First Simulations of Pellet Injections into Heliotron J using HPI2

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Efficient plasma core fuelling is a key challenge for the development of steady-state operation in large magnetically confined plasma fusion devices. At present, cryogenic Pellet Injection (PI) is the most advanced technique for solving this problem. Core fuelling is particularly important for helical machines due to the predicted core particle depletion [1]. However, most studies have been carried out to date in tokamaks [2]. This, compounded by the fact that PI experiments in non-axisymmetric devices are more difficult to interpret due to the complexity of the magnetic fields, has positioned stellarators at a disadvantage with respect to tokamaks. However, this situation has been reverted recently as the main helical devices, Wendelstein 7-X, LHD, TJ-II and Heliotron J, are now equipped with PIs and several studies have been carried out [3–6]. These reveal that plasmoid drift, usually well understood in tokamaks (*i.e.,* directed along the $\nabla\mathbf{B}$ direction), is more complex than expected and not fully understood. For instance, in W7-X, High-Field Side injections were predicted to be advantageous [7]. However, experiments show no, or near negligible, improvement in fuel penetration and efficiency when compared to Low-Field Side injections [3]. Now, new pellet studies performed in the Heliotron J are presented with the aim of obtaining further insights into plasmoid drift in non-axisymmetric devices. In this work, the stellarator version of the HPI2 code [8–10], redeveloped for W7-X and initially benchmarked on TJ-II [7], has been implemented for the Heliotron J geometry. In this version, the fully 3D magnetic configuration is taken into account when calculating plasmoid drifts by averaging the magnetic gradient along the plasmoid parallel length [7]. HPI2 results are compared with experimental observations from Heliotron-J and discussed.

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