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Improvement of the Sensitivity of the Flow Visualization on Supersonic Molecular Beam in the Low-Density Tokamak Fuelling Environment

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Supersonic molecular beam injection is a robust alternative to control the particles in fusion plasma devices. It is widely used in many experimental studies on the burning plasma related physics such as: L-H transition, particle transport study, control of edge localized mode (ELM) and disruption mitigation. Further investigation of some physical problems, especially the interaction between neutral particles and plasma requires the precise distribution of the supersonic molecular beam in the low-density vacuum environment.

A schlieren system is constructed to detect the distribution of the supersonic molecular beam on the testing platform in SWIP[1]. The supersonic molecular beam is visualized by the schlieren system with 400Pa background pressure where the differences in the flow density are large enough[1]. However, the condition is not fulfilled in the low-density environment during the fuelling at the edge of the tokamak vacuum. The sensitivity of the schlieren system should be improved to supplement the imperceptible difference at low gas density conditions. The idea of a multi-pass system with high sensitivity was theoretically proposed [3], which could extend the schlieren technique to plasma densities two orders of magnitude, provides a solution to this problem. In this work, the conventional schlieren system for SMBI is upgraded by adding the partially transmitting mirror. The sensitivity is theoretically calculated, which shows significant improvement after. The supersonic molecular beam is visualized by the upgraded schlieren system with 1Pa background pressure. This work provides a method for direct investigation of the SMBI technique for plasma fuelling and the interaction between them.

References

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