Bremsstrahlung emission modelling and application to fast electron physics

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Measurements of bremsstrahlung emission in the hard X-ray (HXR) photon energy range (30-200 keV) provide a unique diagnostic for the fast electron dynamics. However, the bremsstrahlung mechanism and the properties of HXR detectors result in a complex photon emission spectrum, which prevents a direct reconstruction of the electron distribution function.

Consequently, a complete synthetic diagnostic, R5X2 [1], has been developed in order to calculate the bremsstrahlung emission from first principles and compare the integrated data directly with experiments. R5X2 uses the distribution function calculated by the ray-tracing and Fokker-Planck codes C3PO/LUKE [2][3]. Together, these modelling tools provide an insight in the fast electron physics (radio-frequency current drive, runaway electrons, fast-electron transport, etc).

In this paper, comparison between simulated and measured HXR signals is used to explain the X2-X3 synergy and fast-electron transport in the TCV tokamak during ECCD. A similar comparison is used to analyze recent high-density LHCD experiments in Tore-Supra [4] with a n_e^{-3} dependence in the HXR count rate.

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