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Particle Control and Confinement in the Lithium Tokamak eXperiment (LTX) with Lithium-Coated Walls[1]

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The Lithium Tokamak eXperiment (LTX) is a low aspect ratio tokamak with R=0.4 m, a=0.26 m, and kappa=1.5. The toroidal field is 2.1 kG, plasma current less than 100 kA, and discharge duration less than 50 msec. LTX is fitted with a 1 cm thick heated liner. The plasma-facing surface of the liner is clad with stainless steel, conformal to the last closed flux surface. The liner can be heated to 300 - 400 C, and coated with lithium. With a high-Z steel wall, discharges are strongly affected by wall conditioning. In LTX, the only wall conditioning technique used is lithium wall coating. Discharges without lithium coatings are limited to plasma currents of 15 kA, and discharge durations to 5 msec. With lithium coatings discharge currents and discharge durations increase 5-fold. Peak electron temperatures, from preliminary Thomson scattering measurements, range from 100 - 200 eV. Electron temperature profiles for lithium-wall discharges will be presented. DEGAS2-based estimates of local recycling using an extensive set of Lyman-alpha detectors will be discussed. Particle pumping has been compared for solid, room temperature and hot (300C), liquefied lithium coatings. The fueling efficiency of a number of different gas injection techniques, including supersonic gas injection and molecular cluster injection has been characterized. These techniques can produce fueling efficiencies of up to 35%. A set of liquid lithium injectors to fill the two lower shell segments with up to 50 g of liquid lithium has been installed, as well as an electron beam stirring system to ensure that the plasma contacts a clean lithium surface. In a collaboration with ORNL, the Doppler shifted emission of Li ions has been used to estimate the ion temperature and rotation profiles of LTX discharges. Analysis is in progress and preliminary results will be reported.

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