

The properties of supersonic molecular beam injection in H-mode, L-mode and I-mode plasmas

J. Chen¹, J. Huang¹, Y. Xu¹, J. Cheng¹, X. Q. Wang¹, H. F. Liu¹, X. Zhang¹, H. Liu¹, J. F. Shen¹,

C. J. Tang²

¹ *Institute of Fusion Science, School of Physical Science and Technology, Southwest Jiaotong University, Chengdu 610031, China*

² *College of Physics, Sichuan University, Chengdu 610064, China*

Supersonic molecular beam injection (SMBI) is one of the important fuelling method in fusion plasma. In this paper, the properties of SMBI in L-mode, H-mode and I-mode plasmas are studied by using BOUT++ code. The properties of SMBI with different injection parameters in L-mode and H-mode plasmas are firstly studied. And to compared the results of molecular injection depth and injection efficiency, the results show that the injection depth and injection efficiency of L-mode are significantly larger than that of H-mode. Here, the injection efficiency is defined as the ratio of the total increment of ion density to molecular injection flux. This is because that both the temperature and density in pedestal of H-mode plasma are very high which can significantly enhance the molecule dissociation rate and the charge exchange collision rate of atom and suppress the molecule injection. Therefore, for H-mode plasma SMBI is difficult to penetrate the pedestal to the core region. But are both the density pedestal and temperature pedestal the key factions to suppress the SMBI injection? The case with only temperature pedestal, which is so-called I-mode, and the case with only density pedestal are studied. It is found that in I-mode plasma, molecule injection is slightly shallow than that in the case with only density pedestal. This reveals that the plasma temperature is the more important factor to suppress the molecular injection. All these results are helpful to deeply understand the physical process of SMBI and help people to know the properties of SMBI in different confinement mode plasmas.

Reference

- [1] Polevoi, A. R., et al. *Nuclear Fusion* 57.2 (2016): 022014.
- [2] Yu, D. L., et al. *Nuclear fusion* 50.3 (2010): 035009.
- [3] Yu, D. L., et al. *Nuclear Fusion* 52.8 (2012): 082001.
- [4] Xiao, W. W., et al. *Nuclear Fusion* 52.11 (2012): 114027.
- [5] Wang, Z. H., et al. *Nuclear Fusion* 54.4 (2014): 043019.
- [6] Qian, Y. Zs, et al. *Physics of Plasmas* 27.1 (2020): 012501.
- [7] Manz, P., et al. *Nuclear Fusion* 60.9 (2020): 096011