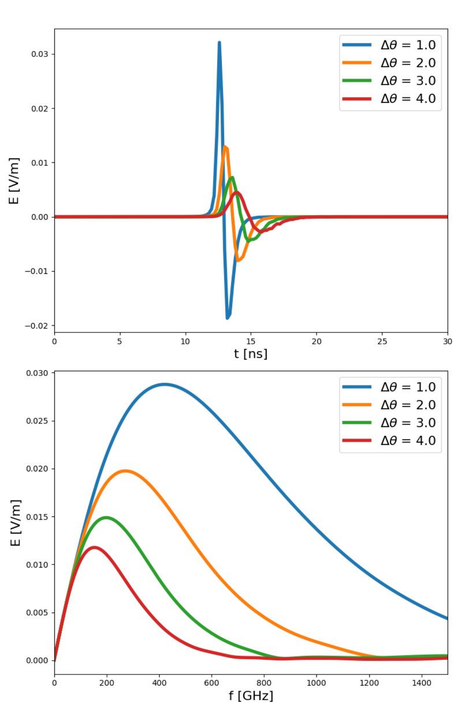
Measuring the Flavor of Ultrahigh Energy Neutrinos with PUEO

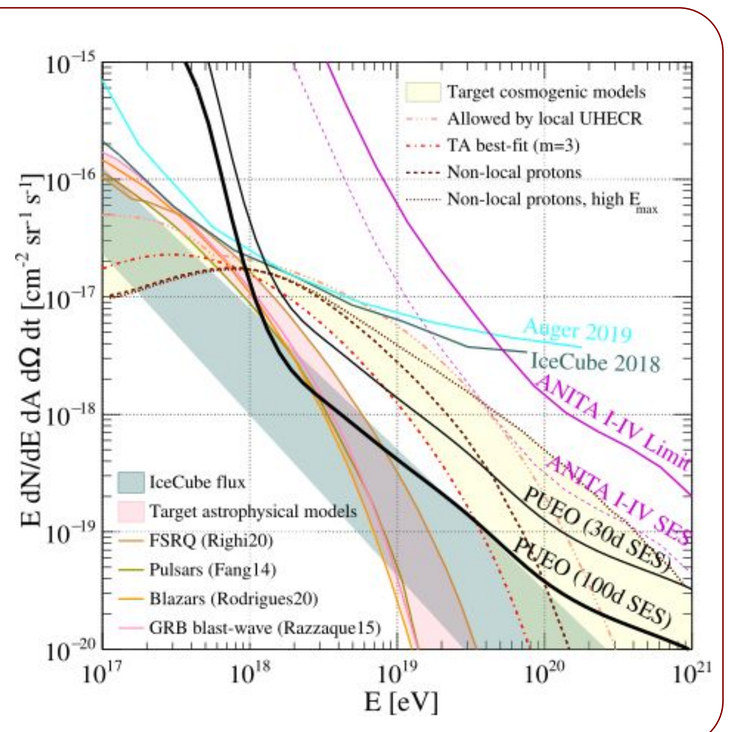
Christoph Welling*, Austin Cummings, Rachel Scrandis
for the PUEO Collaboration

