

HTPD 2018



Contribution ID : 411

Type : not specified

6.32 Pixel-to-pixel variation on a calibrated PILATUS3-based multi-energy soft x-ray detector

Tuesday, 17 April 2018 10:31 (120)

A multi-energy soft X-ray pin-hole camera based on the PILATUS3 100K x-ray detector, produced commercially by Dectris Ltd., has recently been installed on the Madison Symmetric Torus. This photon-counting detector consists of a two-dimensional array of ~100,000 pixels for which the photon lower-threshold cutoff energy E_c can be independently set for each pixel, allowing the measurement of plasma x-ray emissivity in multiple energy ranges with a unique combination of spatial and spectral resolution and the inference of a variety of important plasma properties (e.g. Te, nZ, Zeff). The energy dependence of each pixel is calibrated for the 2-7 keV range by scanning individual "trimbit" settings, which set E_c , while the detector is exposed to fluorescence emission from Ag, In, Mo, Ti, V, and Zr targets. The resulting data for each line are then fit to a characteristic "S-curve" which determines the mapping between the 64 possible trimbit settings and E_c for each pixel. The statistical variation of this calibration from pixel-to-pixel and its effect on overall energy resolution are explored. This material is based upon work supported by the U.S. Department of Energy Office of Science, Office of Fusion Energy Sciences program under Award Numbers DE-SC0015474 and DE-FC02-05ER54814.

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Session Classification : Session #6, Tuesday Morning Poster Session