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P4.1002 Development of nuclear radiation based tomography methods for runaway electrons in fusion plasmas: first results and prospects

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Phase-space tomography is an established technique for inferring physical properties (namely temperature, density and drift velocity) of thermal species in fusion plasmas. Consistent efforts have already been made to extend those techniques to fast ions generated by fusion reactions or auxiliary heating in order to reconstruct their 2D velocity-space distribution [1]. The benefits of reconstructing fast particles distributions is two-fold: from the experimental point of view it permits a more detailed description of plasma species dynamics (e.g. the interaction between fast ions and MHD modes) and also a direct comparison of simulated and experimentally reconstructed distribution. There is an interest in developing new analysis routines to perform a phase-space tomography of Runaway Electrons (REs), benefiting from the experience with fast ions. At present 1D energy distribution reconstruction of runaway electrons at ASDEX Upgrade has been achieved using inversion techniques [2]. In this work we present a new deconvolution tool for reconstructing the RE distribution starting from Gamma-Ray Spectroscopy (GRS) data. Different methods were tested on both synthetic and experimental data for comparison purposes. The algorithms performances when analysing RE spectra were established and multiple transfer matrices, containing information on the sensitivity of the diagnostics to different RE energies, were calculated (e.g. using MCNP or GENESIS codes). Differences in the reconstructions produced using those matrices were studied and robust figures of merit to describe the evolution of the RE beam during a plasma discharge were identified.

[1] M. Salewski et al., Nucl. Fusion 53 (2013) 063019 [2] M. Nocente et al., Rev. Sci. Instrum. 89, 10I124 (2018)

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