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HARD X-RAY COLLIMATION SYSTEM ON T-15MD TOKAMAK *)

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Intense runaway electrons (RE) beams pose a serious problem for safe operation of tokamaks, since the interaction of these beams with the vacuum chamber leads to high thermal loads, sputtering and melting first wall materials [1]. Evolution of RE beams is accompanied by the generation of bremsstrahlung radiation in the energy range up to tens of MeV (in the region of Hard X-Ray radiation), which occurs when RE interacts with plasma ions and with first wall. Measuring the evolution of the spectrum of this radiation from different regions of the plasma allows us to obtain runaway electrons beam evolution data [2].

Two $LaBr_3(Ce)$ scintillation detectors with dimensions of d38.1x38.1mm are used for Hard X-Ray radiation registration. Scintillation crystals arranged in sealed case with PMT and pre-amplifier 2007P. The Data acquisition system is based on ADC NI PXIe-5105. Detectors are located in highly efficient collimation system that provides high spatial resolution. The Collimation system allows to determine the spatial evolution of runaway electrons beams and the localized region of interaction RE beams with intra chamber tokamak elements.

This report presents the design of the collimator used for measurements of bremsstrahlung radiation on T-15MD tokamak. The collimator is a lead-filled housing and a system of coaxial apertures in blocks of attenuating materials – polyethylene and lead. The collimator is equipped with a rotary base with an electromotor. Due to rotary base, it is possible to move collimator field of view along the cross section of plasma discharge. The rotation angle is controlled both manually and remotely using a computer via Ethernet protocol.

To estimate the spatial resolution of the developed collimator design, a Monte Carlo simulation was performed using the GEANT4 code. As a result of simulation, the shielding efficiency for gamma radiation was $4 \cdot 10^2$, from 2.5 MeV neutron flux – $1 \cdot 10^3$, from 14 MeV neutron flux – $1 \cdot 10^2$. In these cases, angular field of view is 0.25°.

References

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*) abstracts of this report in Russian