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Design optimization of a fast-neutron detector with scintillating fibers for triton burnup experiments at fusion experimental devices

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Time-resolved triton burnup studies have been carried out to estimate the behavior of alpha particles in DD fusion experimental devices. In those studies, 14 MeV neutrons emitted through DT reactions in DD plasmas should be measured selectively in the backgrounds of DD neutrons and gamma rays. For that purpose, a scintillating fiber (Sci-Fi) based fast-neutron detector has been adapted because of its advantages such as fast response, design flexibility in detection efficiency by changing the number of Sci-Fi and discrimination property against 2.4 MeV neutrons produced through DD reaction and gamma rays. However, as an optimization study of its design parameters to meet the requirements as 14 MeV neutron detector has never been done, its length had conventionally set to around 10 cm. In the present study, we tested three types of Sci-Fi detectors with three different lengths and compared with the simulated results of energy deposition, through which we tried to understand the phenomena in the detection process of fast neutrons. From the results, it has been shown that, due to the self-shielding of neutrons by Sci-Fi and the attenuation of scintillation photons during the transmission process to the photomultiplier tube, the optimal length of Sci-Fi is concluded to be about 6 cm.

Country or International Organization

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