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Mu2e-II R&D

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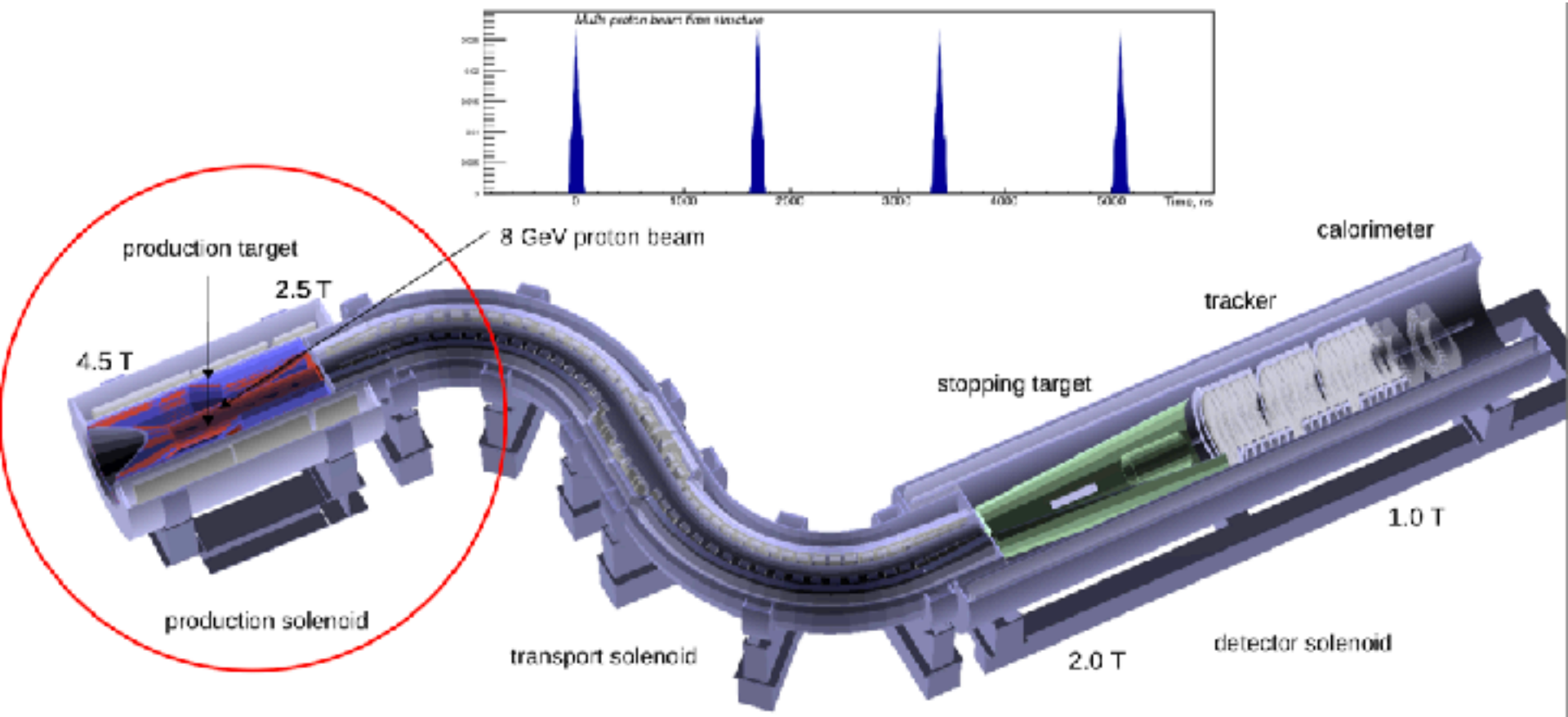
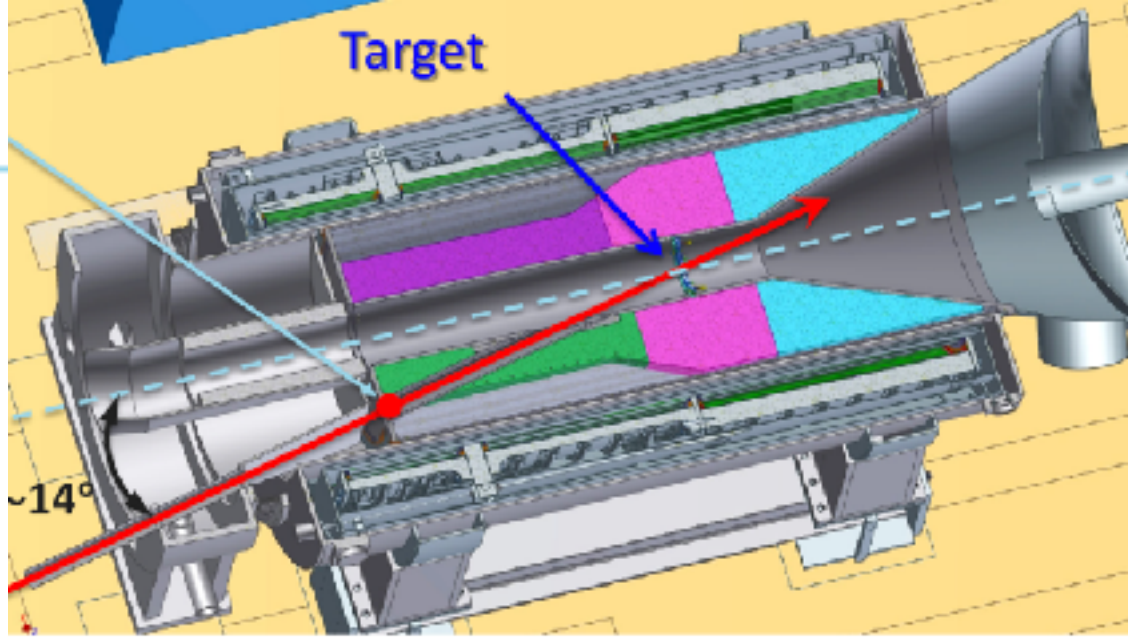
mu2e-II

