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TOF CORRECTION METHOD FOR INSTALLATIONS WITH HEAVY CRYSTALS FOR CREATING A NEUTRON DETECTOR

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Neutron detection is based on the registration of secondary charged particles arising in nuclear reactions with the detector material. The efficiency is determined by the reaction probability and the linear dimensions/material of the detector. For time-of-flight measurements, fast scintillators or gas detectors are usually used. A promising improvement is to replace part of the passive layers with active layers made of bismuth orthogermanate ($\text{Bi}_4\text{Ge}_3\text{O}_{12}$, BGO). BGO is characterized by high density ($\rho \approx 7.13 \text{ g/cm}^3$), low radiation length ($\sim 1.13 \text{ cm}$), radiation resistance, absence of afterglow, and a light yield of ~ 7000 photons/MeV. The absence of cleavage planes allows the crystals to be shaped into any form. Due to its higher density compared to NaI(Tl) and CsI(Tl) and other popular scintillators, BGO provides higher efficiency in detecting photons and neutrons for the same volume. However, the high density causes partial self-absorption of photons, reducing the signal amplitude, which is compensated for by modern electronics with a high signal-to-noise ratio. A significant drawback of heavy scintillators is the long rise time of the signal ($>100 \text{ ns}$), which makes their use for the time-of-flight method difficult. Nevertheless, the requirements for the neutron detector being developed include the possibility of using the time-of-flight (TOF) method. This paper demonstrates the fundamental possibility of using BGO for the TOF method.

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