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8.19 Design of tangential multi-energy soft x-ray pin-hole cameras for tokamak plasmas

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A new tool has been developed to calculate the spectral, spatial and temporal response of multi-energy soft x-ray (ME-SXR) pinhole cameras for arbitrary plasma densities (ne,D), temperature (Te) and impurity densities (nZ). ME-SXR imaging provides a unique opportunity for obtaining important plasma properties (e.g. Te, nZ and Zeff) by measuring both continuum- and line emission in multiple energy ranges. This technique employs a pixelated x-ray detector in which the lower energy threshold for photon detection can be adjusted independently. The simulations performed assumes a tangential geometry and DIII-D like plasmas (e.g. ne,0˜1.0x10ˆ20 mˆ-3 and Te,0˜5 keV) for various impurity (e.g. C, O, SiC, Ar, Ca, Mo and W) density profiles. The computed brightnesses range from few 10ˆ2 to 10ˆ3 counts/ms/pixel depending on the cutoff-energy thresholds, for a maximum count rate of 10 MHz per pixel. These estimates were obtained using FLYCHK x-ray emissivities for arbitrary plasma densities, temperatures between 0.2 and 10 keV, and photon energies between 1 and 50 keV. The XOP code was used to evaluate the x-ray attenuation in various materials (e.g. Be, Al, Si). The typical spatial resolution in the mid-plane is ˜1 cm with a photon-energy resolution of 500 eV at a 500 Hz frame rate.

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