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Spectral Photon Sorting with the Dichroicon in Large Neutrino Detectors

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Identifying Cherenkov photons produced when charged particles interact with scintillators provides additional information about the interaction, including directionality and particle identification, while maintaining the excellent energy and position resolution typical of scintillator detectors. The difference in arrival times of photons with different wavelengths also provides information about the distance to an event in dispersive media. Dichroicons provide access to this information by spectrally sorting photons using a Winston cone made from dichroic filters, which reflects long wavelength photons inconsistent with typical scintillation spectra to one PMT, and passes short wavelength photons to another PMT. A simulation model of dichroicon prototypes has been implemented in the GPU-enabled photon Monte Carlo package Chroma. This model is being used to evaluate the background rejection, particle identification, and direction reconstruction performance of a large liquid scintillator detector, such as Theia, instrumented with dichroicons as the primary photon detectors.

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