

RadioDetectorArraySimulation

A Full Simulation Chain for an Array of Antenna Detectors

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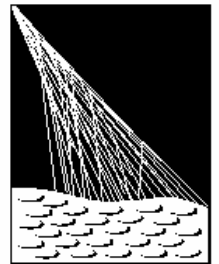
^e Radboud University Nijmegen

GEFÖRDERT VOM



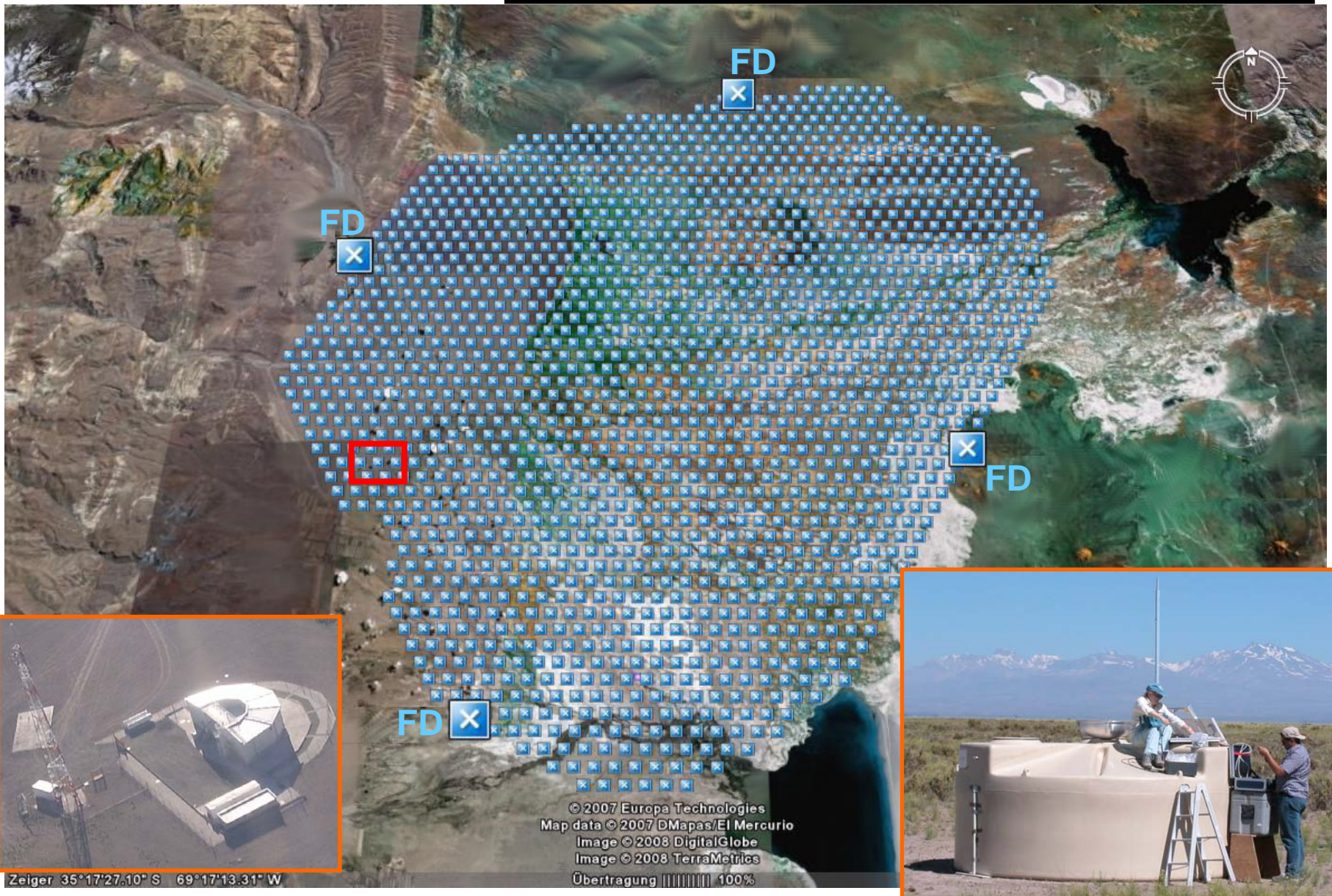
Bundesministerium
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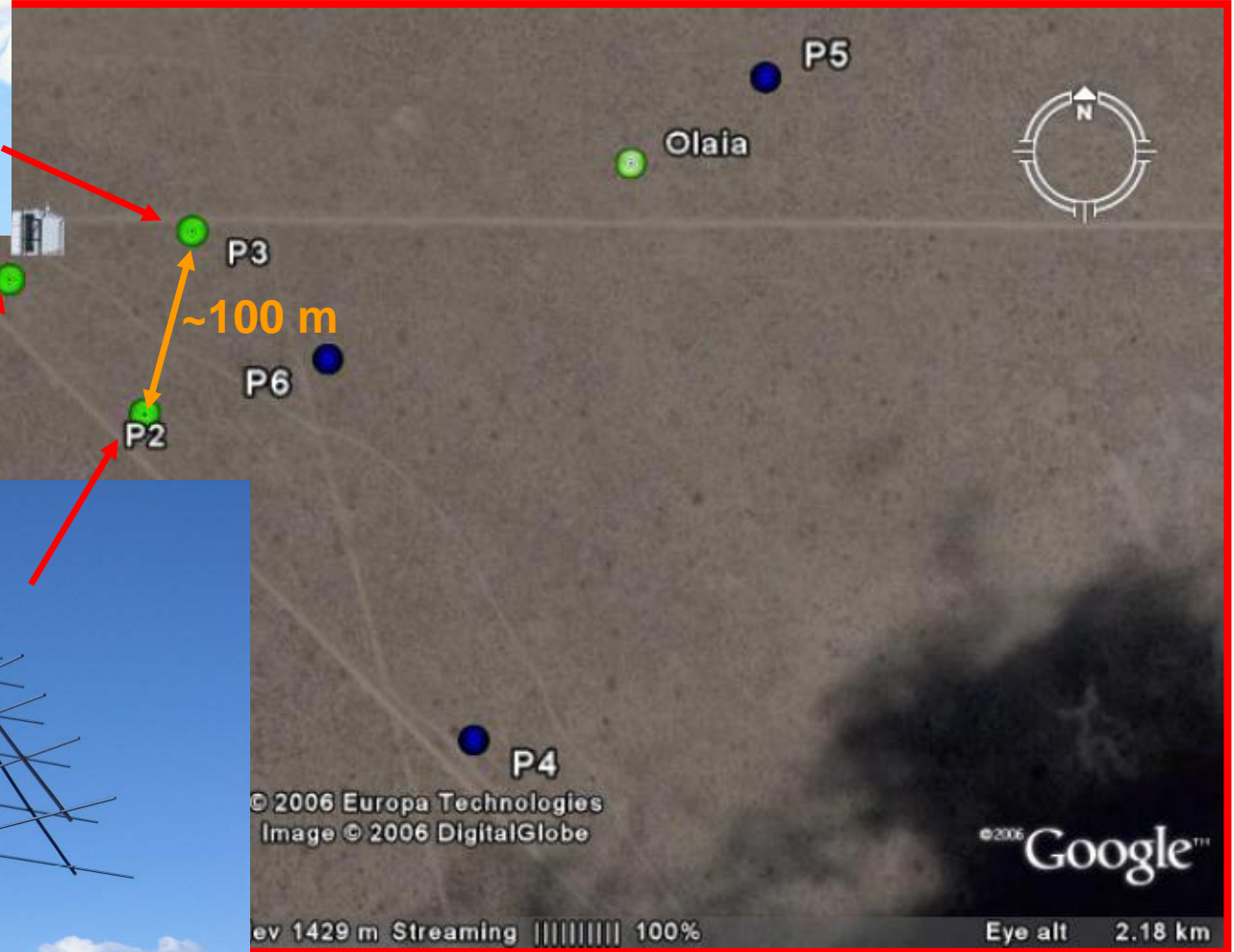
**PIERRE
AUGER**
OBSERVATORY

