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WbLS in neutrino detectors for non-proliferation

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Nuclear reactors generate large fluxes of anti-neutrinos. The weakly interacting neutrinos possess the remarkable ability to traverse extensive distances without interacting with matter. This unique characteristic holds the potential to enable remote monitoring of reactors from hundreds of kilometres, thereby serving as a potent tool for nuclear non-proliferation.

The low light yield inherent in pure water poses a challenge in discriminating low-energy neutrinos using a conventional water Cherenkov detector. In contrast, the novel Water-based Liquid Scintillator (WbLS), developed at Brookhaven National Laboratory (BNL) in the United States, combines the advantages of high light yield from liquid scintillator and prompt Cherenkov signal from water. With the implementation of WbLS, it is feasible to enhance energy resolution while preserving the directionality of detection.

BUTTON is a 30-tonne detector, currently under construction at the Boulby underground facility in North Yorkshire, England. Its purpose is to evaluate the performance of various detection media, including pure water, WbLS, and Gd-loading in water/WbLS. One of the BUTTON-PMT modules, constructed at the University of Edinburgh has been sent to BNL. As planned in our NuSec2024 project, the initial test of a BUTTON-PMT in WbLS is currently underway. This report presents updates on the ongoing collaborative effort between the UK and the USA in this field.

Author: BHATTACHARYA, Deb Sankar (The University of Edinburgh (GB))

Co-author: NEEDHAM, Matthew David (The University of Edinburgh (GB))

Presenter: BHATTACHARYA, Deb Sankar (The University of Edinburgh (GB))

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