



ASKARYAN RADIO ARRAY

Bipolar Triggering

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Current Trigger Method

- ▶ Unipolar triggering using a tunnel diode system and a set upper threshold.
- ▶ Trigger thresholds as high as 6σ above the thermal noise level.
- ▶ Global trigger rate is given by the equation:

$$R = 2 \times N \times \binom{M}{N} \times r^N \times t^{N-1}$$

M : Total number of detectors (8)

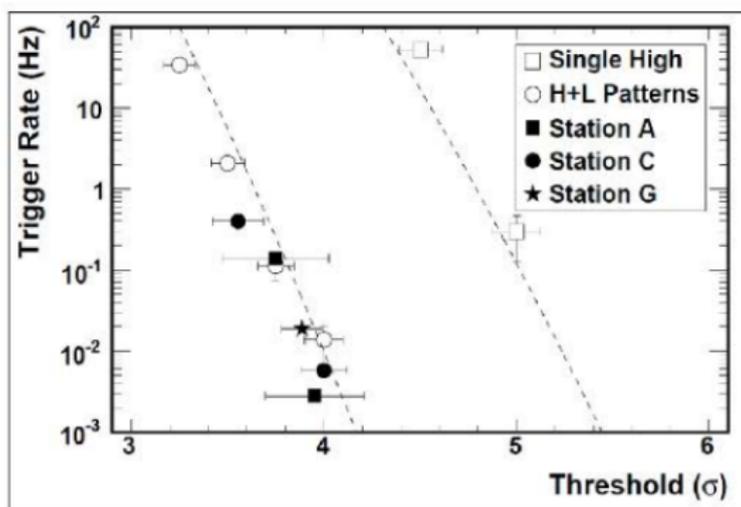
N : Minimum detector threshold (3)

r : Single detector trigger rate ($\geq 10\text{kHz}$)

t : Time window ($\geq 110\text{ns}$)

ARIANNA's Trigger Method

- ▶ Bipolar triggering using template matching with constant upper and lower thresholds and a dynamic trigger rate.
- ▶ Thresholds as low as 3.5σ .



Design and Performance of the ARIANNA Hexagonal Radio Array Systems, S. W. Barwick et al.

My Progress

Currently working on a way to simulate bipolar triggering within ARA.

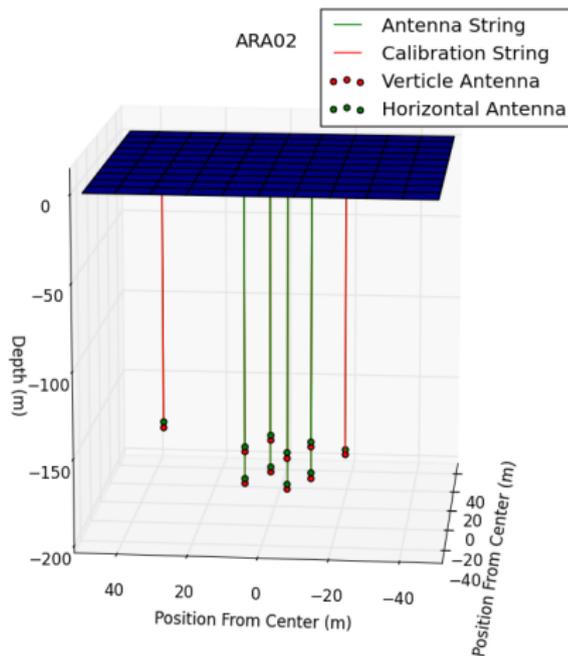
I am in the process of creating a toy ARA simulation with bipolar detection algorithms (possibly similar to ARIANNA's template method).

ARA's unipolar methods will be included for comparison.