Overview Auger



Auger Radio Setup

V-shape dipole antenna

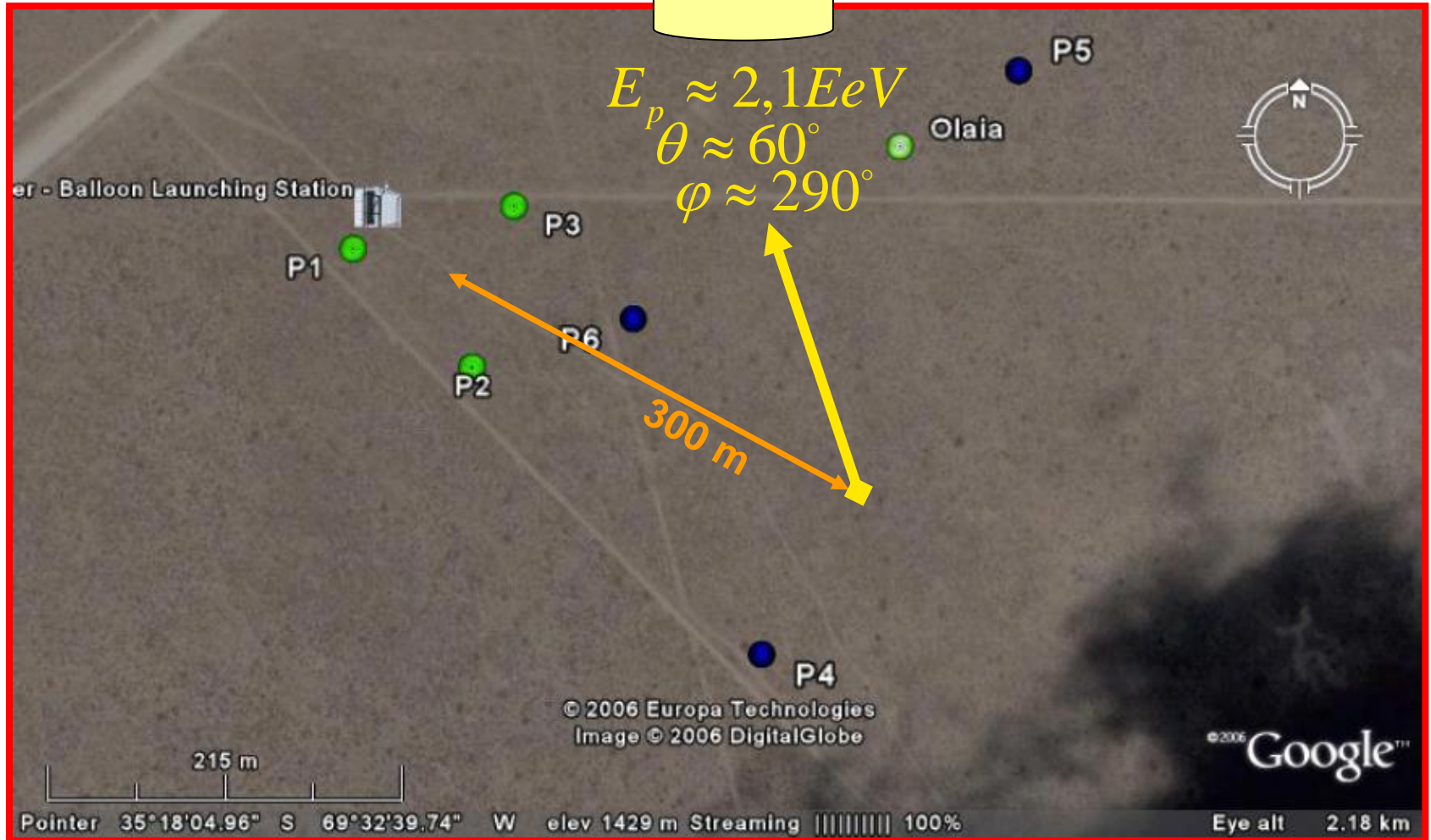
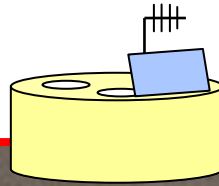


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LPDA: logarithmic periodic dipole antenna

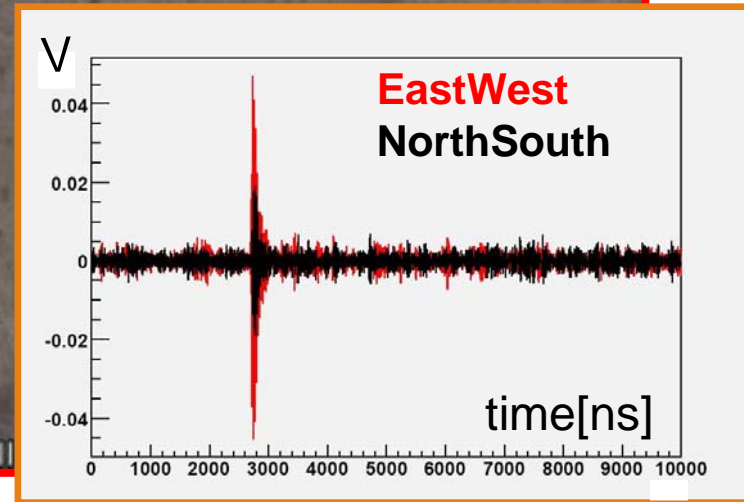
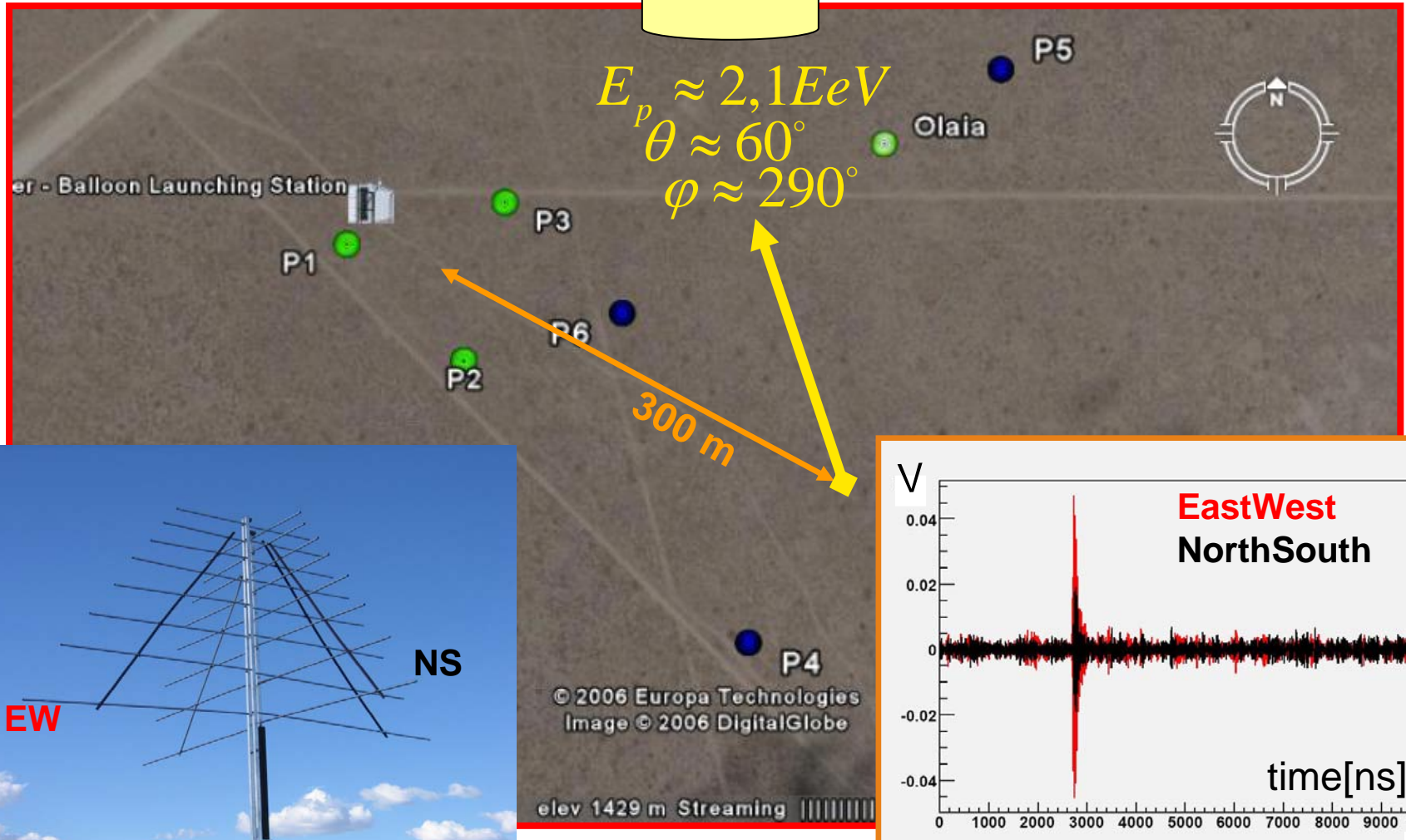
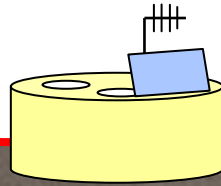
Golden Radio Event

