

P5.1056 The injection of cryogenic pellet series in the stellarator TJ-II

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Cryogenic pellet injection (PI) is a well established fuelling tool used on most medium and large-sized magnetically confined plasma devices. PI technologies are mature and such systems are earmarked as critical items for future reactors. Nonetheless, despite significant progress over recent decades, a complete comprehension of pellet penetration, ablation, and enhanced ablation, as well as of subsequent particle drift/diffusion remains to be achieved. Indeed, understanding these is essential to improve codes and to optimize core fuelling. An issue that has come to the fore with the recent start of operation of the Wendelstein 7-X, a superconducting stellarator, is continuous central particle fuelling [1]. In this case a series of pellets is employed, in which initial pellets cool the plasma outer regions thereby facilitating deeper penetration, and high fuelling efficiencies, for later pellets. In this paper, we report on short series of pellets injected into the TJ-II, a medium-sized stellarator device. This is done in order to elucidate on the effect of an initial small plasma edge-cooling pellet on the penetration depth and fuelling efficiency of subsequent larger fuelling pellet(s).

A PI system is used for low-field side injections into the TJ-II [2]. It is a four-pellet system equipped with a cryogenic refrigerator for in-situ hydrogen pellet formation. Moreover, its flexibility permits separation times between injected pellets to be varied (50 ms). The TJ-II is also fitted with a wide range of diagnostics, thereby making it a powerful tool for pellet physics studies [2, 3]. Previous pellet injection studies on this device revealed a strong penetration depth/fuelling efficiency relationship [2]. In this work, series of pellets, containing between $\sim 5 \times 10^{18}$ and $\sim 2 \times 10^{19}$ hydrogen atoms, are injected into its plasmas heated by either electron cyclotron resonance (ECRH), or neutral beam injection (NBI), heating. Furthermore, series of pellets, with different pellet separation times, are injected in order to determine how penetration depth and fuelling efficiencies depend on this time separation. For instance, it is seen that plasma cooling and subsequent recovery are heating type dependant, being significantly transient, for NBI heated plasma. Finally, the use of a small cooling pellet is seen to significantly modify fuelling efficiency, this depending on separation times.

References

- [1] J. Baldzuhn et al., in preparation (2019).
- [2] K. J. McCarthy et al., Nucl. Fusion 57 (2017) 056039.
- [3] N. Panadero et al., Nucl. Fusion 58 (2018) 026025.

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