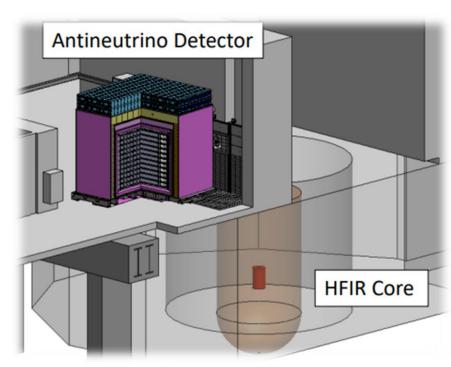
# Cosmic Ray Muons in the PROSPECT Reactor Antineutrino Detector

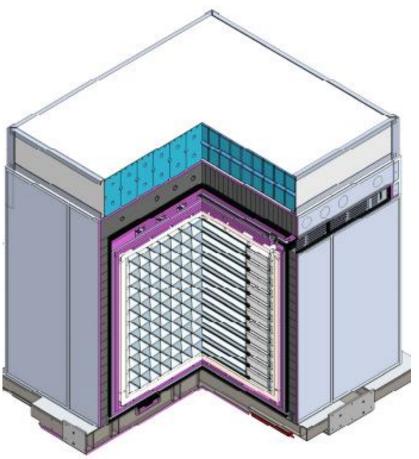
James Minock Drexel University On behalf of the PROSPECT Collaboration



