Contribution ID: **406** Type: **Poster**

ITR/P5-36: Reconstruction of Distribution Functions of Fast Ions and Runaway Electrons in ITER Plasmas Using Gamma-Ray Spectrometry

Thursday, 11 October 2012 08:30 (4 hours)

Vertical Gamma-Ray Camera (VGC) system of ITER is being designed in Ioffe Institute. Using gamma-ray spectrometers allows solving one of the most important issues for the safe tokamak operations - the runaway electrons diagnostics. Monte-Carlo model calculations of bremsstrahlung fluxes in the place of the VGC detectors installation were carried out for different ITER plasmas and plasma impurities. Tomographic measurements of the HXR emission profile can provide important information on runaway beam location in the ITER plasmas and allow estimating the value of the runaway current in the MeV energy range.
Code DEGAS has been developed for deconvolution of gamma-ray spectra emitted from plasmas. The code can be applied to reconstruct the runaway electrons energy distribution basing on the recorded HXR spectra. Results of Monte-Carlo modeling of the gamma-ray spectrometers response functions and bremsstrahlung spectra calculated for electrons in wide energy range are used in the DEGAS code. Deconvolution of gamma-ray and HXR spectra allows identifying nuclear reactions, which take place during plasmas discharge, calculating their gamma-ray lines intensities and determining the maximal energy of runaway electrons with accuracy satisfied to the ITER Project Requirements. Using the DEGAS code during processing of the spectra recorded at JET experiments increased the peak-to-background ratio in 2-3 times. Application of the deconvolution technique during tomographic measurements of gamma-ray emission profiles can facilitate the reconstruction of spatial distributions of different fast ions in ITER plasmas.

This work was supported by RF State contracts N.4k.52.90.11.1094 and N.4k.52.90.11.1151.

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Session Classification: Poster: P5

Track Classification: ITR - ITER Activities