Impurity Transport Studies at Wendelstein 7-X by Means of X-ray Imaging Spectrometer Measurements

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Due to non axis symmetric 3D magnetic fields, impurity transport in the hot plasma core in stellarators is fundamentally different to tokamaks. In view of reactor-like operation, understanding the impurity transport is a prerequisite for steady-state operation. These aspects motivate initial impurity transport studies in W7-X at previously - in optimized stellarators – unexplored, reactor-relevant collisionalities. New effects, like potential variations on flux-surfaces [1] or screening effects due to species dependent transport regimes [2] are examples for aspects which attracted recent interest. Spatio-temporal impurity emissivities were measured by the x-ray imaging spectrometers XICS [3] and HR-XIS [4], optimized to detect He-like impurity emission. These spectrometers provide measurements of the radial electric field [5] and also allow for a direct determination of diffusive and convective transport parameters D and v [6]. Therefore, impurity transport in various stellarator specific transport regimes can be studied. In this paper, a systematic parameter scan varying the electron cyclotron resonance (ECR) heating power and the electron density n_e has been carried out. Furthermore, the specific settings of the power deposition reveal a significant impact on impurity confinement time, possibly driven by changes in the radial electric field at very low collisionalities – uniquely addressable in large stellarators like W7-X. Experimental findings are compared to neoclassical theory [7] and modeled with the 1D transport analysis code STRAHL. The study aims to reveal the impact of aspects entering stellarator optimization (*e.g.* ripples, magnetic mirrors) on the impurity fluxes.

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