Cosmic Ray Backgrounds for an off-Axis Detector
Cosmic Flux for Surface Detector

In 100 kt-yr, expect about 40 intrinsic beam $\nu_e$
What Are We Afraid Of?

Neutrons? x, γ, π⁰? Decay? Mis-ID?– The UNKNOWN

• Can this detector work on the surface?
• Will we need an external veto?
Duty factor \( \approx 5 \times 10^{-6} \)

In 5 calendar years, we will be live for
\(~50\% \times 5\text{yr} \times 5 \times 10^{-6} \times 3.2 \times 10^7 \)
or \(~400\) seconds
\( \Rightarrow 120 \text{ million muons} \)

We need rejection of order 1 in 10 million
to reach intrinsic \( \nu_e \) level

\( \sim 100\times \text{worse if we ever go to resonant extraction (1-2ms)} \ldots \)
What Do We Already Know?

• Scale: need ~ 1 in 10 million rejection

• Beyond confidence regime of simulations
  – Specific values of inefficiencies, correlations, physics parameters
  – Unanticipated processes, conspiracies

• Experience of previous experiments
  – Different energy range than proton decay
  – Needs to be studied for our choice of geometry, absorber, detector.
  – Input welcome! MACRO, SK?
Cosmic Background Studies

We can use a “small” detector

$5 \times 10^{-6}$ duty factor

- 20 ton detector taking data continuously for 1 year
- Compare “50 kt-yr” with beam – really 0.25 ton-year

Regardless of insight from simulation and previous experiments, such a study is quite feasible and affordable
**Cosmic Background Studies**

20 RPCs from Virginia Tech (Belle)

See talk by
C. Hagner

E.g., pairs of planes:
1/3 \( X_0 \) plastic between
10 planes \( \times 0.15 \) m
⇒ ~ 20 tons of plastic
Issues

• Small fiducial region
  – Should be sufficient statistics for as long as fiducial more than 25%

• Only \( \sim 3X_0 \) – electrons can traverse length
  – How good is \( \mu/e \) separation without using track length?
    • Electrons aren’t terribly “shower-like”
  – Can change aspect of detector to study this if we see any potential background.
Status

• Small RPC test stand started at lab 6 at FNAL
  – LODEN test project
• 20 Belle RPCs will arrive soon
• Upcoming work
  – Build appropriate DAQ
  – Choose and build readout strip construction
  – Engineer infrastructure for 20 ton detector
    • Gas, mechanical
  – Procure plastic
Summary

- Surface detector will see 100s of millions of muons during live time
- Need to understand whether these can lead to backgrounds on scale of 40 events
- Direct measurement is surest path forward
- Project to study backgrounds in low density RPC detector at Lab 6:
  - 20 ton detector will give valuable feedback with 1 year of running.