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Evaluating T2K Beam and Beamline Component Alignment with Beam Based Alignment using the Muon Monitor

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T2K is a long baseline off-axis neutrino experiment located in Japan with the goal of precisely measuring neutrino oscillations. To maintain stable beam operation, a muon monitor (MUMON) is used to indirectly measure the neutrino beam direction and intensity via the coincident muons. Ongoing work continues at J-PARC to prepare the beamline for higher intensity beam operation up to a planned 1.3 MW proton beam. As J-PARC continues to upgrade its beam intensity it is imperative to understand component alignment during beam operation to ensure safe operation with an accurate neutrino beam. As the first detector after the target with a baseline of 118 m, the muon monitor is sensitive to small changes in the proton beam direction as well as alignment of the collimator, target, and focusing horns. Machine learning models have been trained on Mumon data to predict primary proton beam parameters. To measure misalignments, proton beam position and angle scan data were cross checked with Monte Carlo simulations to find possible misalignments.

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