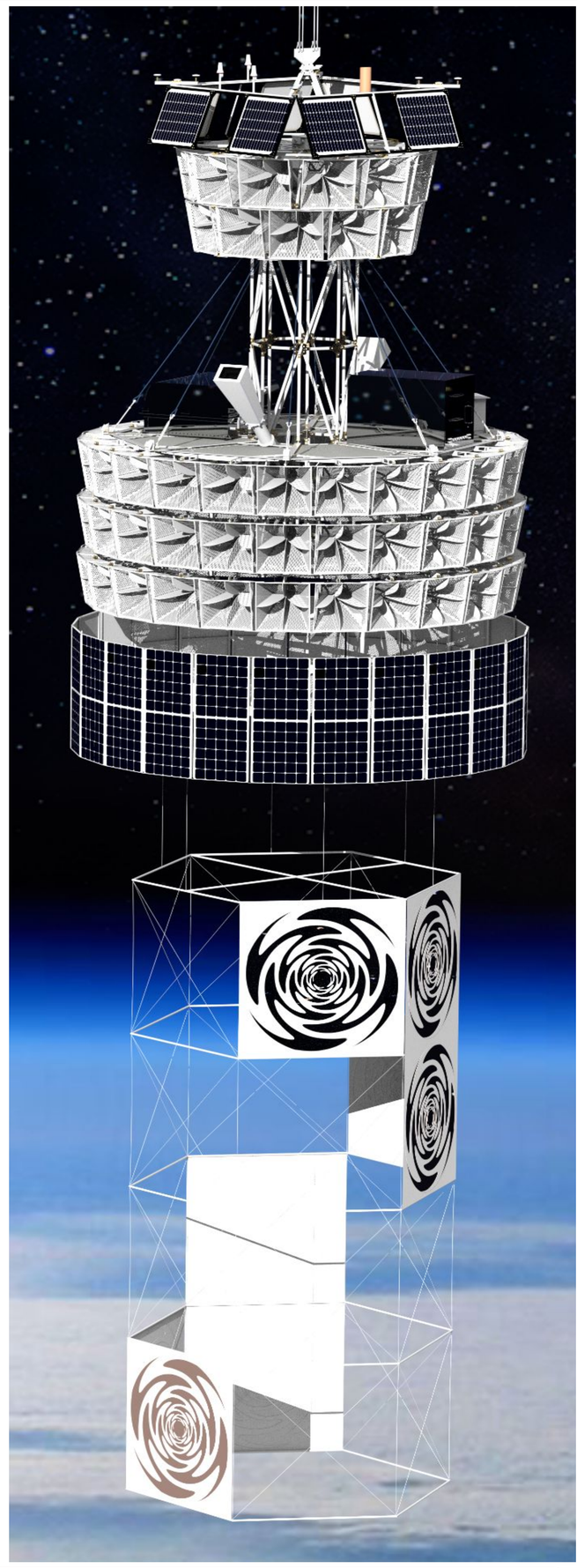
*christophwelling@uchicago.edu

The Payload for Ultrahigh Energy Observations (PUEO)

- Targeting neutrinos above EeV energies
- Askaryan effect: Coherent radio emission by particle showers in dielectric media
- Amplified emission around Cherenkov angle
- Radio attenuation length in ice ~1km
- Long duration balloon detector over Antarctica
- Large volume of ice in field of view
- Builds on success of 4 ANITA flights
- Scheduled to launch in austral summer 25/26

