Form 8

Research Result Report
ICRR Inter-University Research Program 2025

Research Subject: Water Purification System R&D for Precision Neutrino Detectors

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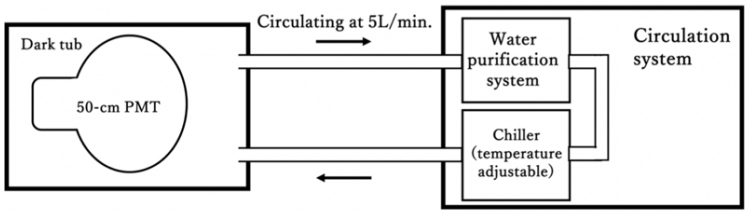
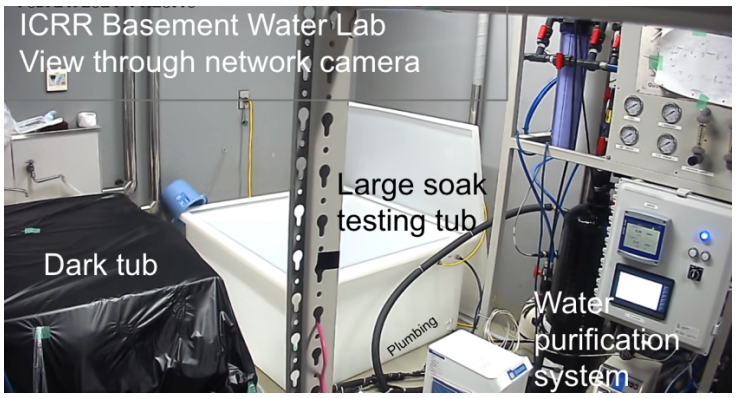
Summary of Research Result :

The water purification system in ICRR (photo below) has provided temperature-controlled ultra-pure water to the Hyper-K PMT test experiment in a dark tub, shown in the diagram above. Temperature dependence between 13.7 – 24.7°C of the relative quantum efficiency continued to be measured to improve the accuracy to less than the required 1% for Hyper-K.





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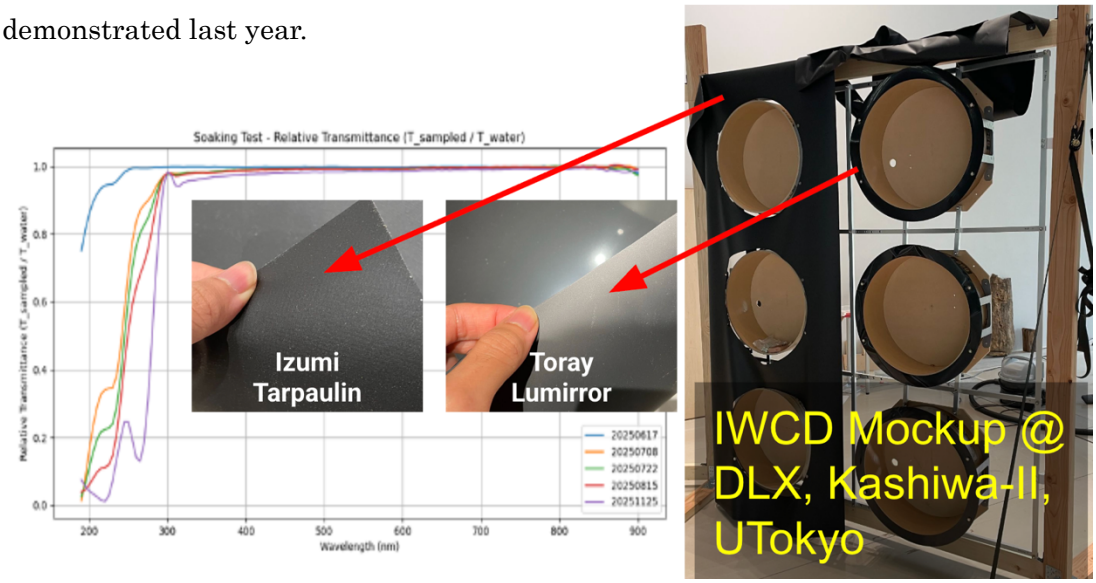
Detector materials for the Hyper-Kamiokande Intermediate Water Cherenkov Detector (IWCD), in particular the blacksheet liner, one of the most abundant material (75% of the wall) in contact with the inner detector, were soaked in ultra-pure water, then measured the water transparency as a function of wavelength by spectrophotometer. The figure below shows how the transmittance as a function of wavelength varied across time for a sample of blacksheet soaked in ultra-pure water. No significant degradation above the 300 nm PMT sensitive region was observed, and that below 300 nm should be recoverable (cleaned) by the purification system as demonstrated last year.



The Water Cherenkov Test Experiment (WCTE) completed CERN beam operations in June 2025. Funding was spent in the previous year for testing potential IWCD water level and temperature sensors in WCTE, which also benefited the WCTE water system operations. These operations included successful loading of gadolinium to 0.03% (same as Super-K), with much appreciated consultation and instruction from ICRR experts.

Data analysis is now on-going, especially for 1) measuring secondary neutron production from tagged pion and proton beams, to tune and constrain final state interaction models in Super-K and Hyper-K, and 2) ^{9}Li production by pions (cosmic muon spallation product) to constrain this background for the Super-K diffuse supernova neutrino background (DSNB) search.

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