event recorded in
coincidence with SD

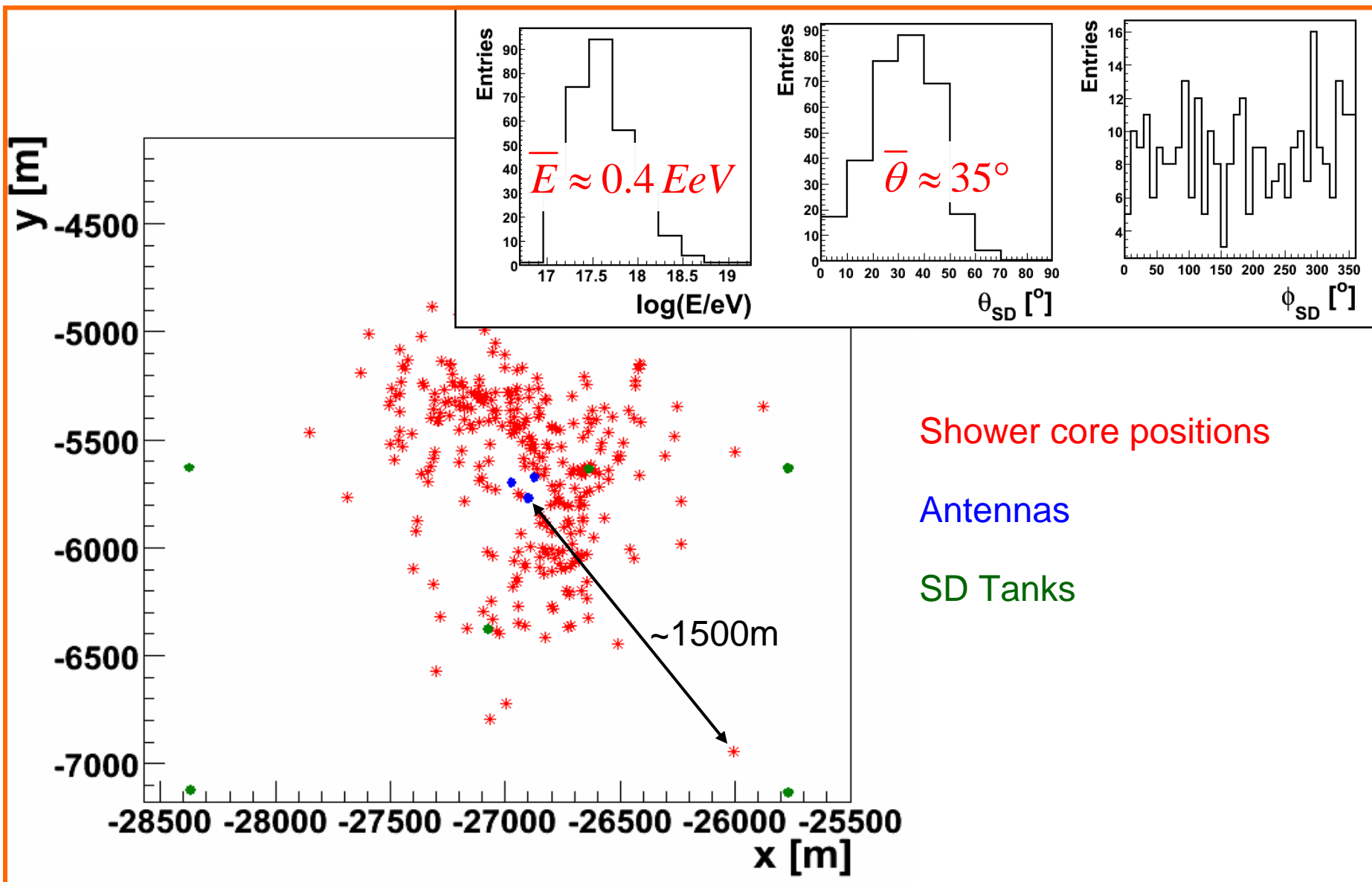


Golden Radio Event

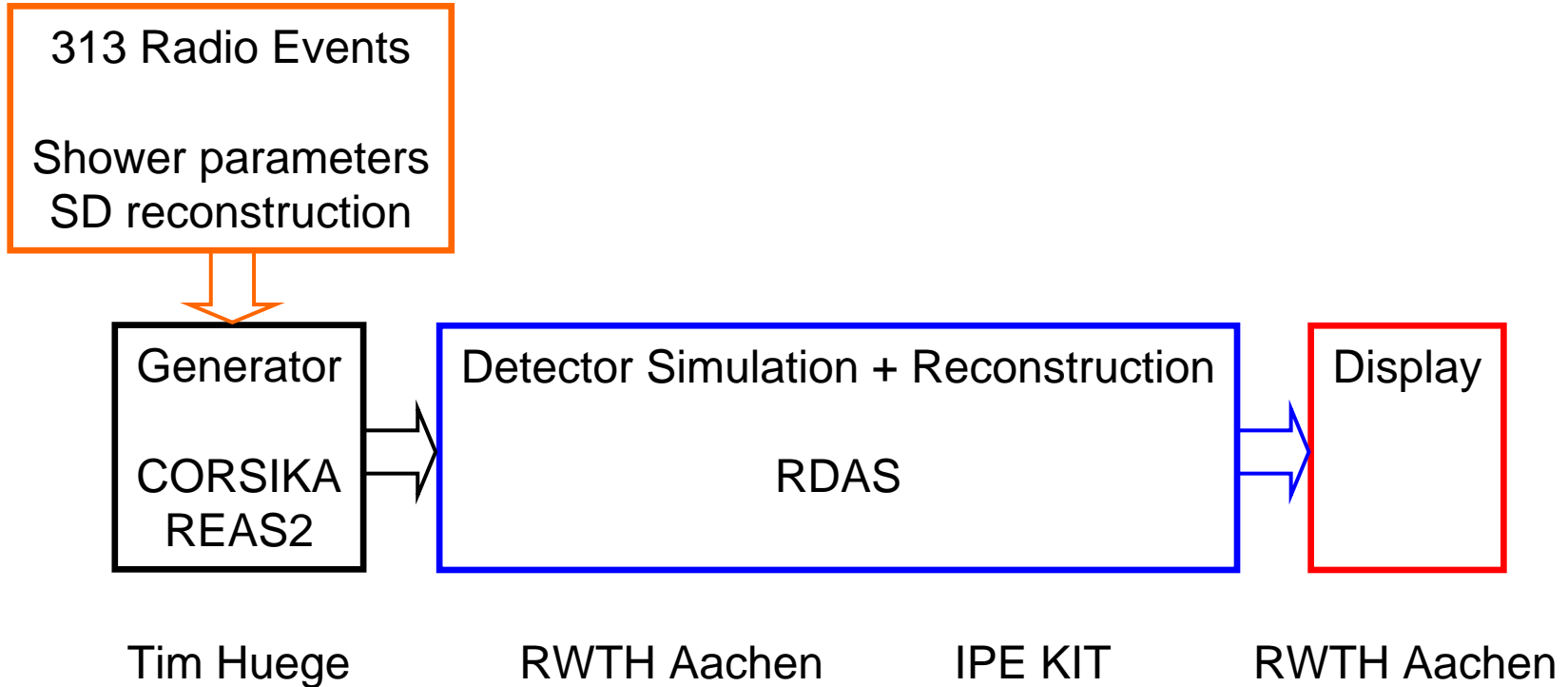
event recorded in
coincidence with SD



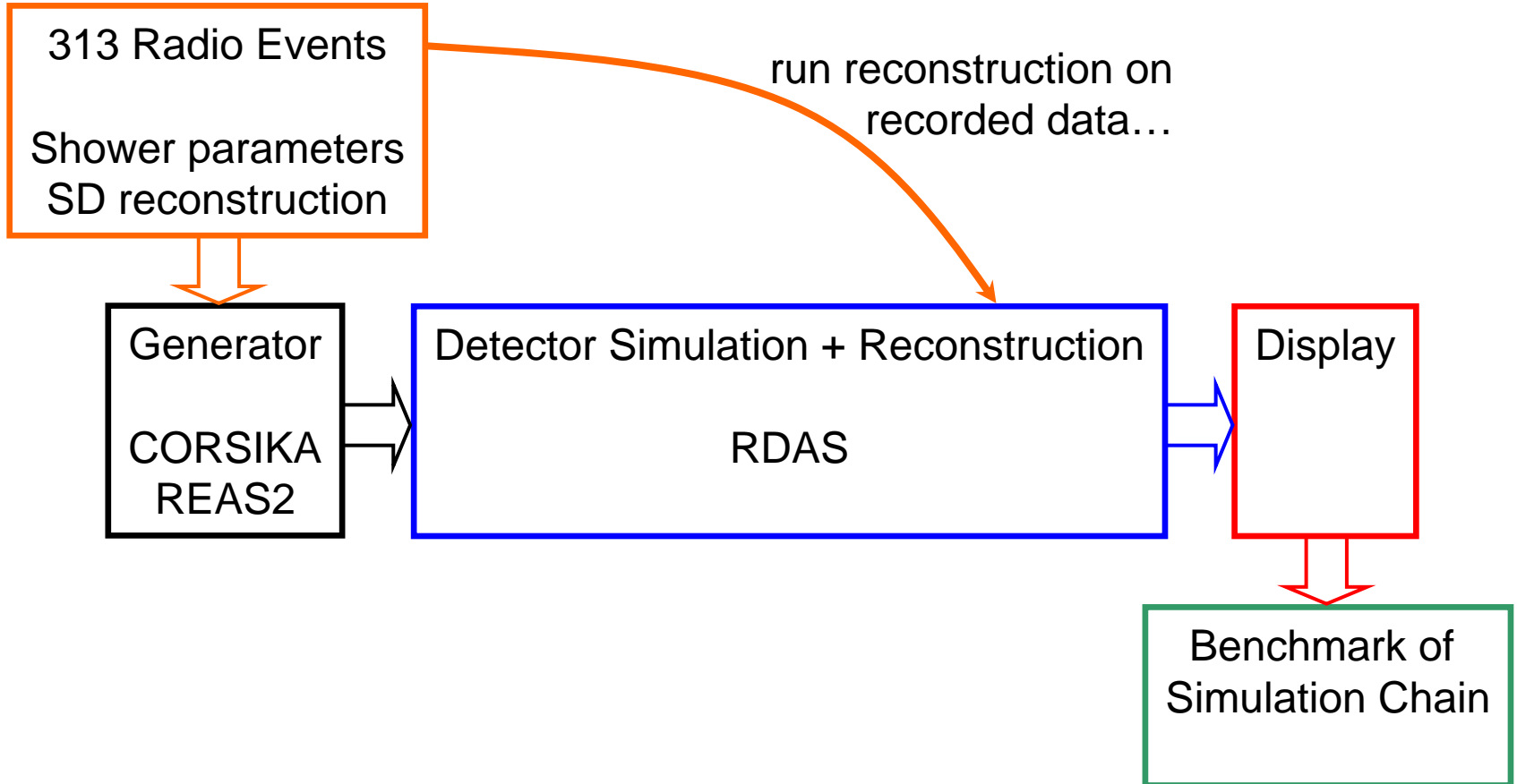
313 Radio Events in Coincidence with SD



