Cosmic Ray Muons in the PROSPECT Reactor Antineutrino Detector

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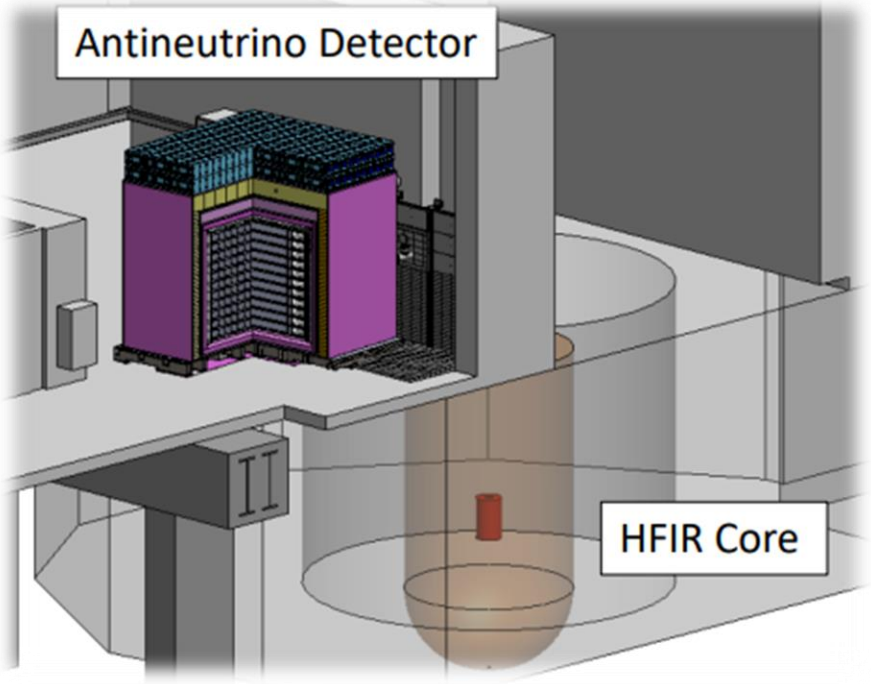
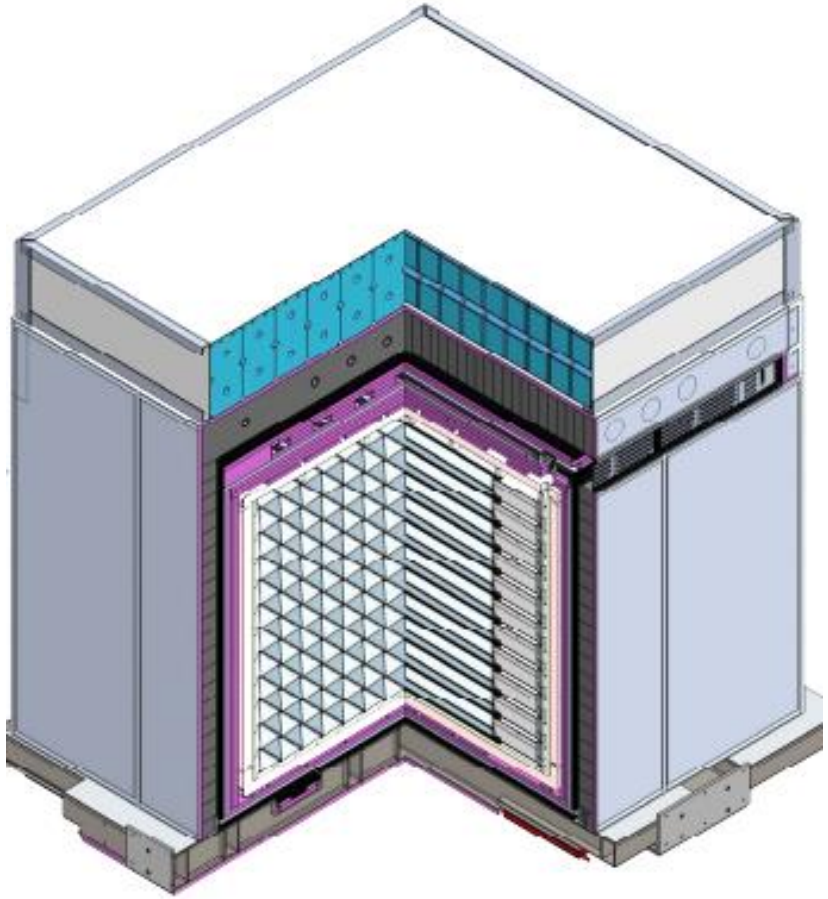
PROSPECT Experiment

- Probe for eV scale sterile neutrino oscillations
- Measure U-235 antineutrino spectrum
- High Flux Isotope Reactor @ Oak Ridge National Lab
- Short baseline – 7-9 meters
- Above ground





