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Enhanced Pedestal H-mode Regime on NSTX[1]

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The largest normalized energy confinement on NSTX ($H_{98y,2}$ >1.5) was achieved in the ELM-free Enhanced Pedestal (EP) H-mode regime that features a wide pedestal with a significant increase in the edge T_i and rotation gradients. One feature of EP H-mode is a beneficial decrease in the impurity accumulation relative to standard ELM-free regimes. Recent analysis and comparison with 1-D transport models indicates that EP H-mode occurs when an increase in the anomalous pedestal transport reduces the edge density and collisionality such that the resulting improvement in the neoclassical ion thermal confinement exceeds the degradation driven by the larger anomalous transport. Linear CGYRO and GS2 calculations indicate the particle and electron energy transport is predominately due to TEMs in the steep gradient region and ETG modes contribute to the energy transport at the bottom of the pedestal. The ion energy transport is in good agreement with neoclassical transport throughout the pedestal. EP H-mode is often triggered by a period of reduced wall recycling following an ELM that leads to a temporary increase in the edge T_i and a corresponding reduction in the ion collisionality. The reduction in the neoclassical transport leads to an increase in the anomalous transport in all channels as the T_e profile is stiff, consistent with linear stability calculations and BES measurements. The increase in anomalous particle transport, combined with a reduction of the impurity pinch, reinforces the lower edge collisionality and can drive a positive feedback where the ion neoclassical energy confinement improvement exceeds the reduction due to anomalous transport. The enhanced thermal confinement at low pedestal ion collisionality motivates the development of actuators for controlling the edge density that are compatible with large core density and heat flux mitigation on NSTX-U.

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