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Electron Profile Stiffness in L-mode Discharges in DIII-D*

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Transport model validation studies are an important part of improving models and understanding of transport in plasmas and are essential to improving predictive capability for next generation, burning plasmas. Stiff models have an important impact on the achievable power gain in burning plasmas such as ITER. Comparison of profile stiffness, defined as the percent change in heat flux relative to the percent change in temperature gradient, is one of many comparisons that can be made between experiment and model simulations. Previous experiments, employing L-mode discharges in DIII-D, focused on searching for a critical electron temperature gradient will be shown with new analysis emphasizing electron profile stiffness measurements. The electron heat flux was varied at the plasma mid-radius by shot to shot movement of ECH power absorbed just inside to just outside the region of interest while holding the total power constant to maintain fixed edge profile conditions. The temperature gradient at the plasma mid-radius increased with heat flux above the minimum gradient achieved and was consistent with an offset-linear functional form between heat flux and temperature gradient. With this relation one can describe a critical gradient as the gradient where the heat flux projects to zero and stiffness becomes a function of the ratio of measured temperature gradient to critical gradient, increasing as the critical gradient is approached. The measured profile stiffness values increased from 2 to 8 as the ratio of local temperature gradient to critical gradient varied from 2 to 1.14 respectively. Planning for future experiments on DIII-D to determine electron profile stiffness at several positions in the plasma and as a function of toroidal rotation velocity will also be discussed.

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