A Maximum Likelihood SXR Tomography Inversion Framework for JT-60SA: Development and Initial Assessment Towards MHD Studies

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During the OP1 campaign of the JT-60SA, two out of three classes of disruption were strongly associated with edge cooling events: *radiative disruptions* and *control failure* ones. The former is due to an unfavourable combination of the edge heating scheme and high gas pumping, while the latter is due to a temperature decrease at the edge during high-density discharges, leading to the growth of an n=1 mode[1]. *Control failure* disruptions align with the edge branch of disruptive behaviour observed at JET for 2/1 modes, where the cooling of the edge of the plasma leads to a shrinking of the current density profile, i.e to an increase of the current density gradient. This triggers the mode to grow rapidly and disruptively [2]. Soft X-rays (SXR) are a fast diagnostic that proved useful during the OP1 campaign also for analysing the 1D radiative signature of MHD modes [1]. This contribution therefore attempts to extend the analysis from radial phase information to phase conditioned 2D emissivity reconstruction, using a Maximum Likelihood algorithm that has previously been applied to bolometric JET and AUG data [3][4] and has also recently been used to support the design of the DTT bolometric diagnostic[5]. Such emissivity maps could, in principle, provide useful information on the spatial radiative structure at the core and/or the edge. As only two overlapping arrays of Be filtered AXUV Lines of Sights (LoS) were available on the same horizontal port during the OP1 campaign [6], a dedicated methodology has been considered to improve the reconstructions. Different phantoms associated with an expected rotating mode have been created to generate synthetic brightness profiles to be compared then with the measured ones, in order to select the best initial guess [7] for retrieving the 2D emissivity map. Successful tests using synthetic data have demonstrated the feasibility of reproducing asymmetric phantoms using the JT-60SA OP1 layout. However, when phase-conditioned measurements were used, no significant spatial differences could be retrieved in the 2D emissivity maps obtained from brightness profiles corresponding to opposite phases of the observed oscillations. While these results highlighted the limitations of applying the methodology to the single horizontal SXR array of lines of sight available during OP1, this study also provides a basis for further studies during the OP2 and OP3 campaigns once the upgraded diagnostic layout has been implemented.

References

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