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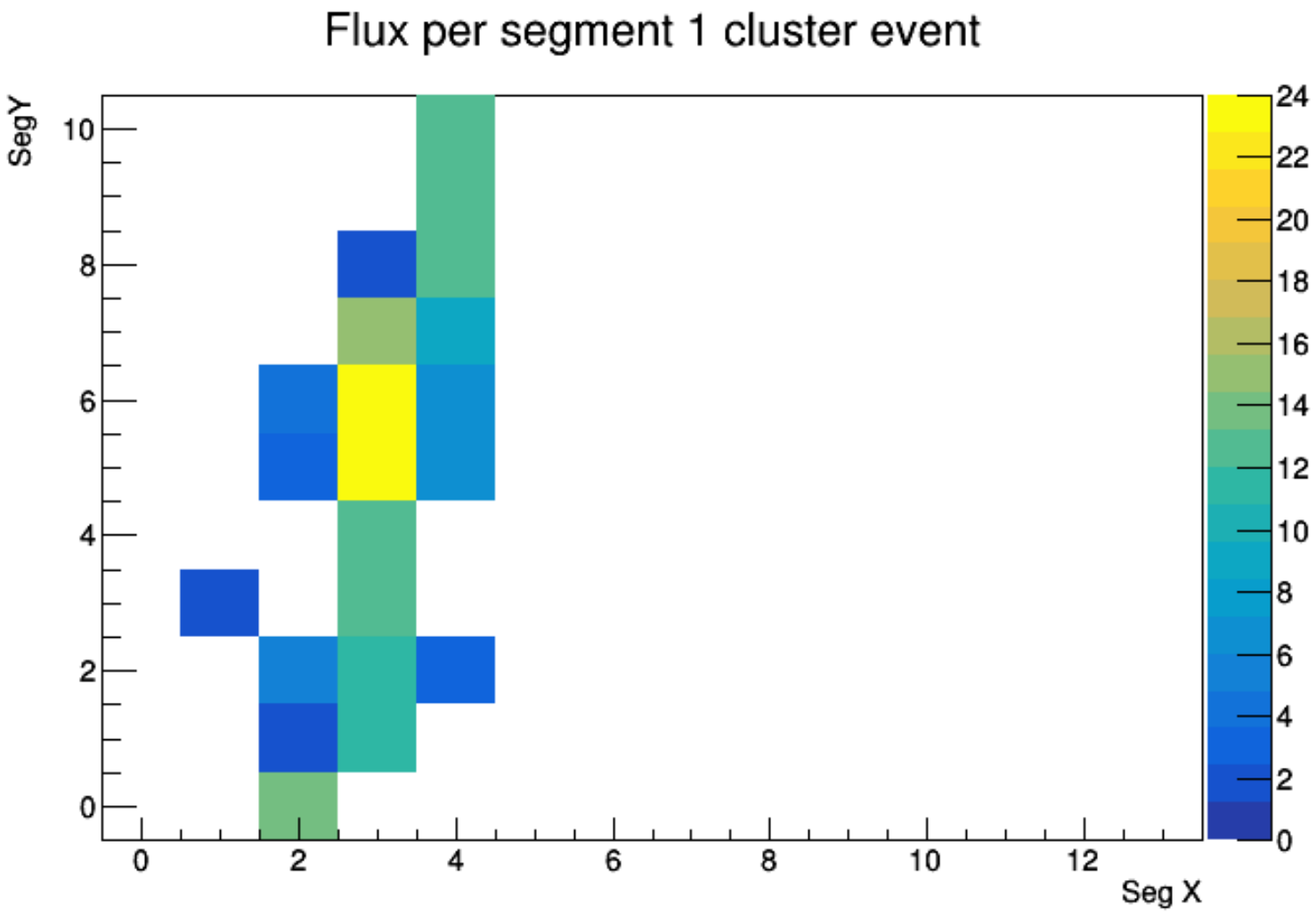
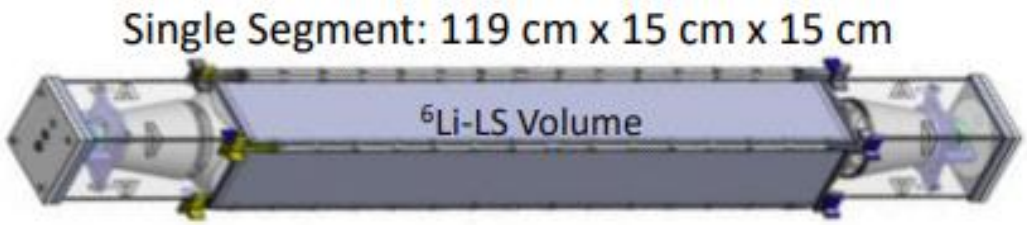
Cosmic Muons

