Light impurity exhaust in the first divertor campaign of Wendelstein 7-X

T. Kremeyer[1], F. Effenberg[1], O. Schmitz[1], V. R. Winters[1], J. Harris[2], R. Koenig[3], P. Kornejew[3], M. Krychowiak[3], D. Zhang[3], M. Jakubowski[3] and the W7-X Team[3]

[1] University of Wisconsin-Madison, Madison WI 53706 USA

[2] Oak Ridge National Laboratory, Oak Ridge, TN 37830 USA

[3] Max-Planck-Institut für Plasmaphysik, D-17491 Greifswald, Germany

Helium, as the ash of burning D-T plasma, is an unavoidable impurity component in fusion reactors. Its efficient removal from the confined plasma of a D-T fusion reactor will play a key role in the path towards achievement of economic fusion power production. The topic of He exhaust is also embedded into the broader question of light impurity removal, for instance of such species used for radiative edge cooling [1]. In this presentation, initial results from impurity gas puff experiments in the first experimental campaign with the island divertor of Wendelstein 7-X, using He as a tracer element and N_2 as well as Ne for radiative edge cooling, are presented. It is shown that with adjusting the current in the divertor control coils, the dwell time of these injected impurities can be controlled. Increased current size yields a decrease of these dwell times, and in general there are two different time constants involved for the fall of the line emission of the impurities.

These results are obtained by analysis of line emission time traces obtained with a set of ORNL Filterscopes [2]. They measure the line integrated line emission intensities of appropriate impurity lines, i.e. He-I 587.4 nm; 667.8 nm; 706.5 nm; 728.1 nm, Ne-I 640.2 nm, N-I 746.8 nm, N-II 500.5 nm. An exponential decay curve was fit to the data which allowed to measure the effective impurity particle dwell time τ_p^* in the observation domain. The systematic changes observed are presently investigated by comparison to the detailed changes in the magnetic structure of the islands in the divertor as response to the increase in the divertor control coil currents and the emission strength at the measurement location.

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References

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