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GEM gas detectors for Soft X-ray imaging in Fusion devices with neutron-gamma background and polycapillary lenses

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A triple Gas Electron Multiplier (GEM) detector has been built and characterized, in a collaboration between ENEA, INFN and CEA to develop a soft X ray imaging diagnostic for magnetic fusion plasmas. It has an active area of 10x10 cm2, 128 pixels and electronics in counting mode. Since burning plasma experiments will have a very large background of radiation, this prototype has been tested with contemporary X, neutron and gamma irradiation, to study the detection efficiencies, and the discrimination capabilities. The detector has been preliminary characterized under D-D neutron irradiation (2.45MeV) up to 2.2 106 n/s on the detector active area, showing a detection efficiency of about 10-4, while the detection efficiency of X-rays is more than three orders of magnitude higher. The detector has been also tested then under D-T neutron flux (14MeV) up to 2.8 108 n/s on the whole detector, with a detection efficiency of about 10-5. Thanks to the adjustable gain of the detector and the discrimination threshold of the electronics, it is possible to minimize the sensitivity to neutrons and gamma, and discriminate the X-ray signals even with very high radiative background. We investigated also the possibility of transporting the SXR radiation far from the machine, by means of polycapillary lenses. They appear promising for these purposes and suitable for Magnetic Fusion Plasma (MFP) X-Ray both imaging and tomography. The tests have been performed in laboratory for characterizing the polycapillary lenses for distances much larger than the optical focal length (15 times) and assessing their optical and imaging properties, in the SXR range 5-25 keV.

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