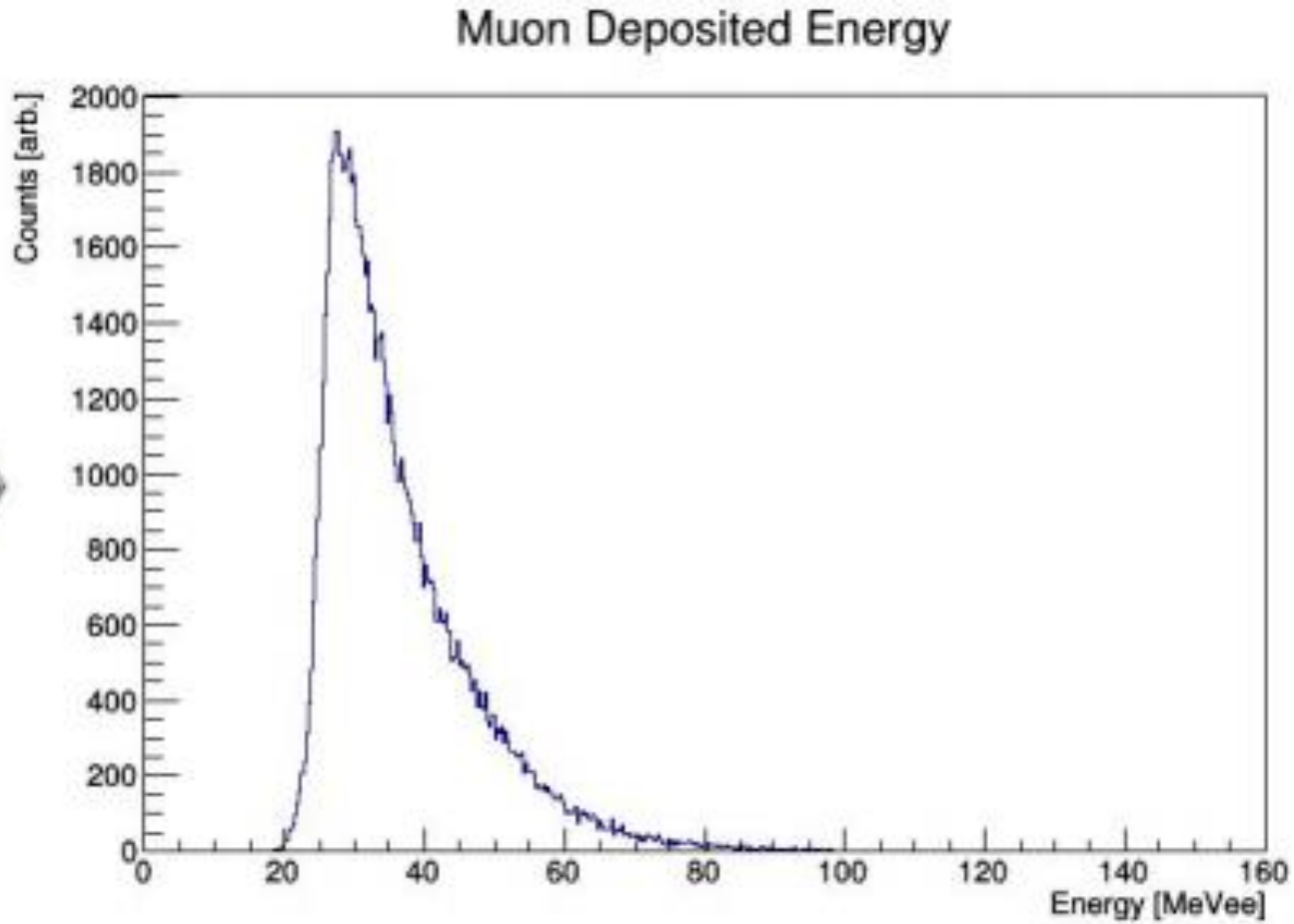
- High efficiency cut
  - >15 MeV
  - ~500 events/sec
- CRY
  - Developed by LLNL
  - Variables
    - Latitude
    - Altitude
    - Season



Energy Deposition of Muons

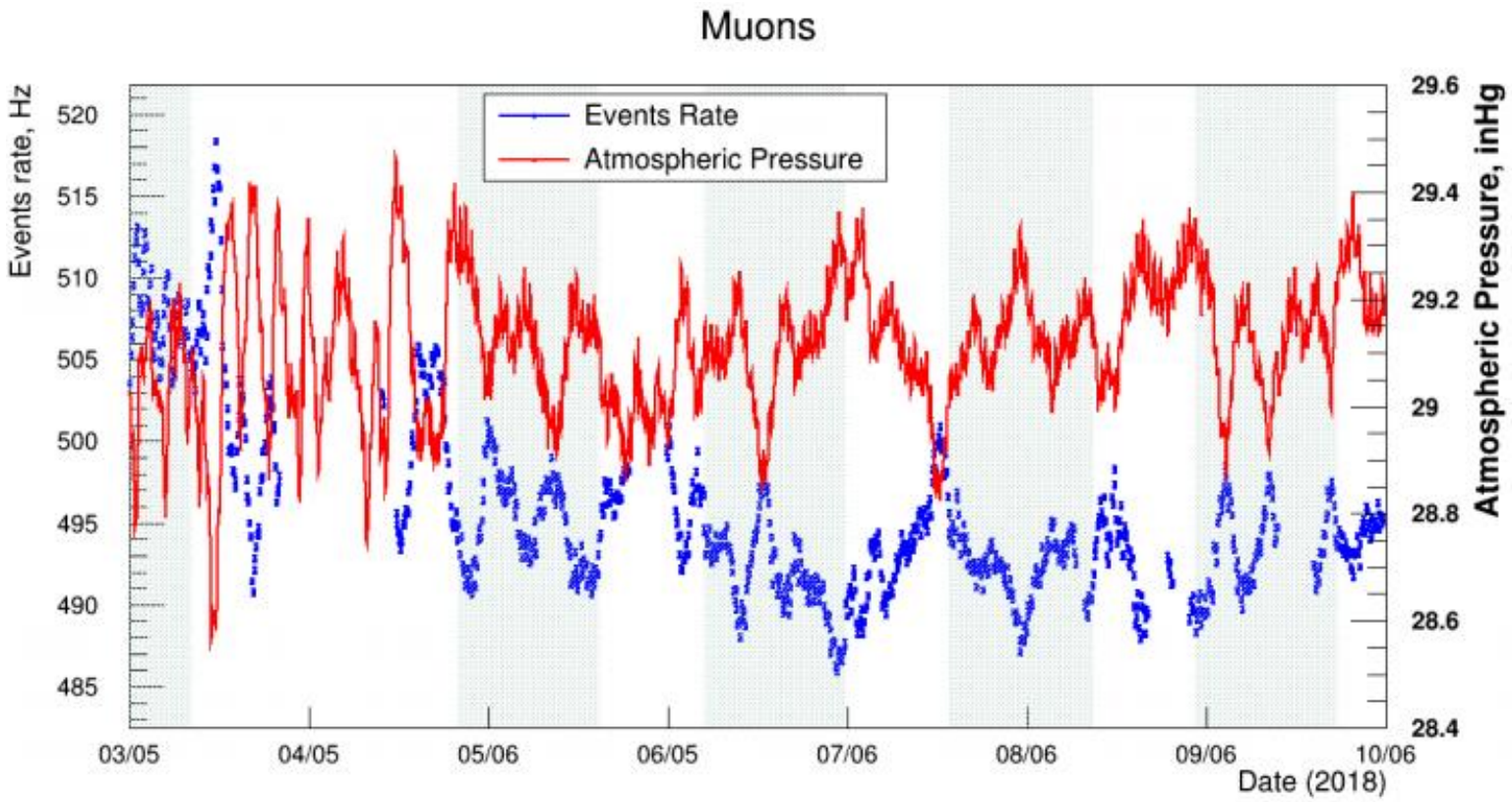
- 2 MeV per cm
- Single segment energy deposition





