Novel Background Rejection Techniques in a Search for Ultra-high Energy Neutrinos Using an ARIANNA Detector Station at the South Pole

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1. Introduction

- Detector station with new antenna configuration deployed in Dec 2018 at the South Pole
- Antenna configuration similar to shallow component of currently planned IceCube-Gen-2 station

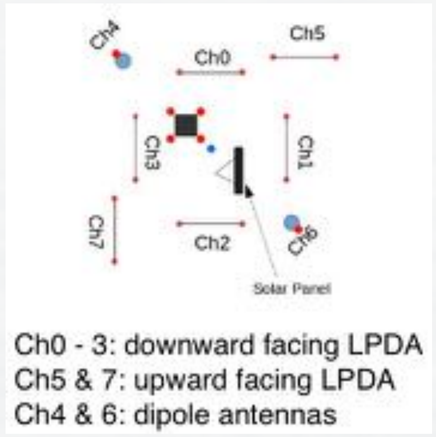
Goal:

- Develop new background rejection techniques utilizing:
  - Upward-facing LPDAs (updown cut)
  - Dipole antennas (dipole cut)

2. Detector Station & Data set

Detector Station:

- location: 5km from the South Pole Station
- Runs approx. half the year with solar panel & battery



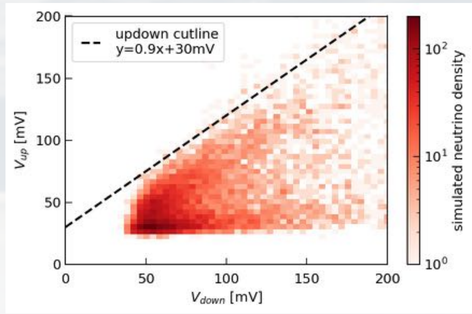
Data set:

- 3 years of data from Dec 2018 – Jan 2021
- 74530 triggers

3. Updown cut

- Neutrinos generate larger signal in downward facing antennas
- Noise from above surface generates larger signal in upward facing antennas
- Cutline calculated from simulation

Passing condition:
$V_{up} < 0.9\ V_{down} + 30mV$
Neutrino efficiency = 99%



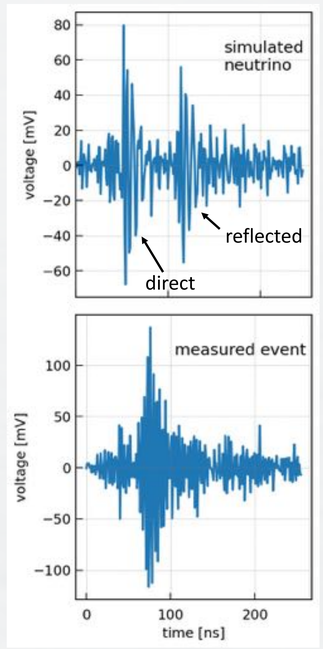
4. Dipole cut

- Up-going neutrino signals creates two pulses in the dipoles due to direct + air/firn surface reflection
- Down-going background creates only one pulse

Cut procedure:

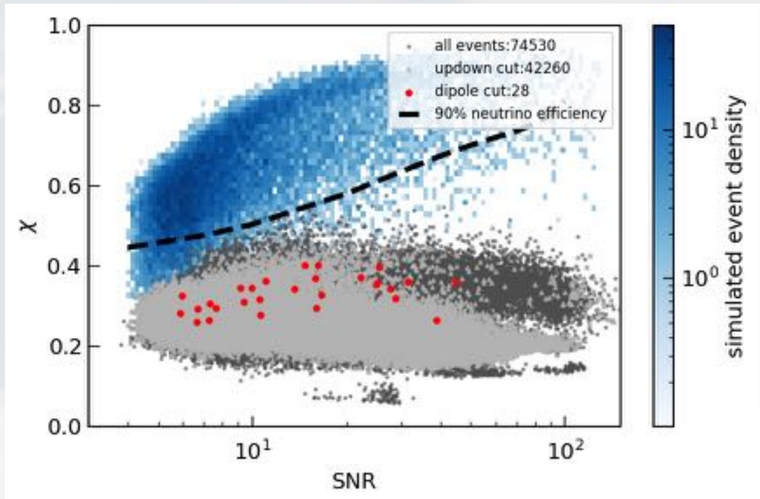
- Create template with two pulses ΔT apart with ΔT calculated from signal direction
- Correlate template with waveform

Passing condition:
Correlation > 0.4



5. Results

- Previous analysis[1] utilized only downward LPDAs to construct a SNR vs χ cut



6. Conclusion

- Highly effective cuts developed utilizing new antenna configuration
- Future direction: incorporate deep learning techniques to reject events using all information available

References

[1]: A. Anker *et al* JCAP03(2020)053