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LETTER

Study of the high fuelling efficiency features of supersonic molecular beam injection

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Abstract
Features of high fuelling efficiency of supersonic molecular beam injection (SMBI) are studied on the HL-2A tokamak. Normalized by fuelled particle inventory, the D_α emission induced by SMBI is about 50% higher than that of gas puffing (GP), indicating that a higher percentage of fuel injected by SMBI will enter the plasma. Strong particle convection (inward pinch) is observed with a hydrogen cyanide (HCN) interferometer as the densities from the core and edge channels increase and decrease, respectively, in the post-fuelling phase. In addition, microwave reflectometry indicates that the peak of fuelled density moves inward. By comparing the SMBI pulses with and without electron cyclotron resonance heating, it is identified that the pinch is driven by the enhancement of electron temperature gradient. Higher enhancement (up to twice) of the normalized electron temperature gradient is observed for SMBI than for GP, and this is another mechanism for the higher fuelling efficiency of SMBI.

(Some figures may appear in colour only in the online journal)