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Improved H-mode with Neon Injection in the DIII–D Tokamak

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DIII–D discharges with neon injection into an ELMing H–mode have been observed to make a transition to an L–mode with improved energy confinement 1.3-2.0 times the pre-neon L–mode phase. We follow the JFT-2M nomenclature [1] and call these IL–modes. Some of the IL–modes discharges make a transition back into an H–mode edge. The energy confinement during the ELM free phase is up to three times L–mode. This improved mode is called IH–mode. Power balance analysis of an IL–mode shows that the electron and ion thermal diffusivities are reduced in the core. The suppressed central transport of the IL–mode remains after the edge transport barrier forms in the IH-mode phase. Direct measurements of the fully stripped neon 10^+ density profile is made with a calibrated charge exchange recombination (CER) system. The neon 10^+ fraction is always less than 1% (normalized to the electron density). The radial electric field can also be computed from the CER measurements on DIII–D. The shear in the E×B velocity is found to exceed the maximum growth rate of the ion temperature gradient (ITG) mode in the core region, a condition for the suppression of turbulent transport. This agrees with the reduced power balance thermal diffusivities near the magnetic axis. In the outer half of the plasma the high wavenumber electron temperature gradient mode (ETG) is the dominant instability. The neon linear response is found to be stabilizing to the ETG modes. The electron thermal transport is observed to have an inverse correlation with the neon concentration in agreement with the ETG growth rate trend.

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