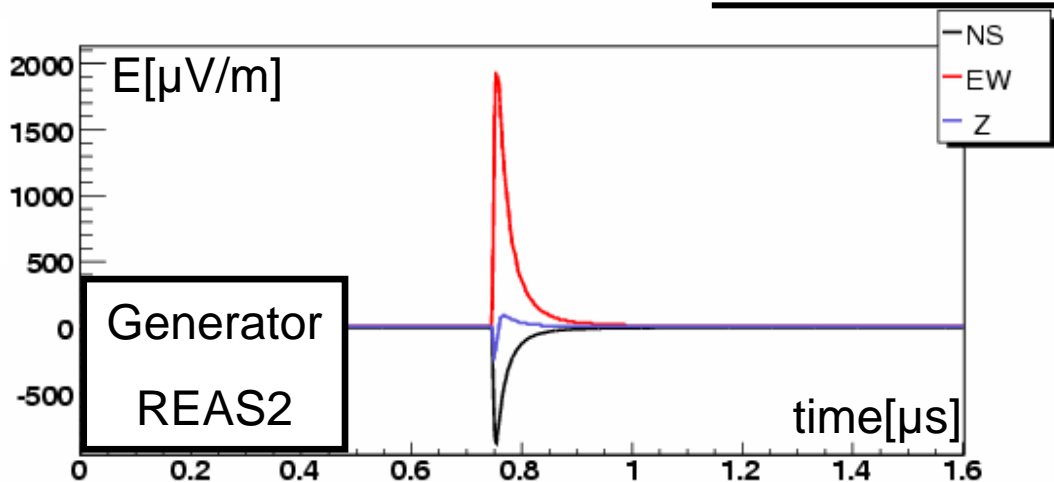
Simulation Chain



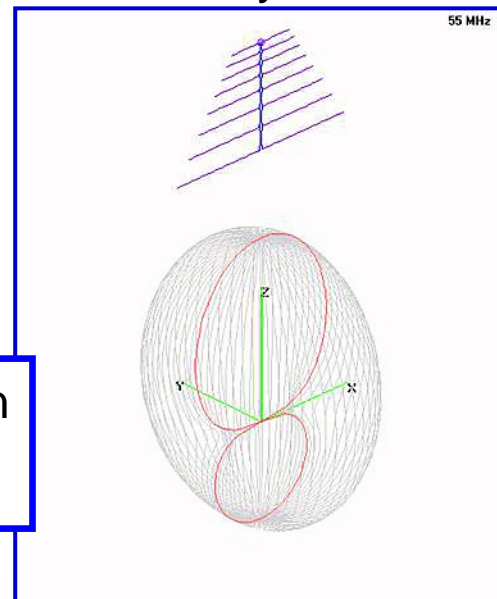
Sim. and Rec. Radio Data in RDAS



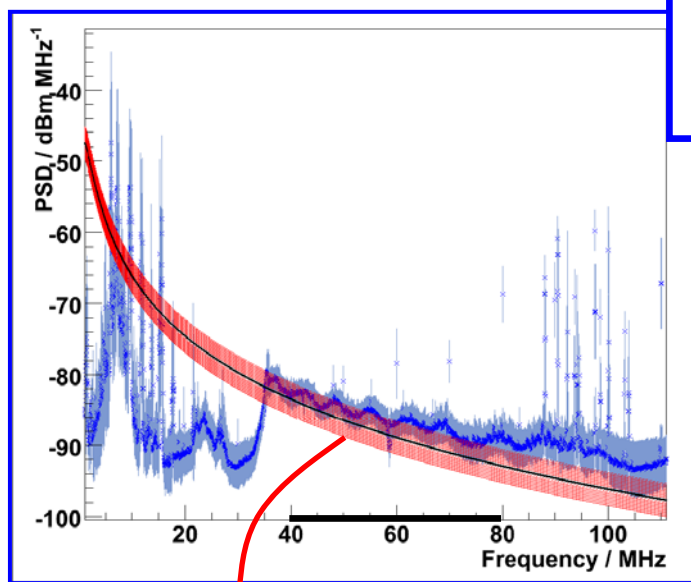
RDAS: Response Calculation and Noise Background



