The NOvA Detectors

- Segmented liquid scintillator detectors
- Far detector on the surface
- Near detector underground, 300 meters water equivalent
- All data continuously digitized
- Buffered for ~20 minutes while trigger decisions are made
- Triggers can request a data time window of 50μs to 45 seconds
- Enables rich non-oscillation physics program

Dark Matter

- Major background: atmospheric neutrinos
- Data-driven background estimate: day sample
- Analysis validation: twilight sample

Magnetic Monopoles

- Magnetic monopoles predicted by various grand unified theories
- Not much theoretical guidance on the mass
- $10^3 - 10^{12}$ GeV
- NOvA Far Detector is unique in being a large tracking detector on the surface
- Sensitive to low mass monopoles that would range out before reaching underground detectors
- Slow monopoles, $\beta < 0.01$ are detected via unmistakable slow track
- Fast monopoles, $\beta > 0.01$ are detected by consistent highly ionizing straight track
- 1000 live-days of monopole-triggered data on tape as of May 2018

\[ \nabla \cdot E = 4\pi p_m \]
\[ \nabla \cdot B = 0 \]
\[ \nabla \times E = \frac{(4\pi J_m + \zeta)}{\epsilon} \]
\[ \nabla \times B = \frac{(1 + J_m + \zeta)}{\epsilon} \]

Supernova Neutrinos

- See poster #13 in this session.

Gravitational Wave Coincidence

- Search for $n \rightarrow \tilde{\tau}$ conversion in $^4$He
- Conversion suppressed in nuclei, but less in carbon than oxygen: advantage over water detectors
- Typical signature is several annihilation pions in a momentum-symmetric star
- Despite being on the surface, expect to be limited by detector overburden

Neutron/Anti-neutron Oscillations

- At GeV and above, tracks point to source
- Total muon rate underground is well-known to be higher in the summer
- MINOS observed winter maximum for multiple muons
- NOvA now confirms this using our Near Detector
- Far Detector analysis underway

Origin of effect is unknown, but thought to be caused by secondary interactions of pions in the denser winter atmosphere

East/West Effect

- Measurement of the east/west asymmetry of the low energy cosmic ray muon flux
- Caused by Earth’s magnetic field: some trajectories of low-energy primaries are forbidden
- Measurement of the field and its impact on cosmic rays is an input for low-energy atmospheric neutrino simulations
- Must be disentangled from detector overburden asymmetries

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