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Neutron detection using a Water Cherenkov Detector with pure water and a single PMT

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We present the performance of a novel neutron detection technique based on a Water Cherenkov Detector (WCD) employing pure water, an inner coating material acting as a light reflector and diffuser, and a single photomultiplier tube (PMT). The detector employed in this work is part of the Latin American Giant Observatory (LAGO) collaboration, that measures the low energy component of cosmic rays. The experiments presented in this work were performed in presence of $^{241}\text{AmBe}$ and ^{252}Cf neutron sources in different neutron moderator and shielding configurations. We show that fast neutrons from $^{241}\text{AmBe}$ and ^{241}Cf sources, as well as thermal neutrons from a neutron moderator, having different spectral characteristics, produce essentially the same pulse histogram shape. This characteristic pulse height histogram shape recorded is a clear signature of neutrons with energies lower than $\simeq 11\text{ MeV}$, and was verified in different experimental conditions. Using this experimental data we estimate the neutron detection efficiency for fast neutrons at the level of $(15\pm 5)\%$.

Also we explain the physical process that produce Cherenkov light from an incoming neutron. Being the material employed as active volume pure water, a cheap and abundant material, the results obtained in this work are of great interest for the construction of low cost and large active volumes neutron detectors for different applications, specially those related with space weather phenomena monitoring as well as the detection of fissile or fusible special nuclear material.

Registered

Yes

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