The Astrophysics Program of NOvA

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For the NOvA Collaboration

The NOvA detectors, designed primarily to discover and measure electron neutrino appearance in a muon neutrino beam, are versatile instruments being used for a variety of astrophysical analyses.

**Multimessenger Astronomy with Gravitational Waves**
- MeV-TeV signals: broad search for any excess
- Especially sensitive to supernova-like neutrinos
- Pre-2019: 100% live for some topologies ≥100MeV, otherwise 0.5% minimum bias
- 2019-present: 100% live for few-MeV - 45s window
- No excesses in 28 LVC events. arXiv:2001.07240. Accepted by PRD.
- Galactic supernova origin of GW largely ruled out for 5 fully-triggered events in 2019

**Magnetic Monopoles**
- Little theoretical guidance on mass
- Far Detector unique in being a large surface tracking detector
- Light monopoles would not reach underground
- β < 0.01: unmistakable slow track
- β > 0.01: highly ionizing track
- 1700 live-days and counting

**Neutron/Anti-neutron Oscillations**
- Search for n → \(\bar{n}\) conversion in \(^{12}\)C
- Typically pions in symmetric star
- Suppressed in nuclei; less in C than O: advantage over water detectors
- Surface detector, but expect to be limited by atmospheric neutrinos
- 700 live-days and counting

**Dark Matter**
- Trigger on upwards-going muons at night
- Search for dark matter annihilation in the Sun
- Remove cosmic muons by timing
- Major background: atmospheric neutrinos

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**Seasonal Multiple-muon Effect**
- Total muon rate underground well-known to be higher in summer
- MINOS observed winter maximum for multiple muons
- Far Detector analysis of surface flux underway

**Neutrinos**
- Increases with multiplicity
- Origin unknown, thought to be reinteractions of pions in denser winter atmosphere
- Identify high energy muons by the showers they induce
- Measure flux over 100 GeV

**Studies of the High Energy Cosmic Ray Flux**
- Identify high energy muons by the showers they induce
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