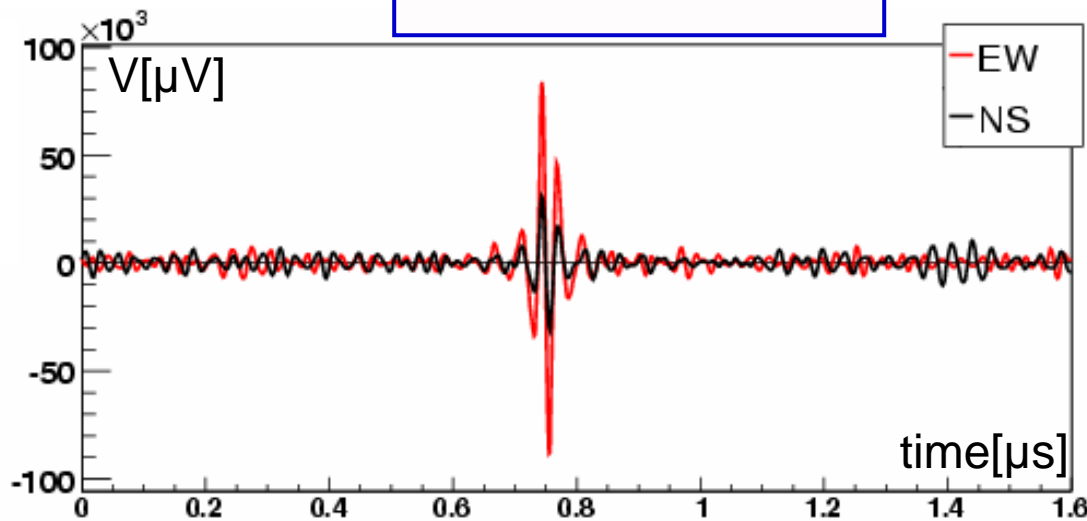
Nec2 Antenna Model
Directivity & Filter



Detector Simulation
RDAS

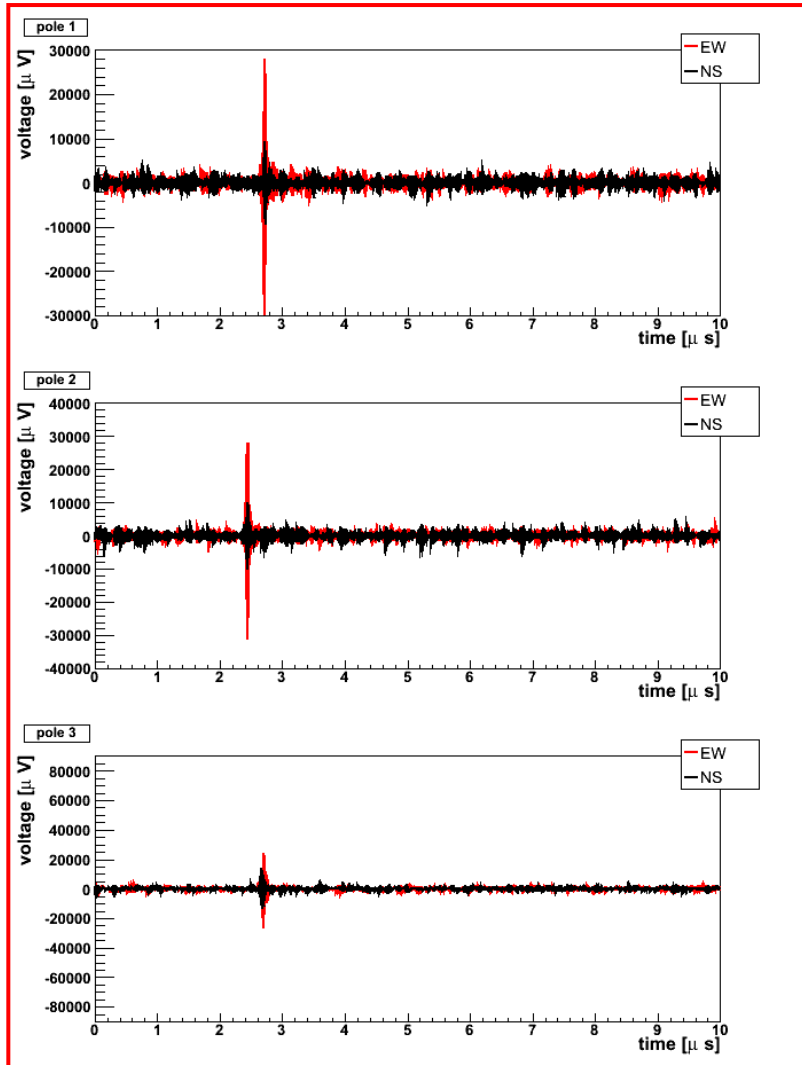


parametrisation of the galactic
radio background by Cane

