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WITHDRWAN Raman Scattering

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Abstract: Water Cherenkov detectors such as Super-Kamiokande are an important detector technology for Neutrino experiments. They consist of large volumes of water surrounded by phototubes that collect Cherenkov radiation created by charged particles. The characteristic Cherenkov ring reveals the particle's information, like the energy and direction of travel. However, the Cherenkov ring is not a sharp ring, and it is disturbed by scattering, which may lead to getting improper information about the particles. Rayleigh, Mie and Raman scattering, as well as absorption, are microscopic processes which are considered to influence light propagation. The Raman scattering effect is a sub-leading effect relative to the Rayleigh scattering and has not yet been implemented in the GEANT4 optical photon model. It is an inelastic scattering of light by molecules which shifts the wavelength of light. In this work, the wavelength shift of Raman scattered light is investigated using the Monte Carlo method. Also, the total number of photoelectrons detected by PMTs is calculated, which shows the relative scale of the Raman scattered photon compared with Rayleigh scattering for two different pathlengths of light, the Hyper-K and the Super-K water tank diameters. The Results predict the probabilities of different outgoing wavelengths for an incident photon wavelength as well as the size effect of the Raman scattering compared with the Rayleigh scattering in large detectors, which is not negligible. All in all, this work indicates that the Raman scattering effect needs to be implemented in the GEANT4 simulation as the calculations show considerable values for that.

Keyword-1

Raman scattering

Keyword-2

Monte Carlo Method

Keyword-3

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