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(G*) Helium Scintillation Background Light in T2K's Optical Transition Radiation Monitor"

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T2K (Tokai to Kamioka) is a long-baseline neutrino experiment designed to investigate neutrino oscillations. The experiment employs a neutrino beam generated by colliding a proton beam with a graphite target. This target area is enclosed within a helium vessel containing the Optical Transition Radiation (OTR) monitor. The OTR monitor plays a crucial role in measuring the profile and position of the proton beam, essential for characterizing neutrino production and ensuring target protection. However, we observe a discrepancy between the beam width measured by the upstream beam monitors and OTR which could be caused by a broad background present in OTR images. We hypothesize this background light originates from scintillation induced by the proton beam. In order to understand the background in OTR images, we have built a Geant4 simulation to test two scintillation mechanisms. We model primary scintillation from excitation of the helium gas by the proton beam as well as secondary scintillation from the proton beam interacting with the upstream collimator and target. By confirming Geant4 simulation results through comparison with ray-tracing studies and experimental data we have developed an accurate model of the background light essential for improving OTR measurements. Minimizing uncertainty in OTR light production mechanisms is critical for fine-tuning the proton beam orbit at the onset of the T2K experiment, while also providing significant insights for physics analysis.

Keyword-1

Particle physics

Keyword-2

Neutrino physics

Keyword-3

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