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Initial Results from the New Pegasus-III Experiment*

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Minimizing or eliminating the need for induction from a central solenoid during startup, ramp-up and sustainment of a tokamak plasma is a critical challenge in magnetic fusion energy. Solenoid-free startup techniques such as helicity injection (HI) and radiofrequency (RF) wave injection offer the potential to simplify the cost and complexity of fusion energy systems by reducing the technical requirements of, or need for, a central solenoid. Pegasus-III is a new solenoid-free, extremely low aspect ratio spherical tokamak (ST) (A > 1.22, I_p < 0.3 MA, B_T < 0.6 T, pulse length ˜ 100 ms) focused on studying innovative non-solenoidal tokamak startup techniques. Pegasus-III will be equipped with a new local helicity injection (LHI) system capable of I_p < 0.3 MA, sustained coaxial helicity injection (CHI) system, transient CHI and a 28 GHz gyrotron-based system for initial electron Bernstein wave (EBW) and electron cyclotron (EC) heating. Initial experiments have focused on establishing high-Ip LHI scenarios and have successfully produced I_p > 200 kA plasmas with I_{inj} ˜ 12 kA with toroidal field of 0.3 T. Near term efforts are focused on increasing B_T to 0.6 T. Follow on experiments will focus on the deployment and testing of transient CHI, modest sustained CHI and low-power microwave studies. Pegasus-III will provide key enabling power plant relevant technology to directly test proposed plasma startup, ramp-up scenarios envisioned for larger scale ST devices, investigating methods to synergistically improve the target plasma for consequent bootstrap and NBI current sustainment.

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