# 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





PROSPECT, NIM A 922 (2018) 287

# Cosmic Muons

- High efficiency cut
  >15 MeV
  - $\sim$  500 events/sec

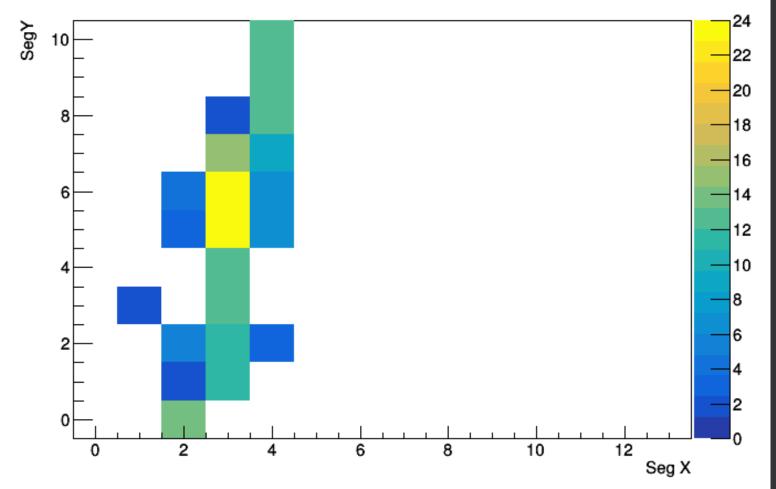
• CRY

- Developed by LLNL
- Variables
  - Latitude

• Altitude

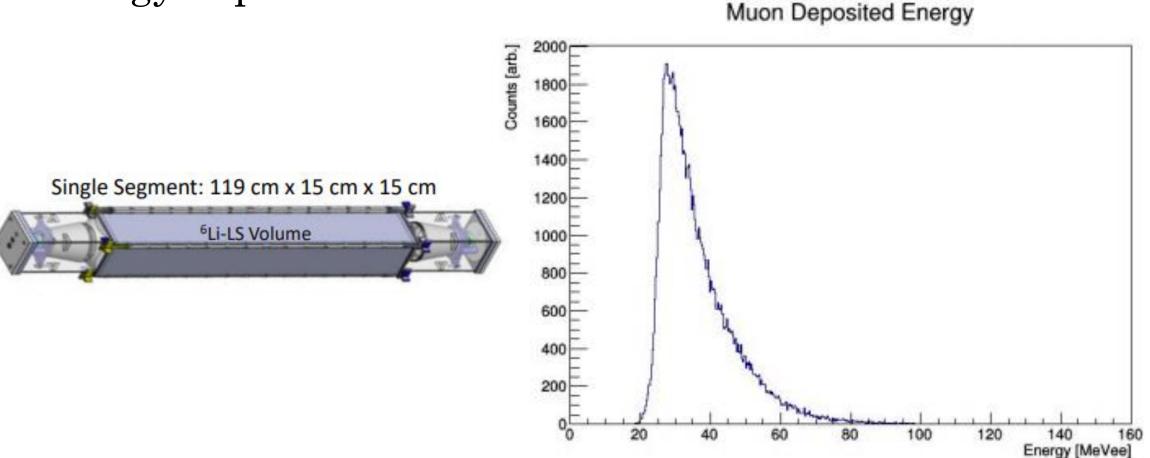
• Season





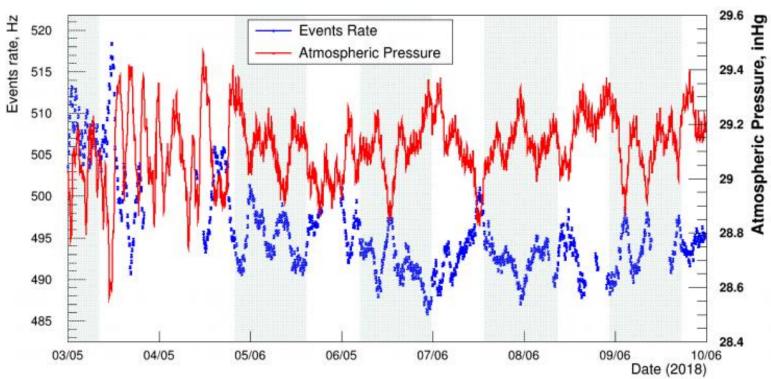
# Energy Deposition of Muons • 2 MeV per cm

• Single segment energy deposition



# Atmospheric Pressure

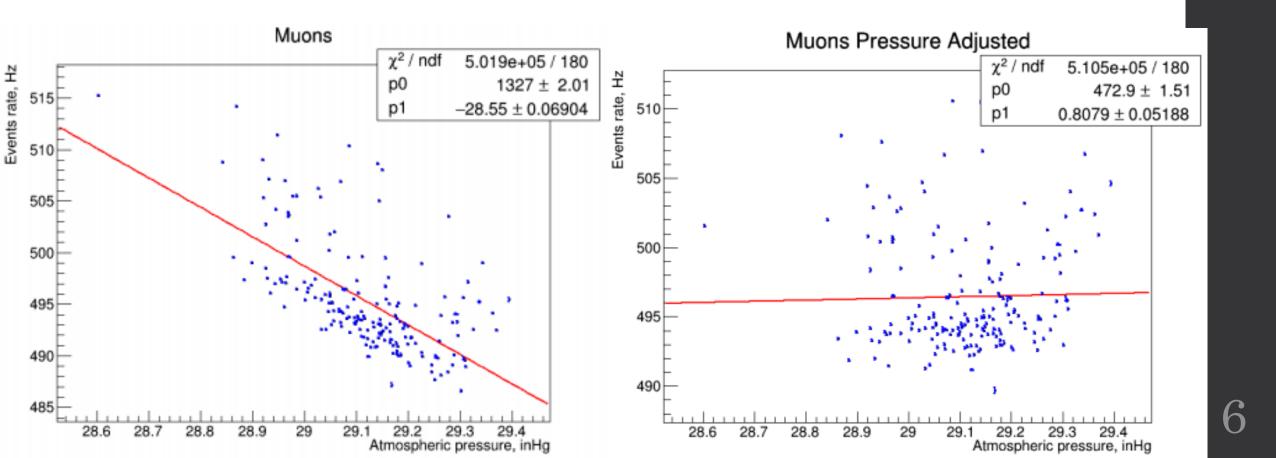
- Pressure and muon anti-correlation
- Atmospheric pressure in red
- Muon events rate in blue



#### Muons

# **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

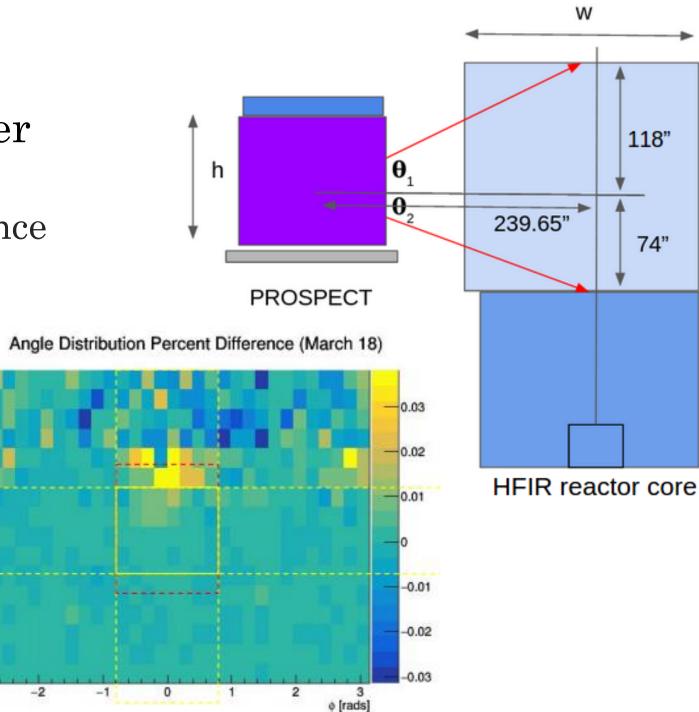
0 [rads]

