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Observation of an isothermal electron temperature profile with low recycling lithium walls in LTX

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Discharges with high edge electron temperatures and flat radial electron temperature profiles, extending to the last closed flux surface, and into the low field side scrape-off layer, have now been achieved in the Lithium Tokamak eXperiment (LTX), with lithium-coated walls. Flat temperature profiles are a long-predicted consequence of low recycling boundary conditions [S. Krasheninnikov, L. Zakharov, G. Pereverzev, Phys. Plasmas 10, 1678(2003)]. Temperature profiles are measured in repeated discharges with Thomson scattering; data from several discharges is averaged at each time point to improve accuracy at low density. Modeling indicates that the ion temperature profiles are also flat, which should eliminate temperature gradient–driven instabilities. The confined plasma therefore appears to be (separately) isothermal in the electron and ion populations. The edge density is very low, with a density profile which decreases approximately linearly with the poloidal flux. So far experiments are transient. Gas puffing is used to increase the plasma density. After gas injection stops, the discharge density is allowed to drop, and the edge is pumped by the low recycling lithium wall. The core impurity content, even in low density plasmas without fueling, and edge electron temperatures of 200 eV, remains low. Z(effective) is approximately 1.5, with most of the increase from oxygen, followed by carbon. The smallest fraction of the Z(effective) increase, especially in the core, is from lithium. An upgrade to LTX, which includes a 35A, 20 kV neutral beam injector to provide core fueling and auxiliary heating, is underway. Two beam systems have been loaned to LTX by Tri Alpha Energy. With core fueling provided by the neutral beam, an equilibrium similar to the "Isomak"[P. Catto and R. Hazeltine, Phys. Plasmas 13, 122508 (2006)] –a tokamak discharge in thermodynamic equilibrium, may be accessible in LTX, for the first time. A widened operational window, in both toroidal field and plasma current, is also planned, as well as eventual operation in diverted geometry. Results from the most recent experimental campaign will be described, as well as the upgraded configuration of LTX. This work was supported by USDoE contracts DE-AC02-09CH11466 and DE-AC05-00OR22725.

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