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HIGH RESOLUTION X-RAY IMAGING AS A POWERFUL DIAGNOSTICS TOOL TO INVESTIGATE ECR PLASMA STRUCTURE AND CONFINEMENT DYNAMICS

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In the frame of the PANDORA project, aiming at measuring for the first time in-plasma nuclear β-decays of astrophysical interest, an innovative multi-diagnostic approach to correlate plasma parameters to nuclear activity has been proposed [1, 2]. This is based on several detectors and techniques (OES, RF systems, interferopolarimetry) and here we focus on high resolution spatially-resolved X-ray spectroscopy, performed by means of a X-ray pin-hole camera setup operating in the 0.5-20 keV energy domain. We here present the setup installed at a 14 GHz ECR ion source (ATOMKI, Debrecen), including the description of the multi-layered collimator enabling measurements with a plasma heated by hundreds of watts. The achieved spatial and energy resolution were 0.5 mm and 300 eV at 8 keV, respectively [3]. In particular, we will describe the results obtained by a new algorithm of analysis applied to Integrated (multi-events detection) and Photon-Counted images (single-event detection) in order to perform spatially resolved spectroscopy. The analysis permits to investigate the plasma in a High-Dynamic-Range (HDR) mode, allowing to study the structure of the plasma, the axial and radial confinement, to estimate fluxes of deconfined electrons, by distinguishing fluorescence lines of the materials of the plasma chamber (Ti, Ta) from plasma (Ar) fluorescence lines. This method also allows a quantitative characterization of warm electrons population in the plasma, which are important for ionization, with estimate of local plasma density and spectral temperatures. Both stable and turbulent plasma regimes can be investigated.

References

[1] D. Mascali et al., EPJ Web of Conf., 227 (2020) 01013

[2] E. Naselli et al., JINST 14 (2019) C10008, published as proceeding of the 3rd European Conference on Plasma Diagnostic (ECPD 2019), Lisboa (Portugal), May 6th - 9th, 2019

[3] S. Biri et al., JINST 16 (2021) P03003

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