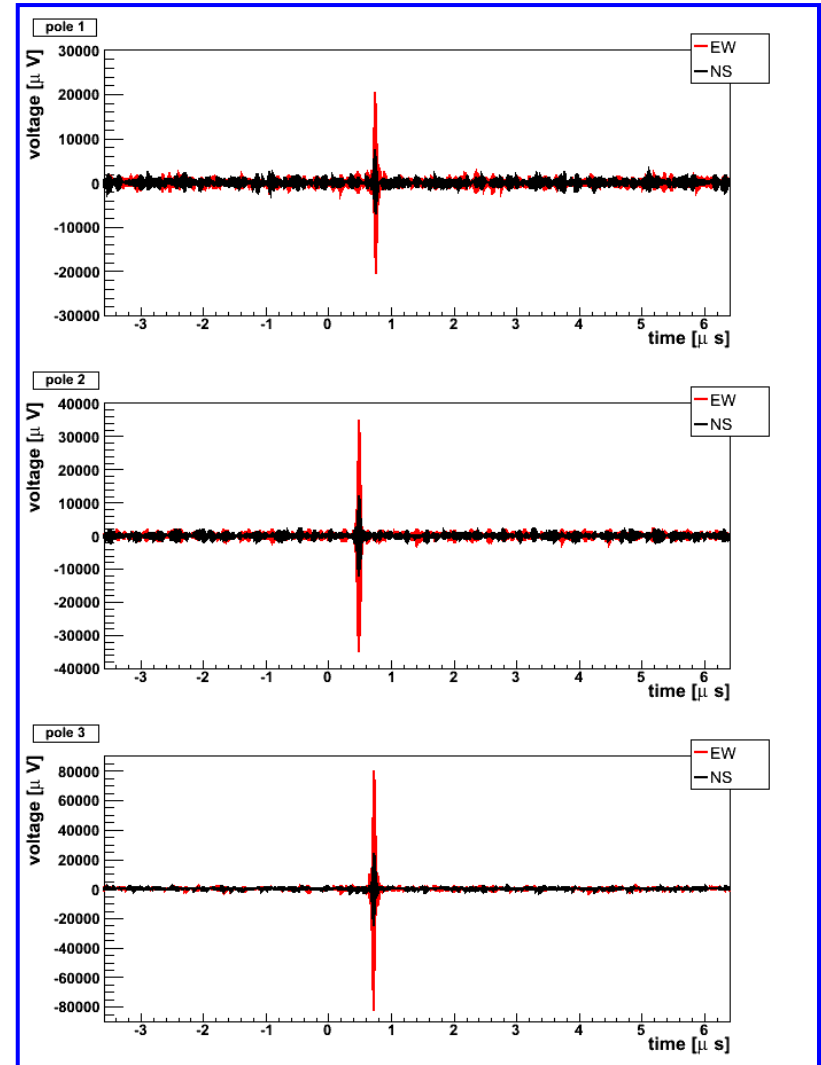


An Example Radio Event

Measured:

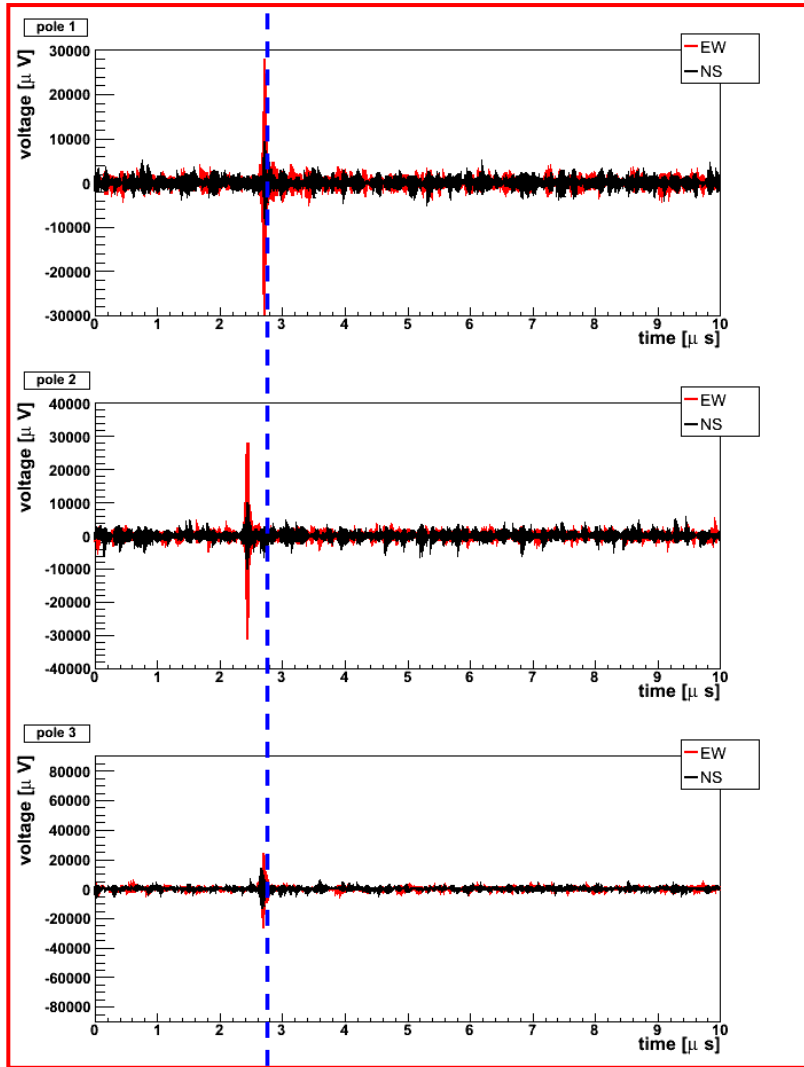


Simulated:

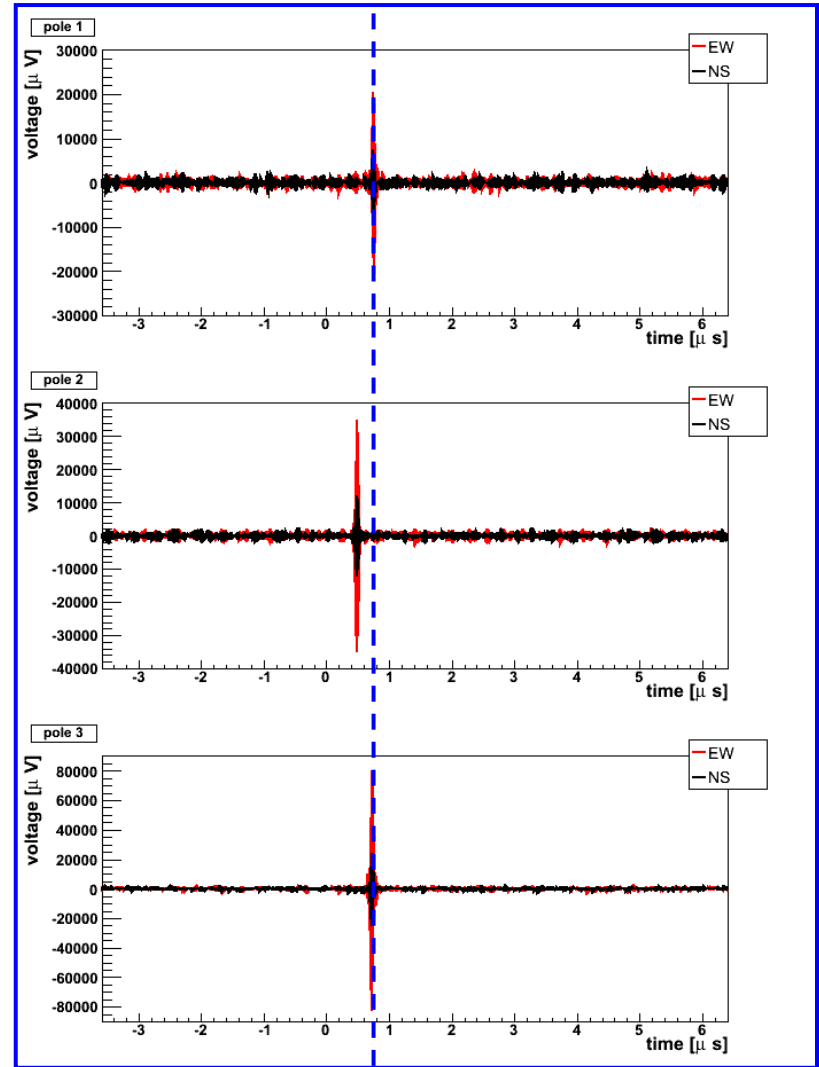


An Example Radio Event

Measured:



