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14.18 Design, construction and installation of a multi-energy soft x-ray (SXR) pinhole camera in the Madison Symmetric Torus (MST)

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A multi-energy soft x-ray (SXR) pinhole camera has been designed and built for the Madison Symmetric Torus (MST) Reversed Field Pinch (RFP) to aid the study of particle and thermal-transport, as well as MHD stability physics. This novel imaging diagnostic technique combines the best features from both pulse-height-analysis and multi-foil methods employing a pixelated x-ray detector in which the lower energy threshold for photon detection can be adjusted independently on each pixel. Further improvements implemented on the new cooled PILATUS3 systems allow a maximum count rate of 10 MHz per pixel and sensitivity to the strong Al emission between 1.5 and 2.4 keV, as well as the characteristic Ar and Mo emission between 2 and 4 keV. The local x-ray emissivity will be measured in multiple energy ranges simultaneously, from which it is possible to infer profile measurements of core electron temperature (Te) and impurity density (nZ) with no a priori assumptions of plasma profiles, magnetic field reconstruction constraints, high-density limitations or need of shot-to-shot reproducibility. The maximum detector frame rate is 500 Hz with expected time and space resolutions of ~2 ms and <1 cm, respectively.

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