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Polycapillary Lenses for Soft-X-Ray Transmission: Model, Comparison with Experiments and Potential Application for Tomographic Measurements in Tokamaks

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In Tokamaks, plasma emits as a volumetric Soft-X-Ray (SXR) source and can give very useful information about plasma stability, shape and impurity content. Measuring the SXR radiation ([0.1 keV; 20 keV]) of magnetic fusion plasmas is a standard way of accessing valuable information on particle transport and MagnetoHydroDynamic (MHD). Unfortunately, the strong constraints imposed by the environment of a tokamak reactor (high neutron fluxes, gamma and hard X-ray emission, high magnetic field and high radiofrequency powers) do not authorize to install in a close vicinity of the machine such detectors. We have thus investigated the possibility of using polycapillary lenses to transport the SXR information to several meters from the plasma. The idea is to protect the SXR detector from the entire environment by a proper shielding. Different polycapillary lenses have been tested in collaboration with CELIA at Bordeaux and results will be shown. In parallel a model of polycapillary transmission has been developed and validated against experiment. Results are presented confirming the great potential of polycapillary lenses for SXR transmission in tokamak plasma.

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