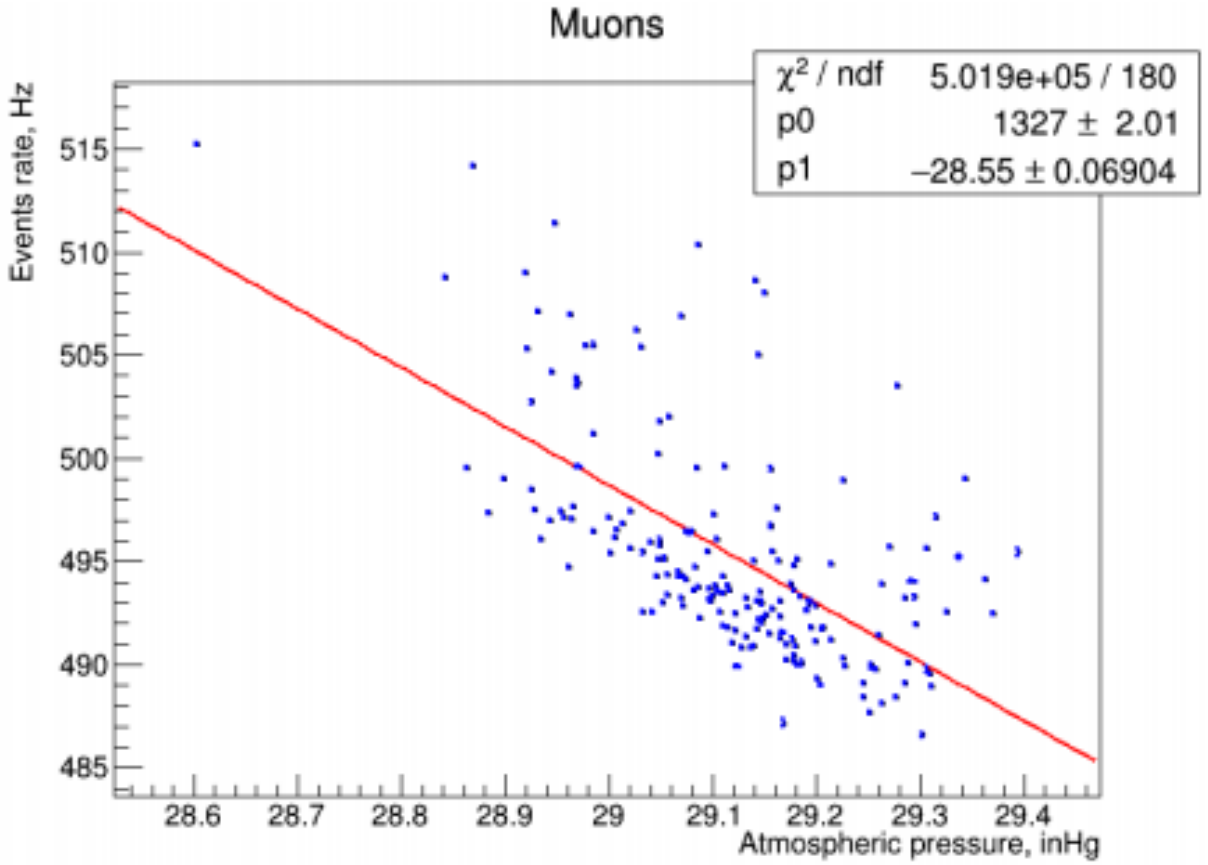
Atmospheric Pressure

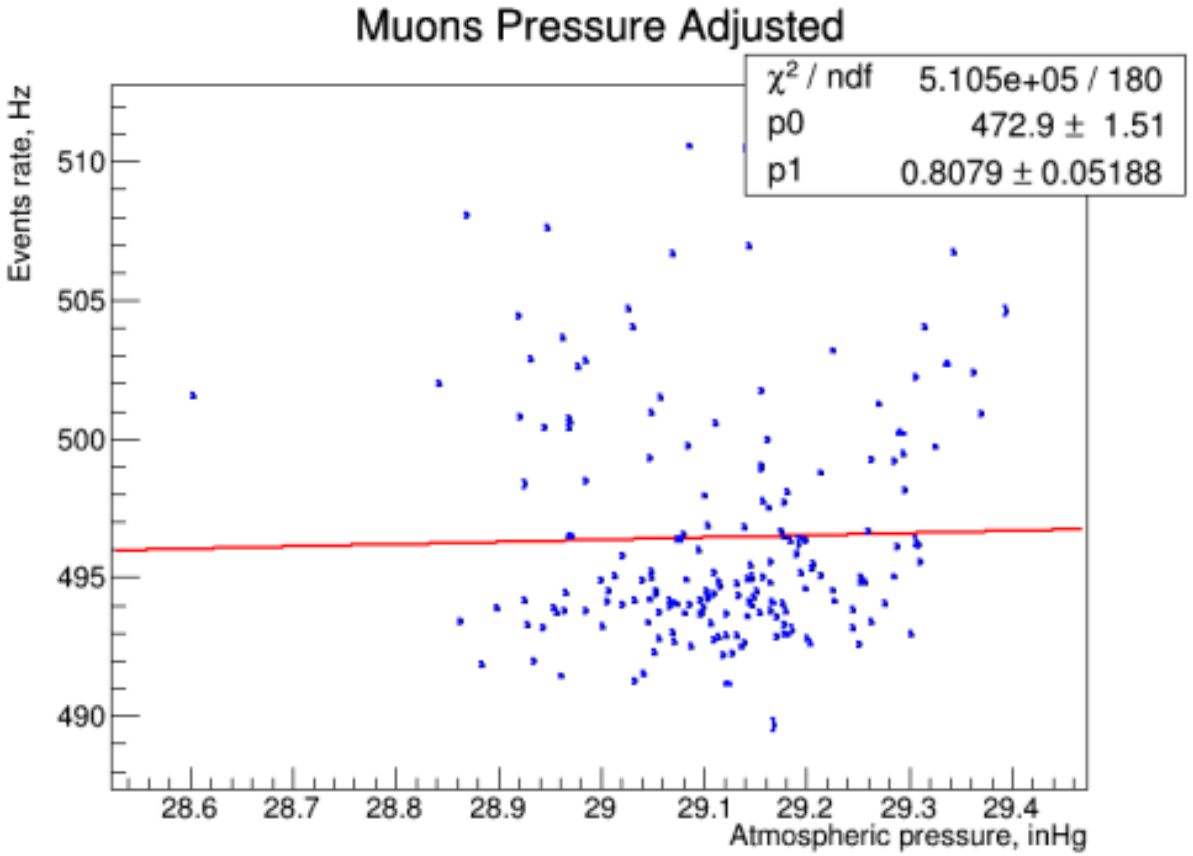
- Pressure and muon anti-correlation
- Atmospheric pressure in red
