Impurity transport studies at Wendelstein 7-X by means of x-ray imaging spectrometer measurements

This paper reports on the effect of on- and off-axis heating power deposition on the impurity confinement in purely electron cyclotron resonance heated He plasmas on the stellarator Wendelstein 7-X. Therefore, impurity transport times $\tau_I$ have been determined after Fe impurity injections by laser ablations and monitoring the temporal impurity emissivities by the x-ray imaging spectrometer HR-XIS. A significant increase of $\tau_I$ has been observed when changing the power deposition from on- to off-axis heating with energy confinement times $\tau_E$ being mainly unaffected. In addition, the scaling of impurity transport properties with respect to a variation of heating power $P_{ECRH}$ and electron density $n_e$ has been investigated by keeping the heating power deposition on-axis. The observed $\tau_I$ scaling compares well to known $\tau_I$ scaling laws observed in other machines. A comparison of $\tau_I$ and $\tau_E$ yields an averaged ratio of $\tau_E/\tau_I = 1.3$ and transport times in the range of $\tau_I = 40\text{–}130$ ms and $\tau_E = 40\text{–}190$ ms. Comparing those absolute values to neoclassical predictions supports the recently observed nature of anomalous transport in Wendelstein 7-X, given within the up to now investigated operational parameters.

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