The He/Ne beam diagnostic for line ratio spectroscopy in the Island Divertor of Wendelstein 7-X

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A line-ratio spectroscopy system based on thermal helium (He) and neon (Ne) collisional-radiative models (CRM) enables measurement of n_e and T_e [1] in front of the horizontal divertor target of the Wendelstein 7-X optimized stellarator [2]. The system has been successfully used in a variety of the device's magnetic configurations, including the standard 5/5 magnetic island configuration. For the second divertor campaign of the device, the observation system has been upgraded, adding 27 new vertical lines of sight to the existing 27 horizontal ones. These lines are channeled to multiple 20 cm and 32 cm Czerny-Turner spectrometers, allowing high spectral resolution observation of diagnostic helium and neon lines, as well as various visible impurity lines and Balmer series lines. Gas injection is realized via two boxes with 5 fast piezo valves each, mounted directly behind the divertor plates in one upper and one lower divertor module, which are magnetically connected in the device's standard 5/5 magnetic island configuration [3]. Helium has been used as a routine gas, while neon has been recently tested in order to extend the applicability of the diagnostic to the detached divertor regime at very low T_e (< 10eV). In this work, T_e and n_e profiles across the divertor island are shown for a variety of experimental conditions, including impurity-seeded and detached plasmas. Also presented here is an early implementation of Bayesian modeling of this diagnostic via the Minerva Framework [4].

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References

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