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Extending and sustaining the low-recycling regime with higher performance discharges, liquid lithium walls, and NBI-heating in the Lithium Tokamak Experiment-β

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Recent experiments in the Lithium Tokamak Experiment - Beta (LTX-β) have extended the duration, performance, and operating conditions of the low-recycling regime first observed in LTX and achieved record values of current I_p, temperature T_e and T_i, pressure p, and confinement τ_E that were 50-200% higher than LTX. The flat temperature profile and hot edge unique to the low-recycling regime has now been sustained with steady, moderate density for multiple τ_E in high performance discharges, and has now been observed in discharges with liquid Li walls. TRANSP analysis assuming neoclassical ion thermal transport is generally consistent with available core T_i measurements. TRANSP estimates of τ_E are up to 3 times the Linear Ohmic Confinement scaling and also exceed H-mode confinement scalings in a variety of high-performance discharge types with fresh solid, passivated solid, or fresh liquid Li walls, with or without flat temperature profiles. τ_E also continues to increase with density even when density is twice the critical density for the Saturated Ohmic Confinement scaling. As thermal conduction losses decrease with flat temperature profiles, core density measurements demonstrate that energy is carried primarily by particle convection, consistent with low recycling. Fast-ion confinement was low in initial experiments but recent high density discharges with roughly doubled I_p, reduced neutral beam injection energy, and adjustments to the beam and plasma position showed distinct NBI heating with an increase in T_e and p_e. Experiments are underway to demonstrate NBI heating in low-recycling, flat-T_e discharges. Analysis will include T_i measurements and assessment of fast-ion confinement and heating using NUBEAM and other codes.

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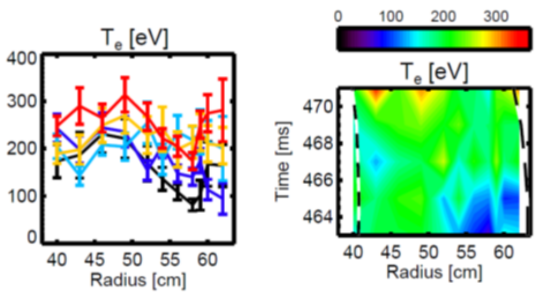

Figure 1: T_e profiles remain flat for several τ_E