Multi-Energy X-Ray Diagnostic for W transport studies and Te measurements in the WEST tokamak

O. Chellaï[1], L. F. Delgado-Aparicio[1], D. Vezinet [2], T. Barbui[1], K. W. Hill[1], N. Pablant[1], B. Stratton[1], P. Van Meter[3,4],

[1]*Princeton Plasma Physics Laboratory, Princeton, New Jersey, USA*

[2]*IRFM CEA Cadarache, Saint Paul lez Durance, France*

[3]*Department of Engineering Physics, University of Wisconsin-Madison, Madison, WI, USA*

[4]*Department of Radiology, Mayo Clinic, Rochester, MN, USA*

A compact multi-energy ($\sim 2-30$ keV) soft x-ray diagnostic (ME-SXR) was designed primarily for impurity transport studies in the WEST tokamak. The WEST tokamak was designed to test the ITER-like tungsten plasma facing components in a long pulse (~ 1000 s) scenario. The diagnostic consists of the Pilatus3 photon-counting detector mounted on a pinhole camera. The threshold energy of the detector is set independently on each one of the $\sim$ 100k pixels, providing a unique opportunity to measure simultaneously a variety of plasma parameters (e.g. T_e, n_Z and ΔZ_{eff}) and providing a higher energy resolution than conventional systems with metal foils and diodes. The design, installation and capabilities of the diagnostic are presented here.

In parallel, a versatile synthetic diagnostic (SD) is under development. The SD is based on the FLYCHK suite [1] which computes the charge state distribution and x-ray emissivity of the various charge states of a selected impurity. For a given $n_e(R,Z)$, $T_e(R,Z)$ and an arbitrary impurity mix (e.g. background, gas-puff or laser blow-off), the SD computes the plasma emissivity over a broad range of photon energies (1-50 keV) and predicts the photon-count on each pixel of the detector using ToFu [2], an open-source python library for fast spatial integration along the line of sight. The SD is used here on three plasma equilibria (WEST, NSTX-U and TCV) to predict the capabilities of the diagnostic in impurity transport studies and Te profile measurements.

References

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