-gain" of the Couette shear flow, (experimentally measured $\times 8$) is limited by both the magnetic diffusivity of liquid sodium, h 750 cm$^2/s$, $Rm \sim 120$, and the diffusivity of the turbulence induced by the Ekman flow. We measure the torque induced by the Ekman flow, thickness, $h \sim rRe^{-1/2}$, $Re \sim 10^7$ and infer the velocity distribution from pressure measurements vs radius. A comparison is then made with an eddy-based theory of turbulence, 1) a laminar sub-layer, 2) log-law of the walls eddy size distribution, and 3) an eddy size truncated at the scale of the Couette shear stability. With this eddy size and stress distribution a turbulent velocity distribution is compared to the measured pressure distribution, and the w-gain. Supported by the DOE.

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