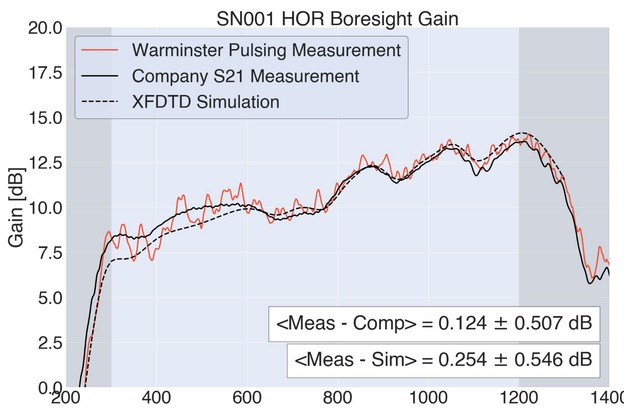


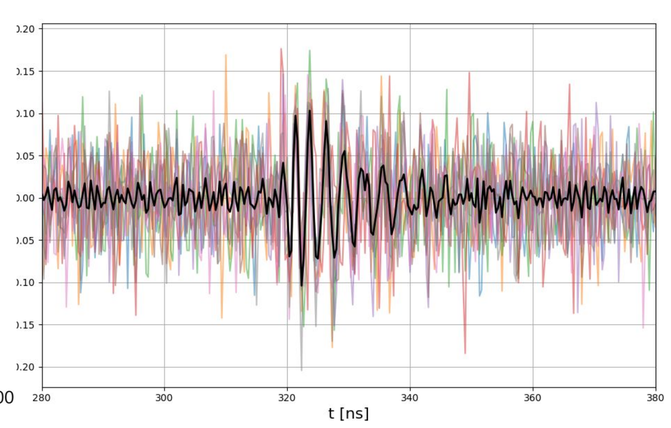




The Main Instrument

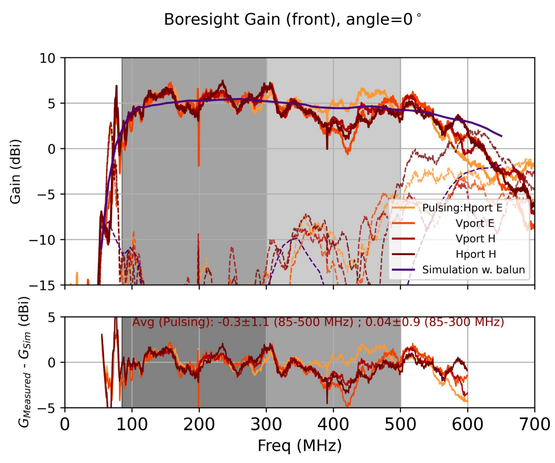
- Targets radio signals from in-ice particle showers
- 96 high gain horn antennas
- 2 polarization channels per antenna
- 24 phi sectors for 2π acceptance
- Sensitive in 300-1200MHz band
- Interferometric trigger to reduce noise

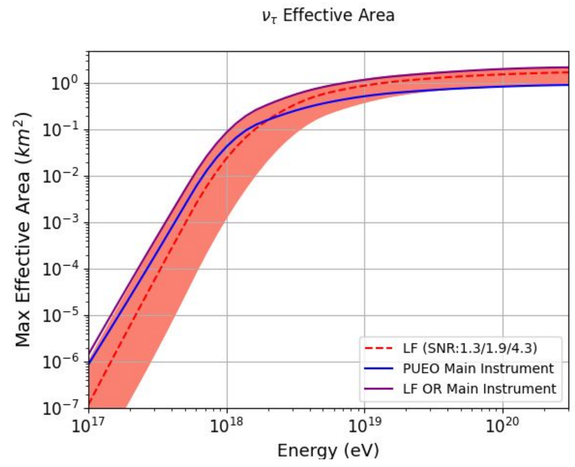




The Low Frequency Instrument

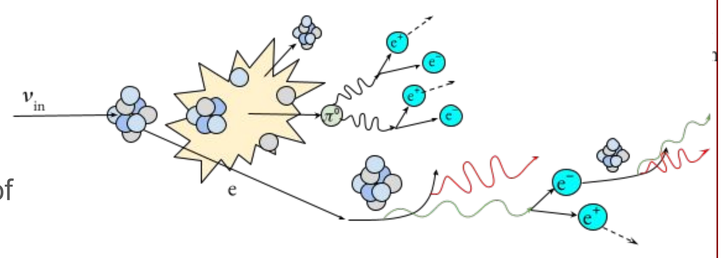
- Drops down after launch
- 8 log-periodic sinuous antennas
- 2 polarization channels per antenna
- Sensitive in 50-500MHz band
- Sensitive to in-air particle showers
  - Cosmic rays
  - Earth-skimming trau neutrinos