- Muon events rate in blue



Atmospheric Correction

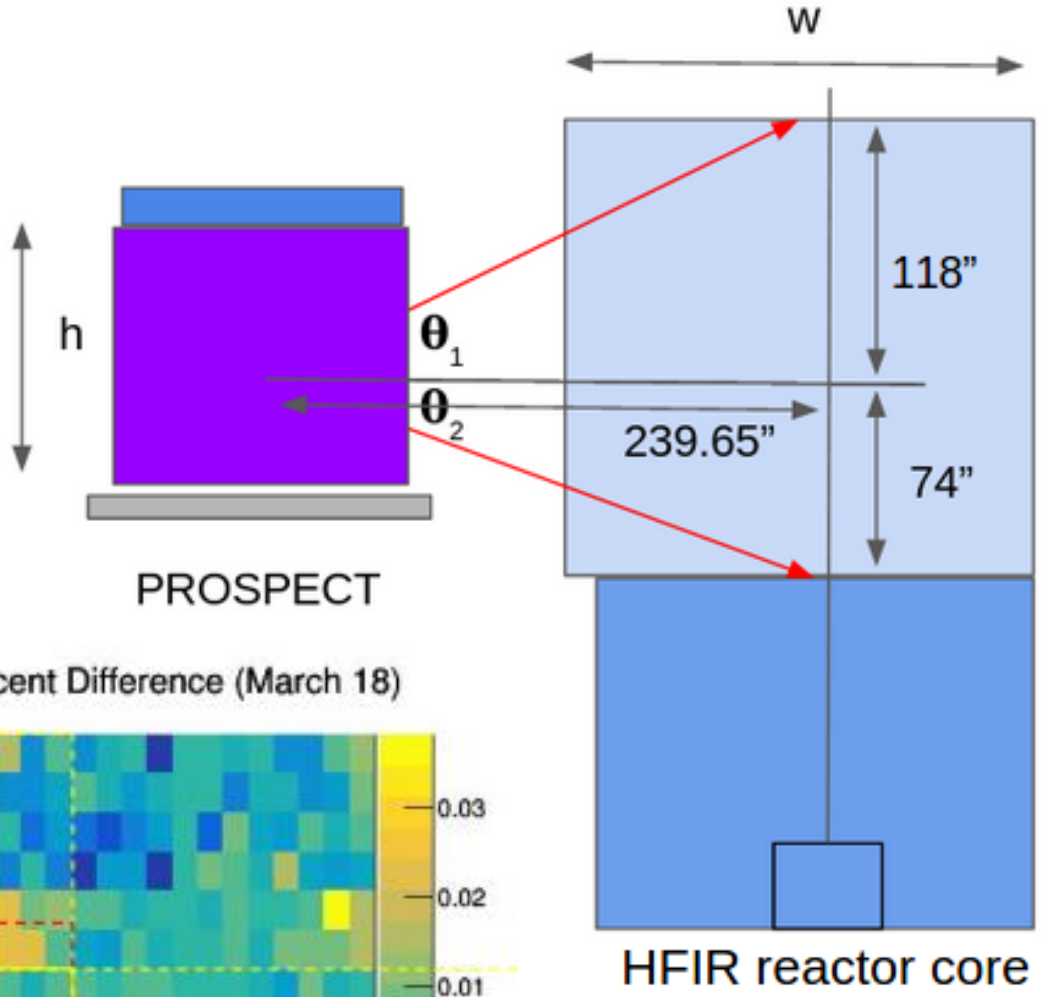
- Inverse relation between Pressure and Event Rate
- Correction applied to give constant event rate