- Muon to electron conversion program to search for neutrino less muon conversion in the nuclear field
  - Complementary to other muon CLFV processes (mu->e gamma)
- Build upon infrastructure and tech developed for mu2e
  - Follow up is interesting no matter what mu2e finds
  - Detector requirements might be different though
- Mu2e-II workshop at Argonne Dec 08 2018
- Mu2e EOI: https://arxiv.org/abs/1802.02599
- Mu2e-II goal: improve sensitivity by x10 using PIP-II 100kW proton beam

Mu2e concept



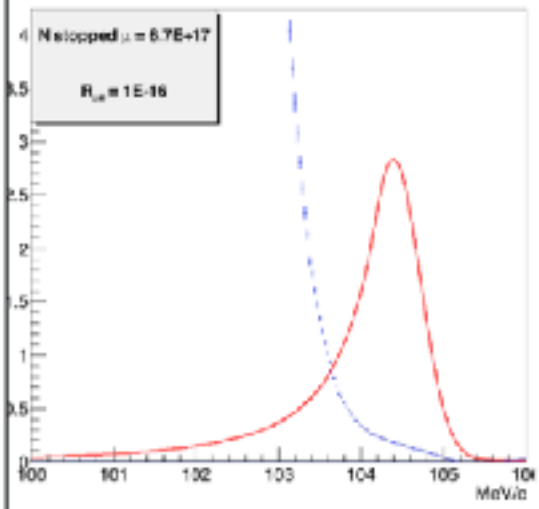
Production target



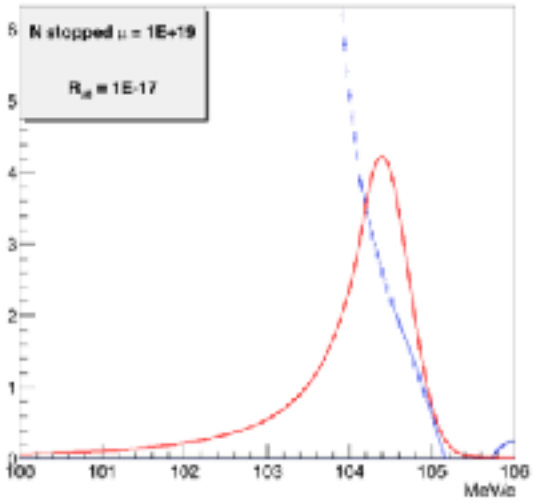
- power density at 8 kW –> 150 MW/m3, comparable to NOva
- at 100+ kW, requirements for rad tolerance exceed current state of art
- need active cooling, conceptual design exists for water and helium cooled systems
- collaborate with RaDIATE consortium
- how to focus 800 MeV/c proton beam on target? - need a conceptual design for the beamline, including new PS

Tracker Resolution toy MC study

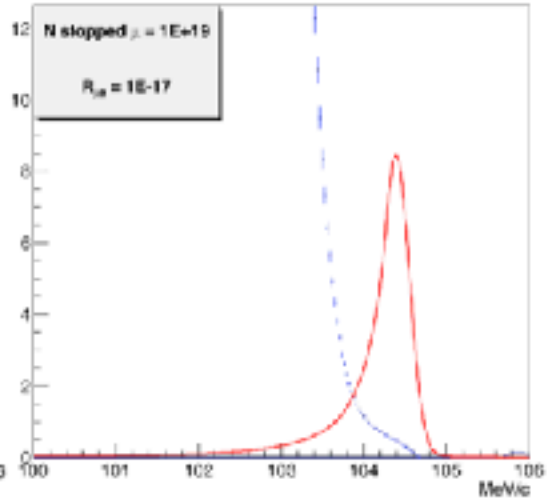
Mu2e



Mu2e-II



Mu2e-II 1/2 resolution



David Brown, LBNL 4 Mu2e-II Workshop 8 Dec. 2017

- straw tracker, 18 tracking stations, D=5mm straws, 15 um mylar (Al+Au), tungsten wires
- background from decays in orbit x10: 2 events
- experiment momentum resolution needs to be improved by x2
- resolution - large fraction from fluctuations of energy losses before the tracker
- occupancy : 2500 hits / proton pulse –> 10000 hits/pulse, non-uniform radially
- thinner straw walls 15um –> 8 um ? lower mass wires ?
- alternative technologies: an utra-low mass rad hard tracker would be of broad interest

Calorimeter

- Energy resolution : < 10%, timing resolution < 500 psec
- performance improvement is not required, however will need to suppress the pileup
- CsI crystals degrade fast after 100kRad
- Mu2e-II will need a faster calorimeter with improved radiation hardness
- most feasible option: BaF2 + fast readout based on UV-sensitive SiPM's.
  Considered as one of the options for Mu2e, R&D has already started
- why special SiPMs? compared to MEG (LXe), BaF2 has 10-20 times lower light yield
- R&D of interest: quantum dot (QD)-based wavelength shifting, yttrium doping of BaF2 to suppress the slow (600 ns) component of BaF2 emission, fast timing with QD-based detectors for PID

The cosmic ray veto system

4 layers of scintillation counters with SIPM-based readout

challenges:

- need to maintain high cosmic muon rejection efficiency (99.9%) - the light yield requirement
  scintillator aging? - studies are already in progress
  one of the directions: improve the light collection with
- "dead time" due to the CRV veto: 5% , accidental coincidences scale quadratically with the beam intensity
  upgrade shielding?
  replace scintillators with RPC's in the high rate areas?

alternative technology of building a highly efficient cosmic ray veto system with low sensitivity to neutrons would be of general interest