**Modelling and Design of a Hard X-Ray Spectrometer for TCV**

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Fast electron populations in tokamak plasmas are vulnerable to runaway acceleration up to relativistic energies as the collisional drag decreases with increasing velocity. These Runaway Electrons (REs) are anticipated to pose a threat to ITER in post-disruption scenarios [1], as they have the potential to cause significant damage that may halt operation [1, 2]. A path to benign termination of RE beams has recently been developed [3, 4] and preliminary experimental findings suggest that it may be related to changes in RE energy [5]. It is therefore necessary to measure these energy distributions to investigate the underlying physics.

In this work, the design and modelling of a Hard X-Ray spectrometer for the Tokamak à Configuration Variable (TCV) is presented. The optimisation of the design for an ITER relevant, LaBr3 scintillator based, Hard X-Ray spectrometer is evaluated under constraints related to calibration, shielding, collimation, signal processing and modelling with the aim of recovering information about the initial energy distribution. This scheme is informed in part by recent measurements made using CeBr3 scintillator detectors on loan from the GOLEM tokamak [6] as well as by simulations performed using Geant4 [7] that are used to build synthetic detector response functions. In this work, favorable shielding and collimation geometries are demonstrated that attenuate the photon flux without adversely affecting the reconstructed spectrum. The inversion of the simulated, detector response to reconstruct the photon energy spectrum is successfully validated using calibration data and test exponential distributions by regularization with Minimimum Fisher Information. This detection method is therefore demonstrated to provide useful reconstructions of the photon energy distribution from measured spectra that may constrain physical models of the electron velocity distribution function.

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