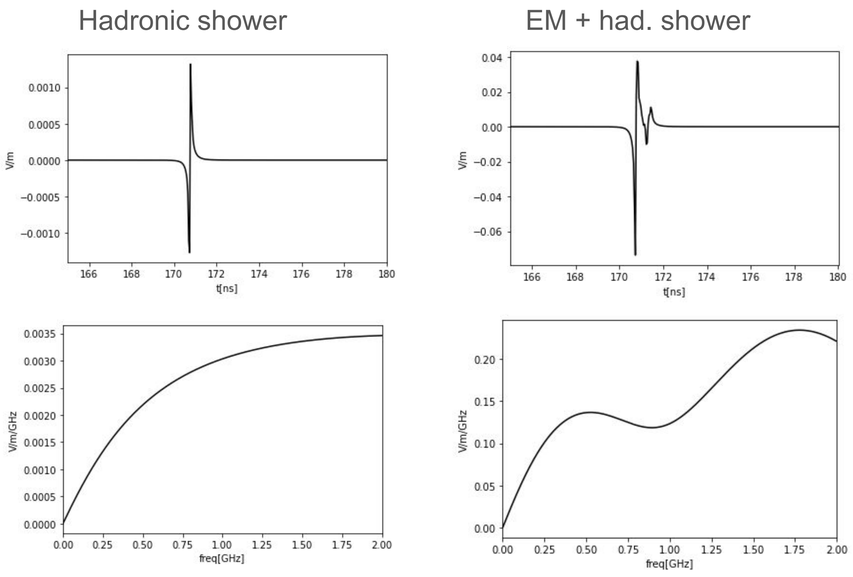




Identifying Electron Neutrinos

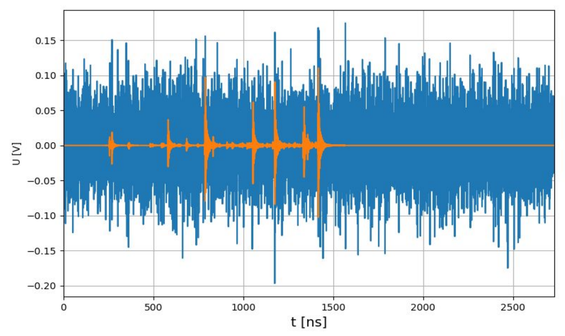
- Neutrino-nucleon interaction produces a hadronic shower
- ν_e CC interaction produces additional EM shower
- EM shower is longer than hadronic shower
- LPM effect: Irregular shape of EM shower
- Interference between radio signals from showers

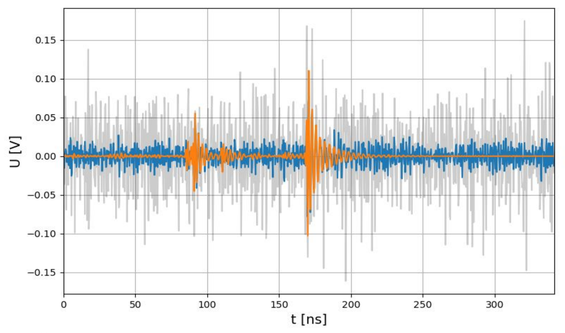


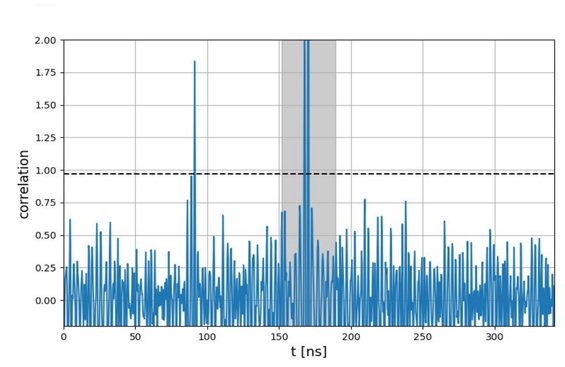


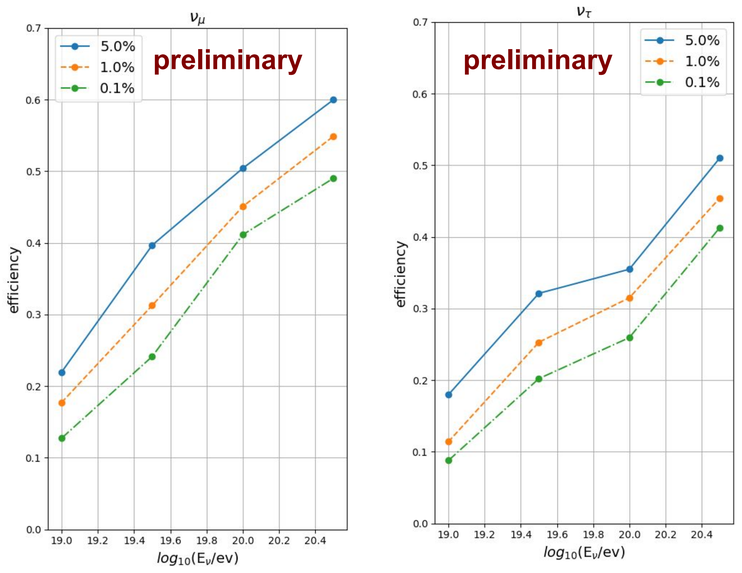
Identifying Muon and Tau Neutrinos

- ν_μ and ν_τCC interactions produce propagating muon/tau
- Muon/tau is not directly detectable, but can produce secondary showers
- Secondary radio signals are likely to appear inside recorded time window
- Search using template correlation









Secondary shower search results