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The Light Readout System of the DUNE 2x2 Demonstrator

The Deep Underground Neutrino Experiment (DUNE) is a long-baseline neutrino oscillation experiment currently under construction at the Sanford Underground Research Facility, with a near detector planned for installation at Fermi National Accelerator Laboratory (Fermilab). The 2x2 Demonstrator, a DUNE Near Detector prototype currently operating at Fermilab, recorded ~30,000 neutrino interactions in 2024, took data with a series of radioactive sources in 2025, and is scheduled to collect several additional months of neutrino beam data in 2026.

Composed of four integrated, single-phase, 600 kg liquid argon modules, the 2x2 Demonstrator prototypes the modular design of the DUNE Liquid Argon Near Detector in beamline conditions. Designed to optimize performance in an unprecedented, high-pileup, neutrino beam environment, the 2x2's four modules are bisected into eight optically isolated time projection chambers (TPCs), each of which contains a pixelated charge readout and 16 wavelength-shifting light traps. The 2x2 Demonstrator uses two distinct light trap designs coupled to a total of 384 Hamamatsu silicon photomultipliers, which collectively provide O(ns) timing with pileup separation on the order of ~200 ns, as well as spatial reconstruction. This talk will provide an overview of the 2x2 Demonstrator's light readout system: its design, its calibration techniques, its performance at high and low energies, and fledgling efforts to incorporate pulse shape analysis tools for applications in the neutrino beam.

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