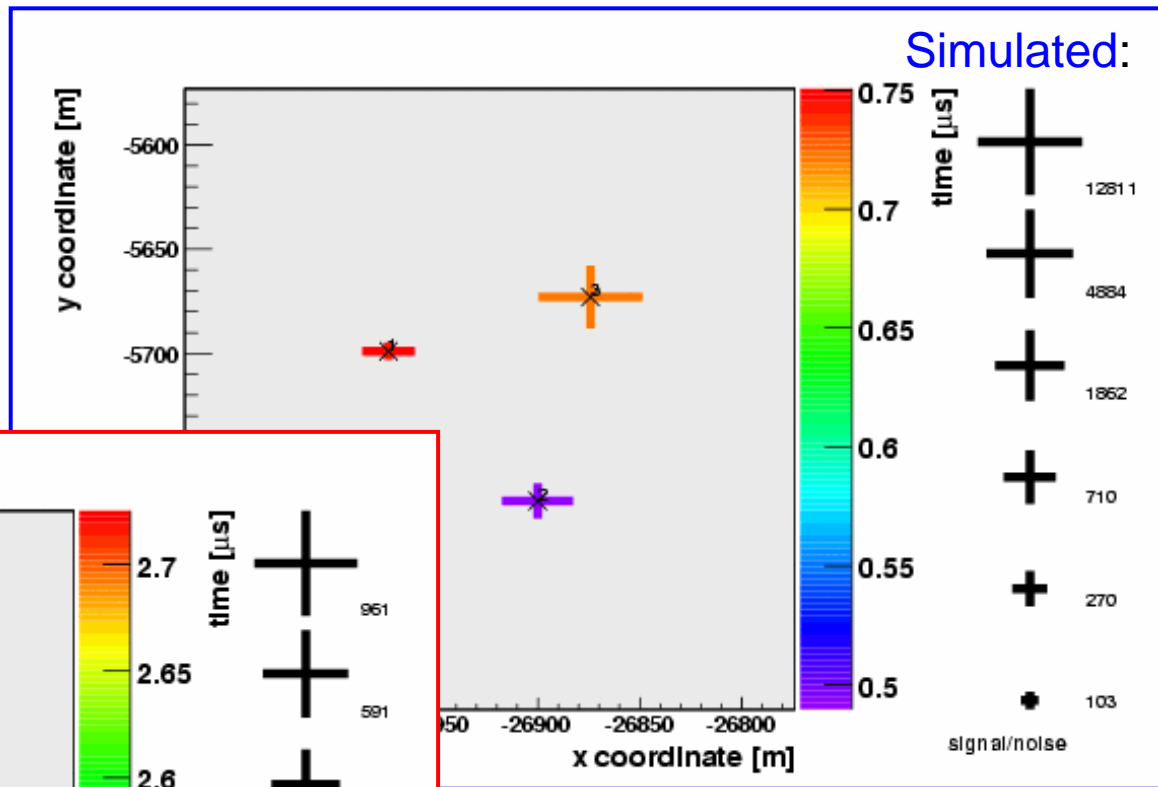
Simulated:



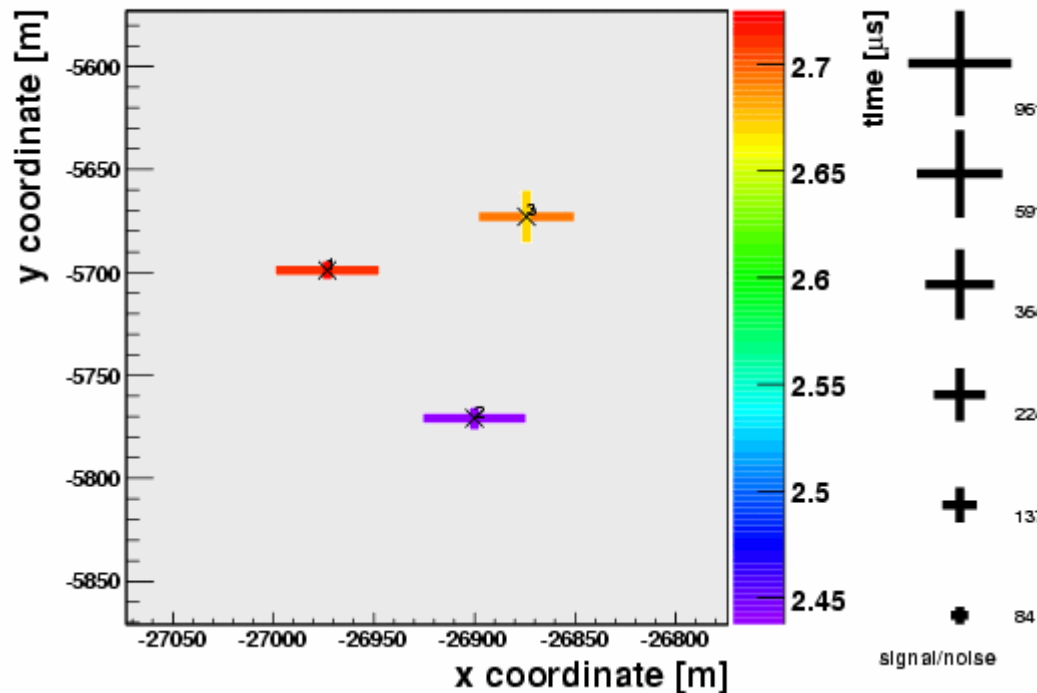
Time differences show direction of the shower

