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Short_Oral_75: A Thermal Helium Beam Diagnostic for the ASDEX Upgrade Divertor

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The power exhaust problem is one of the most critical challenges for realizing a commercial fusion power plant. High dissipative divertor and SOL condition, up to 90% of radiation, are now routinely obtained in several tokamaks providing a possible solution to protect the plasma facing components. However, a complete understanding of tokamak SOL and divertor physics is key to extrapolate with high confidence to a fusion power plant. To this extend, accurate knowledge of the electron density and temperature within the divertor volume is a crucial requirement.

The intrinsic two-dimensional geometry and the extreme plasma parameter gradients pose a great challenge when designing a diagnostic for diverted plasmas. Building upon the experience with the ASDEX Upgrade (AUG) mid-plane system [1], a new thermal helium beam diagnostic for the AUG divertor has been designed and it is going to be operational during the upcoming experimental campaign. The new diagnostic will offer an unprecedented insight into the divertor physics by providing 2D measurements of the electron temperature and density on 32 channels. The system will be coupled to a high-throughput polychromator with a 900 kHz sampling rate [2]. Such temporal resolution is a breakthrough in order to understand turbulence and filamentary transport within the divertor volume, an almost experimentally unexplored field of the divertor physics.

In this contribution the design of the divertor helium beam will be presented. The optical view has been optimised to provide the best spatial resolution while allowing the installation within the closed AUG divertor. To this extend, a dedicated synthetic diagnostic has been implemented within SOLPS to determine the absolute emission of the neutral helium lines of interest. Furthermore, the impact of recycling helium neutrals and of the reduced helium pumping efficiency on the measurements has been analysed by dedicated simulations. Even when assuming an 100% rate of He-recycling, the background ("passive") emission should not interfere with the measurements.

[1] M Griener et al 2018 Plasma Phys. Control. Fusion 60 025008

[2] M Griener et al 2018 Rev. Sci. Instrum. 89 10D102

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