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Gamma ray spectroscopy measurements for diagnosis of ITER plasmas

The goal of ITER, the next generation tokamak, is to obtain and control fusion plasmas with high thermonuclear output power, in order to demonstrate the feasibility of a commercial fusion reactor. In this context nuclear radiation diagnostics, such as neutron and γ-ray spectroscopy, will play a crucial role. Gamma ray spectroscopy is a diagnostic of fast ions and of the confined fusion alpha particles in a fusion plasma device. For this application high energy resolution (say a few percent for gamma ray energies in the range 1-5 MeV) and a high count rate capability, ideally up to a few MHz, are required. Furthermore, the detector will have to withstand the high neutron fluxes produced by the main fusion reactions between deuterium and tritium. Experimental results obtained at nuclear accelerator have demonstrated that the requirements on the energy resolution and count rate can be matched with a LaBr3(Ce) detector equipped with a fast digital data acquisition. In this work, we present recent measurements on the response function of the detector to 2.45 MeV neutrons. The measured data are successfully reproduced by Monte Carlo simulations that shed light on the interaction mechanism between the neutrons and the detector. The presented results are of relevance for the optimization of the detector design, line of sights and neutron shielding for gamma ray spectroscopy measurements on ITER.

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Authors: CAZZANIGA, Carlo (University of Milano Bicocca, Milano, Italy); CROCI, Gabriele (Institute of Plasma Physics "Piero Caldirola", Milano, Italy); GROSSO, Giovanni (Institute of Plasma Physics "Piero Caldirola" , Milano, Italy); GORINI, Giuseppe (University of Milano Bicocca, Milano, Italy); GIACOMELLI, Luca (University of Milano Bicocca, Milano, Italy); TARDOCCHI, Marco (Institute of Plasma Physics "Piero Caldirola", Milano, Italy); NOCENTE, Massimo (University of Milano Bicocca, Milano, Italy)

Presenter: CAZZANIGA, Carlo (University of Milano Bicocca, Milano, Italy)

Track Classification: Scintillating Detectors