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The Role of Neutrals in H-mode Pedestal Formation[1]

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Systematic experiments show that atomic physics is a major factor in determining the edge density scale length in DIII-D H-mode discharges. These experiments have been performed to study the physics that sets the height of the H-mode pressure pedestal. Although the pressure gradient of the pedestal is consistent with limits expected from MHD stability,[2] an understanding of the physics that controls the width of this high gradient region remains elusive. However, both numerical[3] and analytic[4] models of transport barriers suggest that the neutral penetration length is an important scale length for setting the width of the barrier. DIII-D experiments have been conducted to see if the width of the edge density profile in H-mode can be explained by neutral fueling. Data have been compared to predictions of a simple analytic model for the shape of the edge density profile.[5] The experimental data exhibit several features predicted by this model: 1) The edge density profile has a hyperbolic tangent shape in L-mode and H-mode plasmas; 2) The density scale length (width) is predicted within 50% or better for a wide range of data; 3) The density scale length decreases as the pedestal density increases. Preliminary evidence shows that at high density, the width of the electron temperature barrier is larger than that of the density barrier, indicating that additional physics controls the temperature barrier.

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