2.5

1.5

0.5

- Effects muon rate
- Cuts
  - Geometric
  - Energy

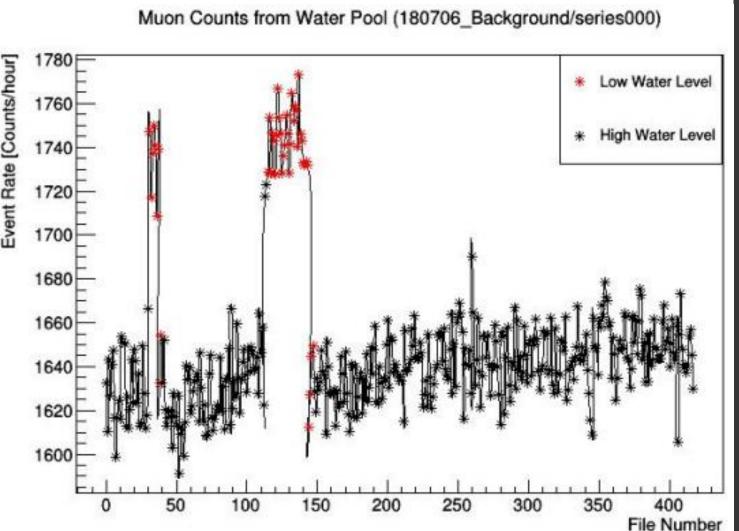


118"

74"

# 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

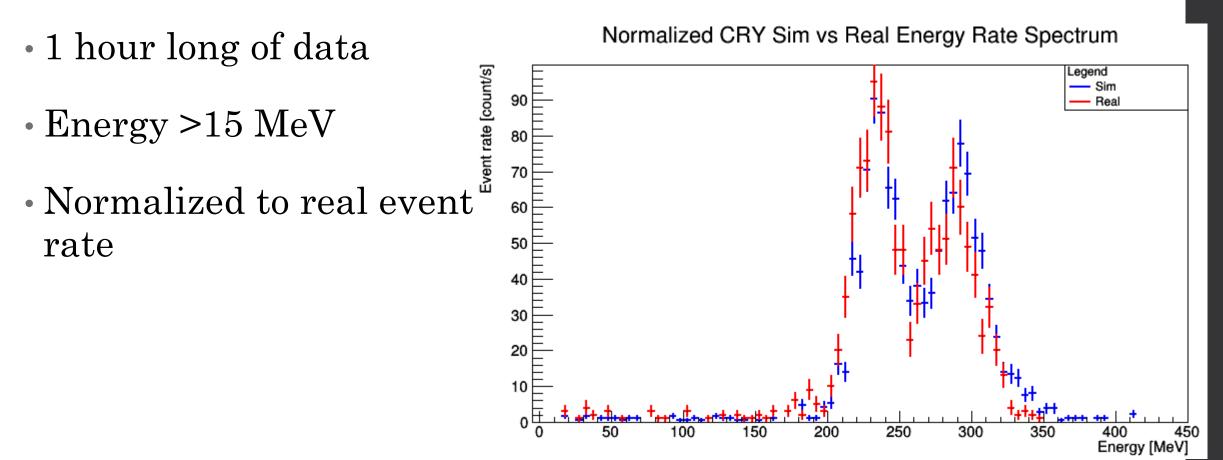


- Cell is excluded from analysis
- Veto rest of detector

140	141	142	143	144	145	146	147	148	149	150	151	152	153
126	127	128	129	130	131	132	133	134	135	136	137	138	139
112	113	114	115	116	117	118	119	120	121	122	123	124	125
98	99	100	101	102	103	104	105	106	107	108	109	110	111
84	85	86	87	88	89	90	91	92	93	94	95	96	97
70	71	72	73	74	75	76	77	78	79	80	81	82	83
56	57	58	59	60	61	62	63	64	65	66	67	68	69
42	43	44	45	46	47	48	49	50	51	52	53	54	55
28	29	30	31	32	33	34	35	36	37	38	39	40	41
14	15	16	17	18	19	20	21	22	23	24	25	26	27
0	1	2	3	4	5	6	7	8	9	10	11	12	13

# Simulation and Data Comparison

• Peaks correspond to columns



# 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

