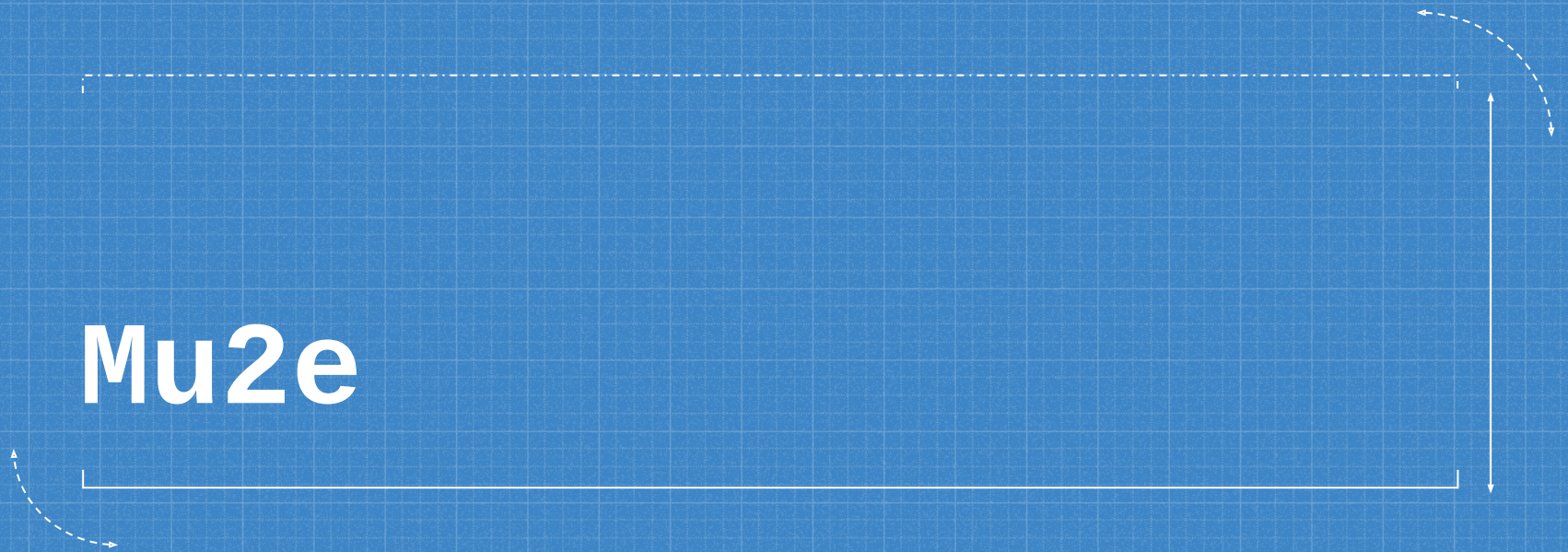
Mu2e



Mu2e Measurements

- Ratio of conversions R_{ue}

- Measurement has some backgrounds
  - Weak Decay of Muons (DIO)
    - Explains the need for high resolution
  - Beam Background
    - RPC (radiative pion capture)
      - Reason for pulsed beams to suppress it
    - Cosmic ray background
      - Everything happening outside detector (will go back to this later)

Solutions to background effects

- Muonic Weak Decay (DIO)
  - Focus on momentum spectrum
  - The michel spectrum endpoint at 52.8 MeV (refer to this later in straw tube tracker)
  - 2 e- 2 neutrinos vs just 1 electron
  -
- Resolution
  - 10^{17} muons ---> 1 event within the MeV of the required endpoint
  - Momentum resolution = 1Me v/c or less
- Beam Flash
  - Proton collisions produced charged and neutral pions
  - Photons ---> electrons go into stopping target, distorting signal
  - Analysis begins at 700 ns to address this, aluminum decay separated from the flash at 864 ns

Background solutions cont.

- Antiproton background
  - Antiprotons higher momentum, thus increased radius of gyration
    - This is filtered by solenoid
    - Antiprotons also have lower KE values, and thus lose energy easily
    - Implementation of 3 absorbers
- Cosmic ray background
  - Need of a cosmic ray background veto system
  - Backgrounds results indistinguishable from signal electrons
    - CRV muon can be misidentified as the electron
    - Electron trapped in the field can be moved to the stopping region
    - Cosmic ray muon striking the stopping target can knock electron out of the signal region (same path as the signal electron)

Experimental Setup

- Magnetic fields transport muons from production target to stopping target
  - 1T - 4.6 T gradient
- System: Production, Transport, Detector

- Production Solenoid
  - Proton beams towards the right “forward” orientation
  - Leftover proton beams backwards
  - Fields drop as muons progress (hence negative gradient)
    - Positive gradients can trap particles
- Transport Solenoid
  - S shape
  - No positive muons captured in stopping target

Experimental Setup 2

- Detector Solenoid
  - Stopping target and detector system
  - Filters antiprotons
    - Higher momentum than muons
    - Higher radius of gyration
      - If not properly stopped increases RPC background
    - Muon Extinction

- Stopping target
  - Pure aluminum
  - Muons pass through stopping material and lose energy
    - Pushes electrons into DIO region

Experimental Setup 3

- Tracker
  - High resolution (minimize backgrounds)
    - Bad resolution: increased background from DIO spectrum
      - Energy loss must be minimized, why?
        - Electrons with a lot of energy loss can be in DIO spectrum as well
- Straw tube tracker
  - Low mass good resolution
  - Mylar
  - Filters out Michel decays
- Calorimeter
  - Disks with holes to accommodate muon beam remnants and beam flash
  - Electrons enter at 55 degrees