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Optimization of GEM based detector structure aimed at plasma soft–semi hard X-ray radiation imaging

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The proposed work refers to the development of gaseous detectors for application at tokamak plasma radiation monitoring. Soft–semi hard X-ray region radiation measurement of magnetic fusion plasmas is a standard way of accessing valuable information on particle transport and magnetic configuration.
In this work, Gas Electron Multiplier (GEM) based imaging technique is proposed to perform advanced imaging, capable of photon energy discrimination, which can reach a very accurate spatial and temporal resolution and can provide lots of information on radiation, temperature and impurity distribution, MHD, etc., including data processing on the fly (in real-time) usable for plasma control purposes.
The work will highlight the latest development and optimization on GEM detector structure for utilization in soft–semi hard X-ray radiation detecting system. The photon sensitive configuration is based on triple GEM amplification structure followed by the pixel readout electrode. The efficiency of detecting unit is adjusted for the radiation region of about 2-15 keV. The present work will introduce the preliminary laboratory results on the detector characteristics obtained for the constructed detecting chamber based on newly designed and developed GEM foils. The operational characteristics and capabilities of the detector will be compared with the ones based on standard (commonly used) copper GEM foils. First laboratory tests will be done by means of tuned X-ray laboratory source (2-9 keV), commercial X-ray tube (10-13 keV) and 55Fe iron sources presenting detector's imaging capabilities. Stream-handling data acquisition mode will be applied for the data acquisition with timing down to the ADC sampling frequency rate (~13 ns) which allows uncovering the invaluable physics information about plasma dynamics due to excellent time resolution. The spatial resolution and imaging properties of this detector will be studied in this work for conditions of laboratory moderate counting rates and high gain.

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