

Simulations for GRAND-BEACON

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Monte Carlo Simulation



- Multiple Antenna Arrays on Mountains Tau Sensitivity
- Monte Carlo which calculates the effective area of any configuration of mountaintop phased arrays to point-sources of neutrinos
- Accounts for the effective areas of individual stations overlapping



From each station, find where a cone in the source direction $(-\hat{r})$ intersects Earth

Union of all the areas = A_g . Uniformly sample tau exit points (\hat{u}_i)









- Use MARMOTS to optimize the sensitivity of the phased arrays by altering:
 - Altitude
 - Station layout
 - Antenna model
 - Location



- Use MARMOTS to optimize the sensitivity of the phased arrays by altering:
 - Altitude
 - Station layout
 - Number of stations
 - Number of antennas
 - Station spacing
 - Antenna model
 - Location



- Use MARMOTS to optimize the sensitivity of the phased arrays by altering:
 - Altitude
 - Station layout
 - Antenna model
 - Gain
 - Bandwidth
 - Field-of-view
 - Sky-coverage
 - Location



- Use MARMOTS to optimize the sensitivity of the phased arrays by altering:
 - Altitude
 - Station layout
 - Antenna model
 - Location
 - Magnetic field
 - Topography





Effective Area: Argentina*

- 24 stations w/ 24 antennas
- 1 km elevation, 3 km spacing
- 50-200 MHz matched antenna, 5 dBi gain
- 120° FoV, West-facing, SNR = 5 threshold



* Without topography

Phasing Efficiency Simulation

- Assumption: phasing improves SNR by $\sqrt{N_{\rm ants}}$
- At what distance between antennas is this no longer valid?
- RASPASS setup:







Sparse Array Simulations

- Triangular grid of 65 antennas with 500 m spacing
- Use DANTON to generate tau decays seen by the central antenna with $\psi < 3^\circ$
- Two simulation sets:
 - 250 events with $E_{shower} \in [10^8 10^{10}]$ GeV
 - 972 events with $E_{shower} \in [10^{7.3} 10^9]$ GeV





-67.925 -67.900 -67.875 -67.850 -67.825 -67.800 -67.775 Longitude [deg]

Sparse Array Simulations

- RASPASS simulates radio emission at each antenna
- Simulations will be used to test interferometry (next presentation)

Event 90: $\tau^- \rightarrow v_\tau e^- \bar{v}_e$. $E_{shower} = 6.44e + 08 \text{ GeV}$, $\theta_{exit} = 0.77^\circ$, $h_{decay} = 1.21 \text{ km}$



Summary

- MARMOTS is being used to optimize the sensitivity of the phased arrays at 100 PeV
- RASPASS simulations suggest 90% phasing efficiency for antennas within 250 meters of each other
- DANTON + RASPASS simulation library will be used to test interferometry capabilities



