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Bent Crystal Channeling for Optimized Beam Shadowing and Proton Extraction at Mu2e

The Mu2e experiment is designed to investigate the CLFV through the observation of a neutrinoless muon-to-electron conversion in the field of an Al nucleus. The observation of such a process would be clear evidence of physics beyond the standard model. Due to the rarity of this process, a cutting-edge, intense muon beam is required to achieve an improvement of the current single-event sensitivity by 4 orders of magnitude. To achieve this goal, a primary proton beam with 8 GeV is extracted from the Fermilab Delivery Ring using the slow resonant extraction technique. Mu2e requires ~ 3.6 × 10^20 protons-on-target to meet its goal; hence, it is crucial to minimize the extraction losses. An important source of such losses are the particles impacting on the electric septum blade. A very promising solution to the problem lies in the beam shadowing scheme tested at CERN SPS. In this approach, a bent crystal is strategically placed upstream of the septum, deflecting particles from the blade at a precise angle via the phenomenon of channeling. As a result, a zone with reduced particle flux is created downstream of the crystal, safeguarding the septum anode by minimizing interactions with the beam. This work explores the optimization of beam shadowing design and the process in the manufacturing and characterization of the bent crystal sample. It emphasizes the promising role of channeling in bent crystals, and it underscores the significant potential of channeling in bent crystals to assist the Mu2e experiment.

Secondary track

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