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EX/P7-08: Investigation of L-I-H Transitions Facilitated by Supersonic Molecular Beam Injection and Pellet Fuelling on the HL-2A Tokamak

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H-mode operation is extremely important and has been chosen as the standard operation scenario for ITER to meet its objectives, but the physical mechanism of H-mode access has not been fully understood and the power threshold for the L- H transition remains uncertainty. L-H transition induced by pellet injection has been studied on DIII-D, in which process the intermediate phase (I-phase) is recognized with quasi-periodic oscillations and turbulent instability bursts. Besides spontaneous slow L-H transitions, L-I-H transitions are facilitated on the HL-2A tokamak at lower neutral beam heating power by pulsed intense edge fuelling such as pellet and supersonic molecular beam injection (SMBI) ,which give us high opportunity to investigate the underlying mechanisms of the L-I-H transitions and the influence of fuelling on the transitions as well.

Because the edge pressure is initially adiabatic to pellet or SMB ablation, the plasma density increases much and the edge electron temperature drops. Then density remains at high level, the edge is re-heated and the temperature rises gradually, thus a delay time is needed for the edge pressure gradient is sufficient to induce the I-phase. The plasma remains in I-phase for about 20 ms and is heated further towards edge pressure highly enough to cause an H-mode transition. The phenomenon is consistent with the scaling of power threshold (Pth) versus line-averaged density in low density branch, where Pth decreases with density increasing

The edge density and thus edge pressure are higher in I-phase than that in L-mode, but lower than that in H-mode. In I-phase, the energy confinement is better than in L-mode but worse than in H-mode. The density pedestal formation process with SMBI is similar with pellet fuelling. At high density plasma, SMBI is found usually to kill a spontaneous I-phase and stop the potential L-H transition. The radial electrical field and shear flow at edge region, mainly driven by edge pressure gradient, are also presented to investigate the L-I-H transition.

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