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Improved Confinement During Magnetic Levitation in LDX[1]

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We report improved particle confinement in the Levitated Dipole Experiment (LDX) when the high-field superconducting dipole is magnetically levitated. Magnet levitation eliminates power and particle losses to mechanical supports and causes radial transport processes to determine the profiles of the confined plasma. Initial LDX experiments used multiple-frequency electron cyclotron resonance heating (ECRH) to produce quasi-stationary discharges with stable high-beta energetic trapped electrons when the superconducting dipole was mechanically supported[3]. When the mechanical supports are fully retracted and the dipole is magnetically levitated, the pressure increases and becomes more isotropic, and the plasma density is seen to increase by 2 to 5 as compared with supported operation. Variations of the microwave heating power, power deposition locations, and neutral fueling rates are used to investigate plasma confinement and profile evolution. Density profile measurements were obtained with a multi-chord interferometer, and under certain circumstances these show a rearrangement of the density profile that results in a highly peaked profile with equal number of particles per flux tube. Such a density profile is the expected stationary state that accompanies the strongly peaked pressure profiles of active magnetospheres and is also the very favorable, centrally peaked profile required for fusion applications. Low frequency fluctuations are seen during rapid profile evolution, but the fluctuations are reduced during this stationary state. Finally, we report excellent technical operation[4] as evidenced by (1) accurate position control of the levitated dipole magnet, and (2) the enhanced float time and reduced cryostat warming during magnetic levitation.

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