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Improved Core Fueling with Pellets Injected from the High Field Side of the DIII-D Tokamak[1]

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Deuterium pellets have been injected into DIII-D plasmas from the high field side (HFS) leading to the formation of peaked density profiles with a peaking factor ($n_e(0)/\langle n_e \rangle$) in excess of 2.5. The peaked density profile plasmas formed with the high field side pellets develop internal transport barriers when centrally heated. The transport barriers are formed in conditions where $T_e \sim T_i$ and $q(0)$ is above 1. Deeper core fueling is possible with HFS injected pellets than with the same size pellets injected from the low field side (LFS), despite a factor of four lower velocity. The peaked density profiles, characteristic of the internal transport barrier, persist for several energy confinement times and survive through L-mode to H-mode transitions.

Pellets are injected from the inner wall, outer midplane, and a vertical port with the three guns on the DIII-D pellet injector using curved guide tubes. Density profiles after injection show pellet mass deposited inside the penetration radius for the HFS injected pellets, suggesting that a drift of the pellet ablatant occurs in the major radius direction. Pellets injected from the LFS show shallower mass deposition than the HFS or vertical pellets despite much higher pellet speeds. This apparent fast outward drift of the deposited pellet mass is hypothesized to occur from ∇B and curvature induced effects. The pellets injected from the different locations are also used as probes to investigate transport barrier physics and modify plasma edge conditions. Transitions from L to H-mode have been triggered by pellets from both the HFS and LFS, effectively lowering the H-mode threshold power by 2.6 MW. Pellets injected into H-mode plasmas are found to trigger edge localized modes (ELMs). The ELMs triggered by pellets injected from the inner wall and vertical port are similar to Type 1 ELMs, while the ELMs triggered from the outer midplane pellets are of significantly longer duration.

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