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The Short-Baseline Near Detector at Fermilab

The Short-Baseline Near Detector (SBND) is a 112-ton liquid argon time projection chamber (LArTPC) neutrino detector located 110 meters from the Booster Neutrino Beam (BNB) target at Fermilab. Its main goals include searches for eV-scale sterile neutrinos as part of the Short-Baseline Neutrino (SBN) program, other searches for physics beyond the Standard Model, and precision studies of neutrino-argon interactions. In addition, SBND is providing a platform for LArTPC neutrino detector technology development and is an excellent training ground for the international group of scientists and engineers working towards the upcoming flagship Deep Underground Neutrino Experiment (DUNE).

SBND began operation in July 2024, and started collecting stable neutrino beam data in December 2024 with an unprecedented rate of $\sim 7,000$ neutrino events per day. During its currently approved operation plans ($2024-2027$), SBND is expected to accumulate an exposure of around 10×10^{20} protons on target, recording nearly 10 million neutrino interactions. The near detector dataset will be instrumental in testing the sterile neutrino hypothesis with unprecedented sensitivity in SBN and in probing signals of beyond the Standard Model physics. It will also be used to significantly advance our understanding of the physics of neutrino-argon interactions ahead of DUNE. After the planned accelerator restart at Fermilab (2029+), opportunities are being explored to operate SBND in antineutrino mode in order to address the scarcity of antineutrino–argon scattering data, or in a dedicated beam-dump mode to significantly enhance sensitivity to searches for new physics.

SBND is an international effort, with approximately 40% of institutions from Europe, contributing to detector construction, commissioning, software development, and data analysis. Continued European involvement and leadership are essential during SBND's operations and analysis phase for both the success of SBND/SBN and its role leading up to DUNE.

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