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Eos: A Ton-Scale Hybrid Neutrino Detector

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Hybrid neutrino detectors utilize both Cherenkov and scintillation light to detect neutrino events, combining the lower energy threshold of pure scintillator detectors and enhanced direction resolution of water detectors. The benefits of hybrid detectors provide for advancements in fundamental physics goals as well as in applications such as nuclear nonproliferation. Experiments with small benchtop hybrid detectors have shown success in Cherenkov/scintillation separation, but a ton-scale test of hybrid detector technologies is needed to extrapolate the performance to larger hybrid detectors like the planned Theia detector with a fiducial volume of tens of kT. Eos is a detector with an approximately 4-ton target fiducial volume under construction at UC Berkeley and Lawrence Berkeley National Laboratory. The detector, featuring fast photomultiplier tubes (900 ps transit time spread), a novel water-based liquid scintillator (WbLS) target, and a first large-scale test of spectral sorting, will provide a test-bed for emerging technologies required for hybrid detectors. Furthermore, Eos will deploy calibration sources to verify the optical models of WbLS and other liquid scintillators with slow light emission, to enable an extrapolation to kT-scale detectors. This input will support the development of advanced techniques for reconstructing event energy, position, and direction in hybrid detectors significantly. After achieving these goals, Eos can be moved near a nuclear reactor or in a particle test-beam to demonstrate neutrino event reconstruction or detailed event characterization with these novel detection technologies.

Early Career

Yes

Primary author: BALDONI, Adam (Pennsylvania State University)

Presenter: BALDONI, Adam (Pennsylvania State University)

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