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Neutral particle analysis of ion temperature and fast ions in the ST40 tokamak

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The high-field spherical tokamak ST40 is equipped with a 15-channel neutral particle analyser (NPA), which measures neutral atom fluxes for hydrogen at energies between 1-49 keV along a radial line of sight. The diagnostic is used for inferring the ion temperature within the plasma as well as the distribution and time evolution of fast ions from up to 2 MW of NBI heating at time resolution of up to 0.1 ms.

An analysis workflow has been implemented for interpreting the measured fluxes based on a suite of plasma modelling and synthetic diagnostic codes. A fast semi-analytic model called Npafit has been implemented for estimating the ion temperature by fitting a Maxwellian distribution to the measured fluxes. For more detailed analysis and inferring properties of the fast ion distribution, a workflow consisting of the Monte Carlo orbit-following code ASCOT5 and the synthetic NPA module FIDASIM has been developed. Additionally, simple synthetic models for the various sources of background noise have been included to estimate the signal to noise ratio.

In this contribution results are presented from applying the workflow for error estimation in the ion temperature measurements and for assessing the diagnostic performance in upcoming high-performance ST40 operating scenarios.