What I have so far:

- ▶ Pulse shape/size generator based on the station geometry and a random event vertex.
- ▶ Crude bipolar detection algorithm based on the ARIANNA trigger method

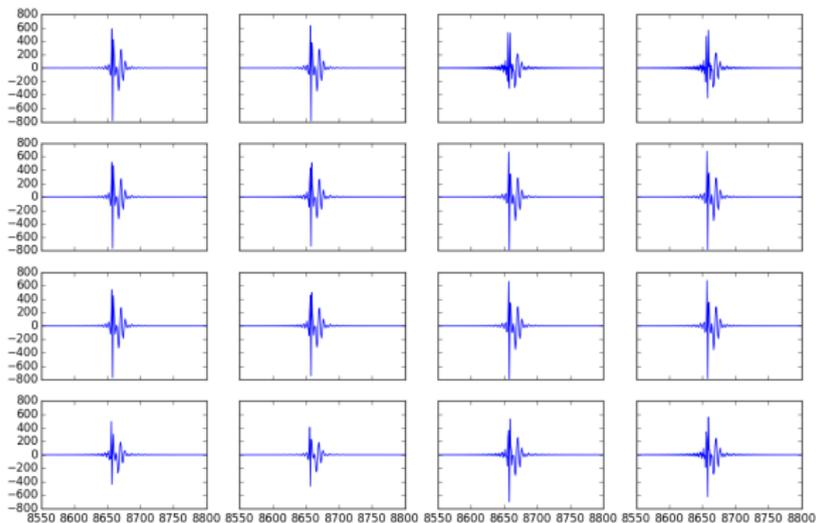
Station geometry visualization:



Simulation Method:

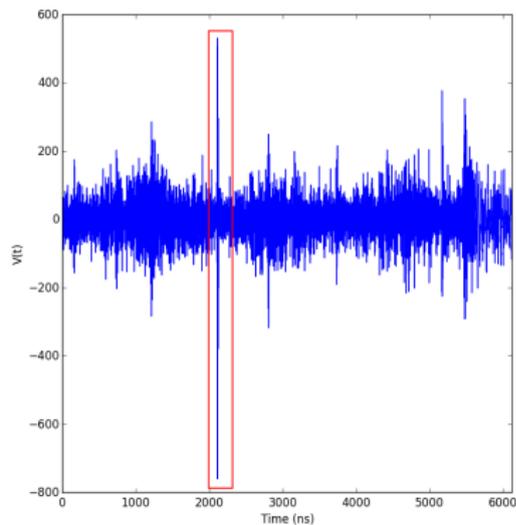
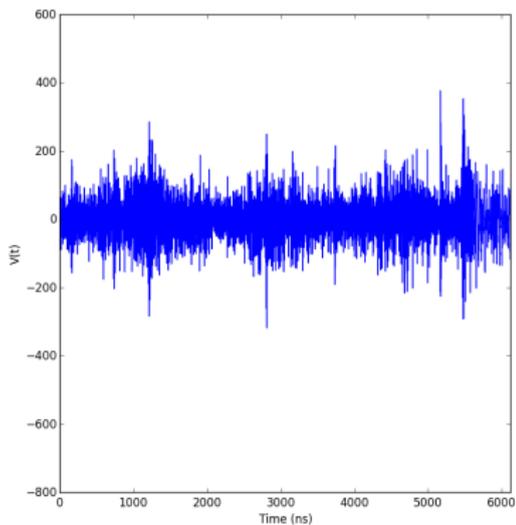
- ▶ Random event is generated with a vertex location and direction along with a fixed energy (100 EeV).
- ▶ The energy and angle between the incident direction along with antenna direction are passed to a Monte Carlo simulation created by Jordan Hanson (KU).
- ▶ This Monte Carlo simulation creates an pulse from the given parameters using the Greisen formula.

Event impulse example:



Antenna polarity is not yet taken into account.

Embedded bipolar pulse in white noise:



To Do

- ▶ Finish implementing antenna polarity into the simulation
- ▶ Apply bipolar and unipolar triggering algorithms to data

Are there advantages to using bipolar triggering?