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First Plasma Results from the Levitated Dipole Experiment[1]

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On August 13, 2004, the first plasma physics experiments were conducted using the Levitated Dipole Experiment(LDX). LDX was built at MIT's Plasma Science and Fusion Center as a joint research project of Columbia University and MIT. LDX is a first-of-its-kind experiment incorporating three superconducting magnets and exploring the physics of high-temperature plasma confined by dipole magnetic fields, similar to planetary magnetospheres. It will test recent theories that suggest that stable, high-β plasma can be confined without good curvature or magnetic shear, instead using plasma compressibility to provide stability. (Plasma β is the ratio of plasma pressure to magnetic pressure.) In initial experiments, 750 kA of current was induced in the dipole coil which was physically supported in the center of the 5 m diameter vacuum chamber. Deuterium plasma discharges, lasting from 4 to 10 seconds, were formed with multi-frequency ECRH microwave heating of up to 6.2 kW. Each plasma contained a large fraction of energetic and relativistic electrons that created a significant pressure that caused outward expansion of the magnetic field. Reconstruction of the magnetic equilibrium from external magnetic diagnostics indicate local peak plasma $\beta \approx 7\%$. Along with an overview of the LDX device, results from numerous diagnostics operating during this initial supported campaign measuring the basic plasma parameters will be presented. In addition, observations of instabilities leading to rapid plasma loss and the effects of changing plasma compressibility will be explored.

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