Contribution ID: **213** Type: **talk**

Radiation, thermal, and mechanical studies toward the design of a pion-production target for Mu2e-II

Tuesday, 13 July 2021 16:30 (15 minutes)

The Mu2e experiment being constructed at Fermilab will search for indications of Charged Lepton Flavor Violation by measuring 105-MeV electrons emitted in conversions of negative muons into electrons in the nuclear field without emission of neutrinos. Mu2e-II is a proposed upgrade to the baseline Mu2e experiment to extend the reach by an order of magnitude. To enhance charged-pion production, the Mu2e-II upgrade will rely on a 100-kW 800-MeV proton beam from the dedicated linac accelerator complex PIP-II to be built at Fermilab. Mu2e-II will reach a higher sensitivity than the Mu2e baseline by increasing the rate of negative muons stopped in the detector's stopping target foils by a factor of about 10. Such sensitivity will allow Mu2e-II to reach New Physics mass scales up to $2 \cdot 10^4$ TeV. For Mu2e-II we are considering a novel conveyor target with spherical target elements moved through the beam path both mechanically and by a gas flow. We will discuss our recent advances in conceptual design R&D for a Mu2e-II target station, based on energy deposition and radiation damage simulations involving Monte-Carlo codes (MARS15, G4beamline, and FLUKA) as well as thermal and mechanical analyses to estimate the survivability of the system. The concurrent use of several simulation codes is intended to allow us to elucidate the specific systematic uncertainty inherent in simulations. Our simulations warrant that some other designs are less preferable and support our assessment of the target station's required working parameters and constraints. We show how thermal and mechanical analyses determine the choice of cooling scheme and prospective materials for the conveyor's spherical elements.

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Yes

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Session Classification: Accelerators, Operations, and Quantum Computing and Sensors

Track Classification: Accelerators