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The High Pressure gas Time Projection Chamber: a Future Neutrino Detector

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Understanding neutrino-nucleus interaction cross-sections at the 1-2 percent level will be crucial for the next generation of long baseline neutrino experiments. Due to its low hadron momentum detection threshold, a High Pressure gas Time Projection Chamber (HPTPC) is a strong candidate for achieving a significant reduction in uncertainties on these cross-sections. An HPTPC is part of the baseline design of DUNE and a candidate for use in Hyper-Kamiokande.

An optically read out prototype HPTPC, rated to 5 bar of pressure, was built at Royal Holloway, University of London. The detector was used to make proton scattering measurements on at the CERN East Area T10 beamline from August to September 2018.

In order to improve experimental uncertainties on neutrino-nucleus cross-sections, it is important to improve the models that we use to describe them. HPTPC data will be used to tune the final state interaction parameters in NEUT, the primary neutrino Monte Carlo generator used by the T2K experiment. This tuning will enable a reduction in the systematic uncertainty of neutrino oscillation measurements made by T2K and future experiments.

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