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Overview of MST Research J.S. SARFF, University of Wisconsin-Madison and Center for Magnetic Self-Organization in Laboratory and Astrophysical Plasmas, MST TEAM — MST progress in advancing the RFP for (1) fusion plasma confinement with ohmic heating and minimal external magnetization, (2) predictive capability in toroidal confinement physics, and (3) basic plasma physics is summarized. Validation studies for nonlinear resistive MHD employ MST's advanced diagnostics and modeling using the NIMROD and DEBS codes. Major diagnostic improvements include an upgraded FIR system, improved DNB for CHERS and MSE, and Thomson scattering (TS) upgrades. Deep-insertion probes measure the dynamo emf associated with two-fluid MHD and Hall effects. Integrated data analysis of SXR and CHERS yields the best measurement of Z_{eff}=2 to date. X-ray spectra reveal formation of an energetic electron tail during reconnection events, evidence that particle energization occurs for both ions and electrons. New theoretical work identifies an island-induced Alfven eigenmode consistent with modes seen in NBI-heated plasmas. A resonant magnetic perturbation technique controls the locked-phase for quasi-single-helicity plasmas, allowing improved diagnosis and 3D equilibrium reconstructions. Small-scale density fluctuations are consistent with density-gradient-driven trapped electron modes, also predicted in GENE modeling. Supported by US DoE and NSF.

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