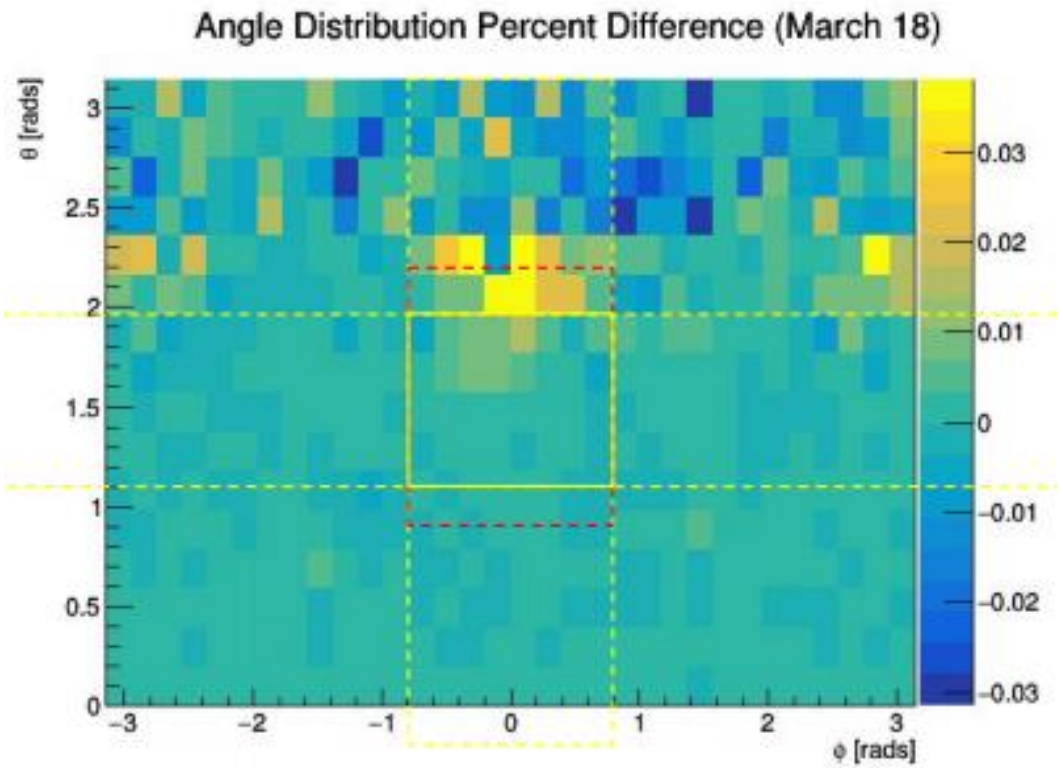




Water Level

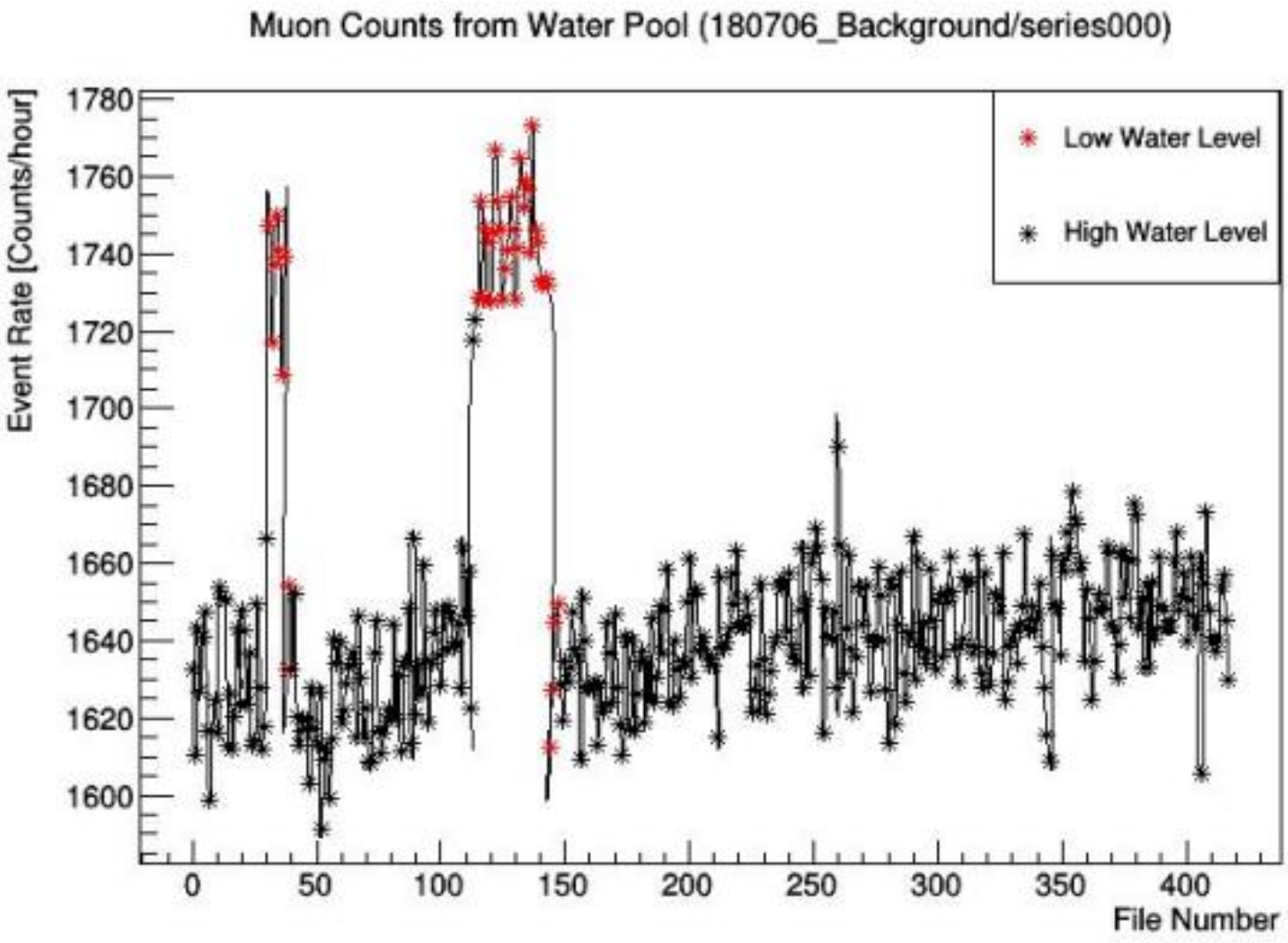
- Water pool located over reactor
  - Drops due to maintenance
- Effects muon rate
- Cuts
  - Geometric
  - Energy





