First results of the endoscope system for divertor plasma observation at Wendelstein 7-X

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At the end of the test divertor unit campaign (OP1.2b) of Wendelstein 7-X the first endoscope for divertor plasma observation was used to measure line integrated 2D line emission in the island divertor region of the machine [1]. The endoscope is equipped with 2 cameras for the UV range and 3 cameras for the visible range. All cameras employ filter wheels with narrow band interference filters allowing observation of the lines of interest. In addition, the cameras for the UV range are equipped with image intensifiers to observe less intense lines such as those of H_2 and CH. An overview spectrometer with the same field of view allows control of parasitic line emission in the vicinity of the lines of interest.

Such a configuration of the endoscope allows simultaneous observation of 3 He lines in visible range, specifically at 667.8 nm, 706.5 nm and 728.1 nm. Together with the dedicated gas injection system located in the field of view of the endoscope and the He-line ratio method it allows calculation of the n_e and T_e profiles [2]. In OP1.2b a set of dedicated shots with He-injection was performed in the standard divertor configuration of Wendelstein 7-X.

Recently, the collisional-radiative model (CRM) of the 3D edge plasma code EMC3-EIRENE has been updated [3]. This CRM includes the up-to-date atomic helium data base and exploits the new Goto CRM code. The diagnostic module of EIRENE allows to produce synthetic images of the endoscope's cameras. In this work the synthetic images produced with EMC3-EIRENE are compared with those measured during He puffs. The absolute photon fluxes are compared and the modelling results are benchmarked. Once the synthetic diagnostic is proven to provide correct results, it is important for testing the tomography algorithm. The tomographic reconstruction is planned for the high heat flux divertor campaign, when the second endoscope with a perpendicular field of view to the first one will be installed.

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[2] M. Goto, 2003 Journal of Quantitive Spectroscopy and Radiative Transfer 76 331-344
[3] W. Zholobenko et al, 2018 Nucl. Fusion 58 126006