



Contribution ID: 292

Type: **Poster**

A Camera-based Optical Calibration System for Water-based Neutrino Telescopes

Friday, 15 December 2023 14:49 (1 minute)

The angular resolution and energy threshold of a water-based neutrino telescope are significantly influenced by the level of absorption and scattering experienced by Cherenkov photons in the medium. Unlike glacial ice, the dynamic water environment can lead to changing optical properties within the large detector volume. Therefore, the use of a real-time calibration system among the detector array is necessary. This paper introduces a novel calibration system based on CMOS cameras and steady LED light sources. Its efficient image processing algorithms enable real-time optical measurements. The system is highly suitable for implementation in the future TRIDENT detector. The successful demonstration of this camera system at a depth of 3420m by the T-REX experiment in 2021 further validates its effectiveness.

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Session Classification: Poster