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Type: Long talk (25min. + 10min. Q/A)

Machine learning for event reconstruction at SNO+

Tuesday 28 October 2025 14:30 (25 minutes)

SNO+ is an operational multi-purpose neutrino detector located 2km underground at SNOLAB in Sudbury, Ontario, Canada. 780 tonnes of linear alkylbenzene-based liquid scintillator are observed by ~9300 photomultiplier tubes (PMTs) mounted outside the spherical scintillator volume. SNO+ has a broad physics program which will include a search for the neutrinoless double beta decay of ^{130}Te .

Machine learning techniques based on transformers are being actively developed for reconstruction tasks at SNO+. We show how data from SNO+ consisting of sets of PMT hits can be effectively prepared for a transformer by tokenizing on a per-hit basis. We present transformer-based reconstruction algorithms for fitting the position and direction of events, and compare the performance of these algorithms to likelihood maximization techniques. We demonstrate position reconstruction with ML on real detector data of coincident radiogenic backgrounds, observing the same marginal improvement over likelihood maximization that is seen in MC at the same energy. We demonstrate the capability for simultaneous reconstruction of event position and direction in MC, which has proved impractical with likelihood. We show that the simultaneous fit significantly reduces bias in the position vertex for higher-energy events, while mitigating shortcomings in the direction fit associated with an imperfect position vertex.

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