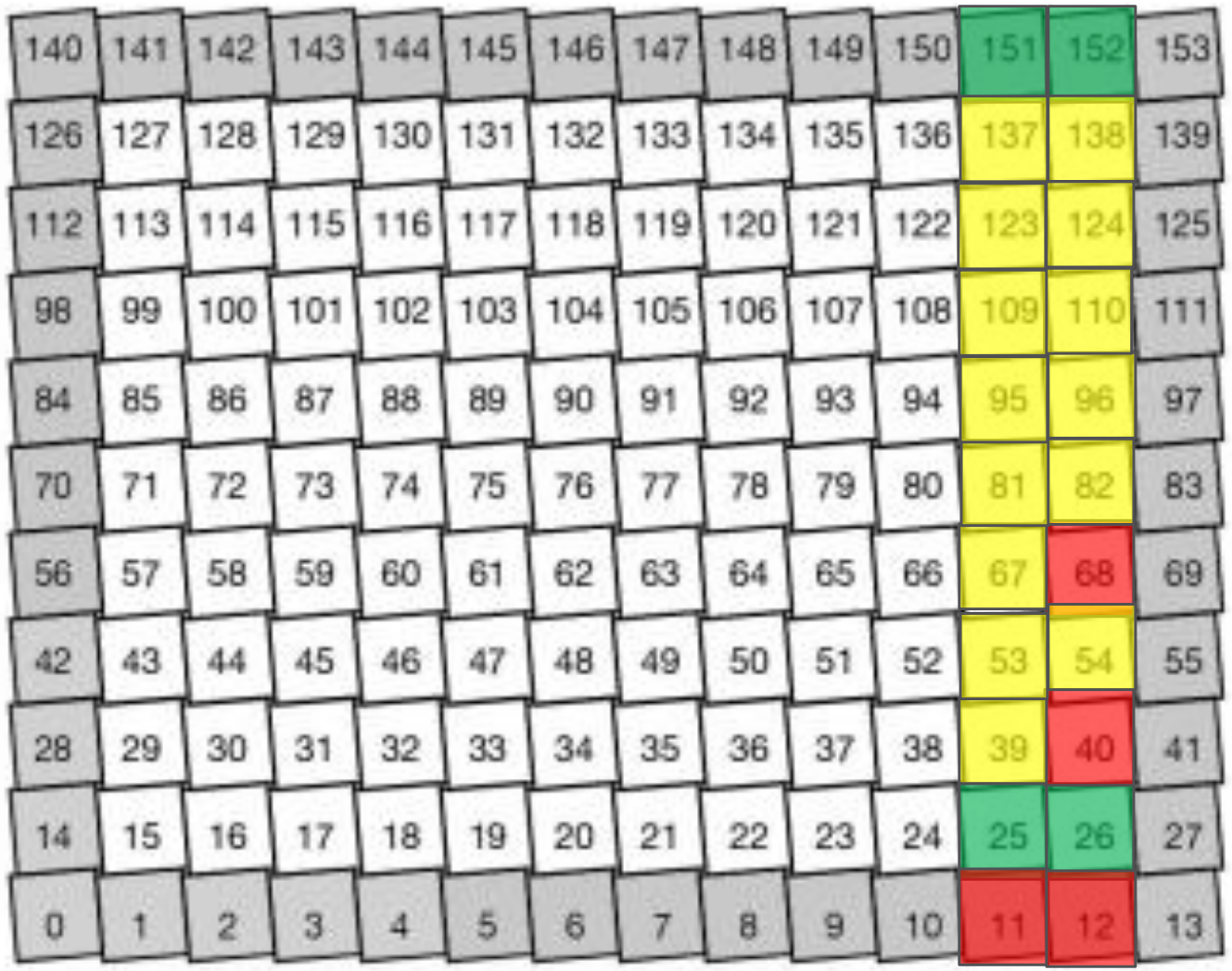
Water Level cont'd

- Difference in event rate
- Each file is 1 hour in length
- Data taken during July 2018
- Rate is events/hour



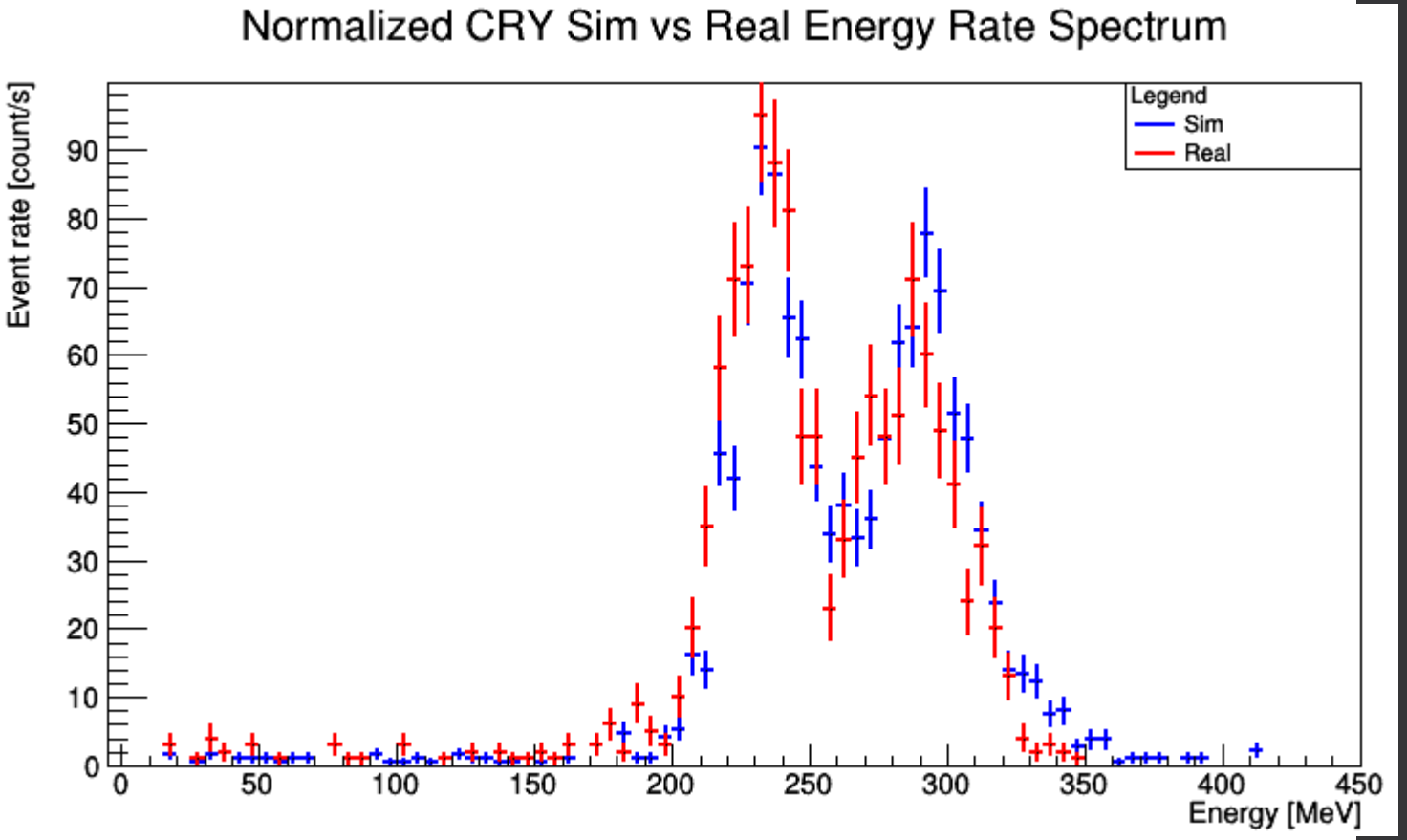
Downward Muon Cuts

- Geometry cuts
  - Straight
  - Through going
  - High purity
- 2 columns
  - Muon must pass
  - Cell is included
  - Cell is excluded from analysis
  - Veto rest of detector



Simulation and Data Comparison

- Peaks correspond to columns
- 1 hour long of data
- Energy >15 MeV
- Normalized to real event rate



Summary

- High rate of cosmic muons in PROSPECT
- Time dependent muon rates studied
  - Atmospheric pressure
  - Water pool levels
- CRY simulation and analysis to understand corrections
- Simulations validate high purity cuts for studying additional time dependence

PROSPECT Collaboration