Contribution ID: **144** Type: **Poster**

Scintillating fiber and perovskite-based sensors for X-ray diagnostics on ECR plasmas

Monday, 8 September 2025 16:30 (1h 30m)

Within the SAMOTHRACE ecosystem, funded by the EU Next Gen Program, and synergically with the INFN PANDORA project, we here present the development and application of two novel and versatile X-ray sensors, particularly suitable to monitor high X-ray fluxes from ECR plasmas.
Such systems, based on organic scintillating fibers (Sci-Fi) coupled to Si-photomultipliers and X-ray sensitive perovskite polycrystals, feature low intrinsic efficiency and high radiation hardness, and are cheap and durable if compared to common Si detectors. Their rapid response, versatility and stability make them very interesting tools for ion source plasma diagnostics.
Sci-Fi have been developed and tested at INFN-LNS to check for the first time its sensitivity at soft X-ray domain (< 50keV). Further measurements have been performed on the B-minimum ECRIS at ATOMKI. The system is flexible (7 m long fibers with 1 mm diameter) and fully suitable to the high voltage of the extraction systems, so it was coupled externally to the plasma chamber. The X-ray emission from ECR plasma has been measured at different RF power (100 −400W) and plasma regimes, by tuning the B-field configurations, well resolving the emission variations in the time scale of 100 ms and distinguishing stable from unstable plasma regimes.
Perovskite-based X-ray sensors, developed at CNR-IMM, were irradiated by a mechanically shuttered X-ray tube to test the time-response in the ms range. It has been tested at zero bias voltage in the X-ray energy range of 5 −50keV, producing signals of the order of few nA at the lowest photon flux. A Si-PIN detector was used to benchmark the X-ray emission.
Fast-responding self-powered perovskites and flexible scintillating fibers can open the route to new generation of X-ray sensitive detectors for studying plasma instability phenomena not only in ECR sources. Moreover, their use could be of wide and interdisciplinary interest on any fields requiring the detection of high radiation fluxes.

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Session Classification: Poster Session

Track Classification: Ion source plasma and beam diagnostics