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Selected beam measurements at PIP-II injector test facility

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The Proton Improvement Plan-II Injector Test (PIP2IT) Facility had been fully constructed and commissioned at Fermilab during 2020-21. The PIP2IT beamline includes a H⁻ ion source capable of delivering 15 mA, 30 keV DC or pulsed beam, a Low Energy Beam Transport (LEBT), a 162.5 MHz, continuous wave (CW) Radio Frequency Quadrupole (RFQ) that accelerates the beam to 2.1 MeV, a 10-m Medium Energy Beam Transport (MEBT) and a SRF section that comprises one cryomodule of each family of Half Wave Resonator (HWR) and Single Spoke Resonator (SSR). The beam is accelerated up to 16 MeV through the SRF section and transported to the beam dump via a High Energy Beam Transport (HEBT) line. This paper describes current understanding of the PIP2IT beamline optics and details selective beam measurements including beam trajectories along the beamline, variation in trajectories due to hysteresis in superconducting solenoids, and characterization of transverse kick exerted by beam chopping system on bunches. The paper also presents a comparison between the model-based and measured beam trajectories. This comparison enabled diagnosis of polarity swap of HWR solenoid and BPMs in the beamline.

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