An Example Radio Event: Event View

$$S/N = \frac{A^2}{\sigma_{\text{noise}}^2}$$



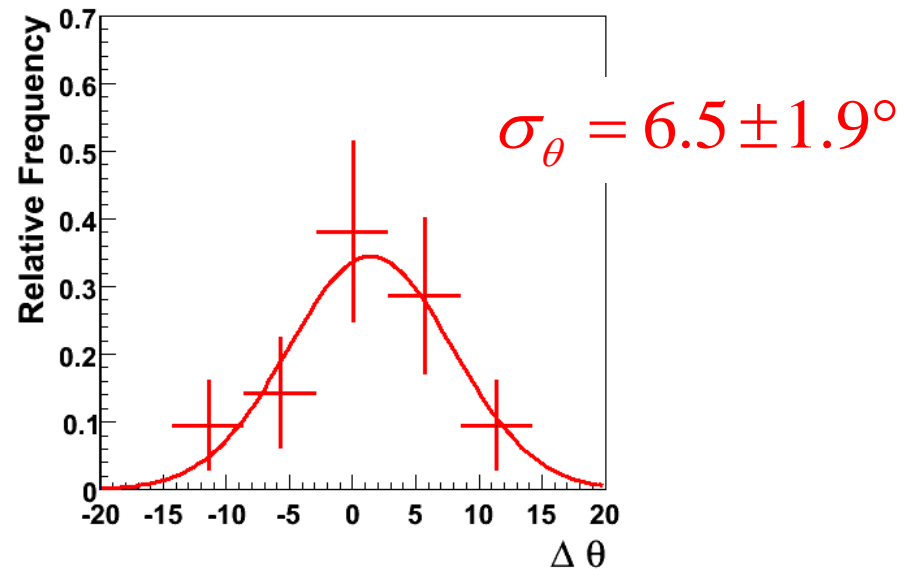
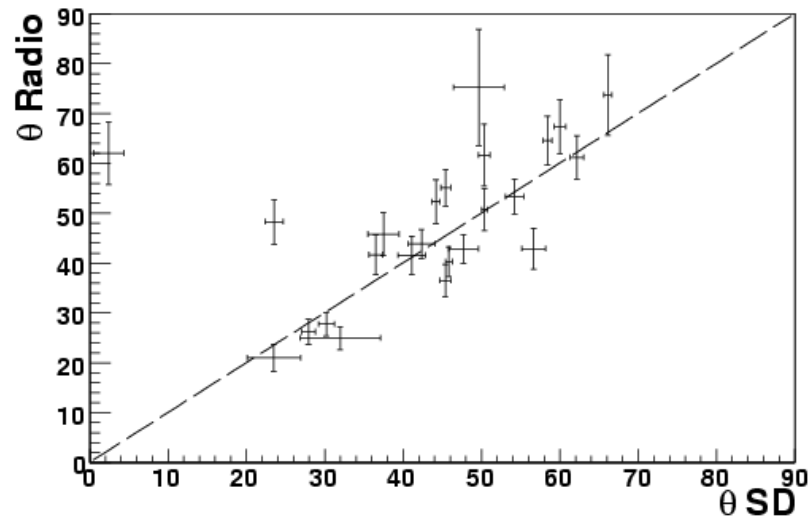
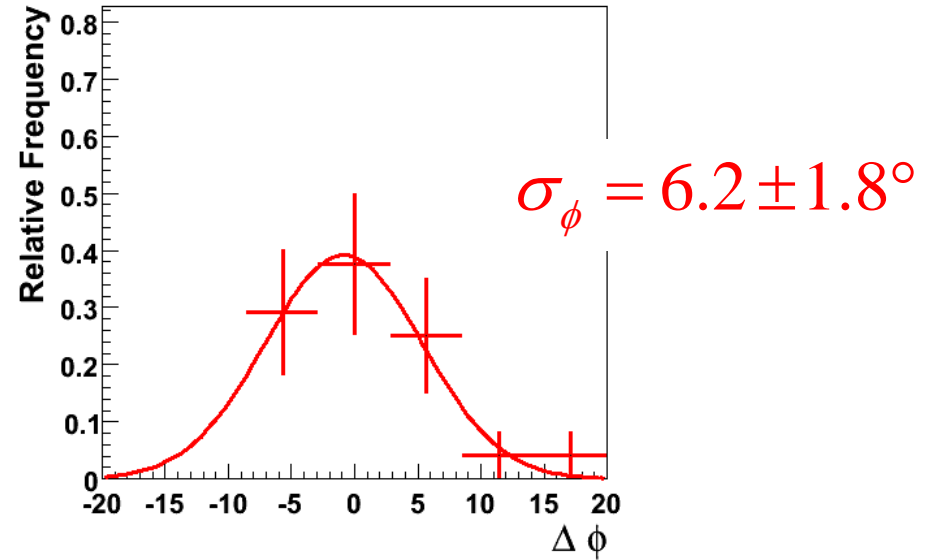
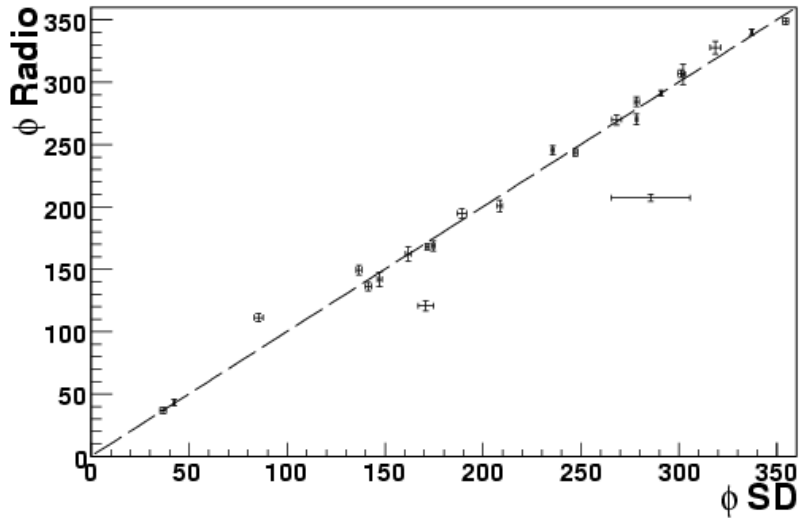
Measured:



use amplitudes with $S/N \geq 14$
for the reconstruction...

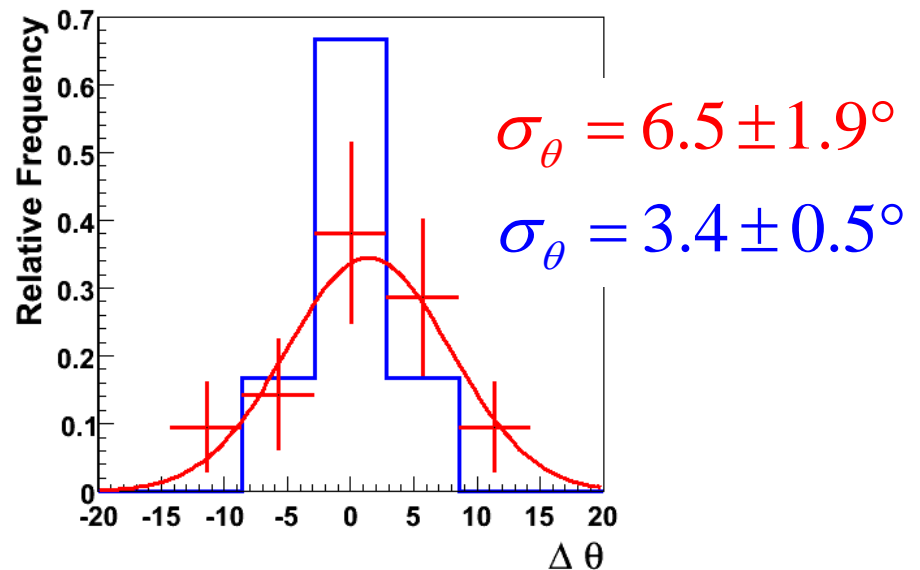
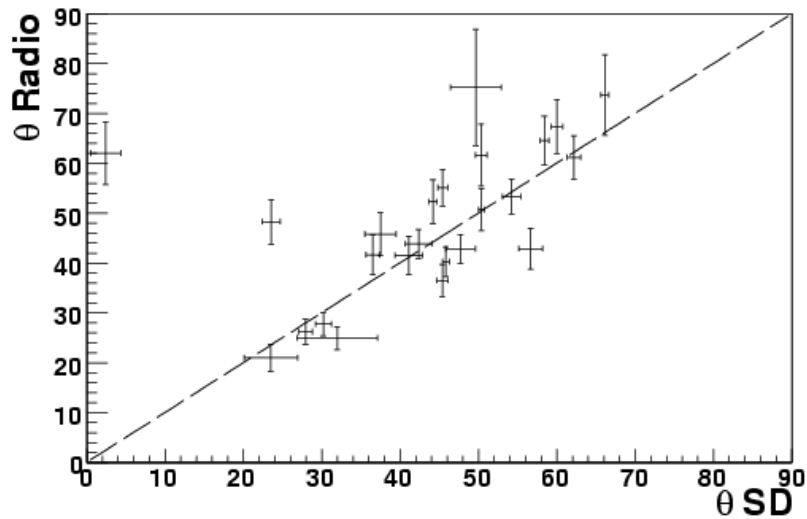
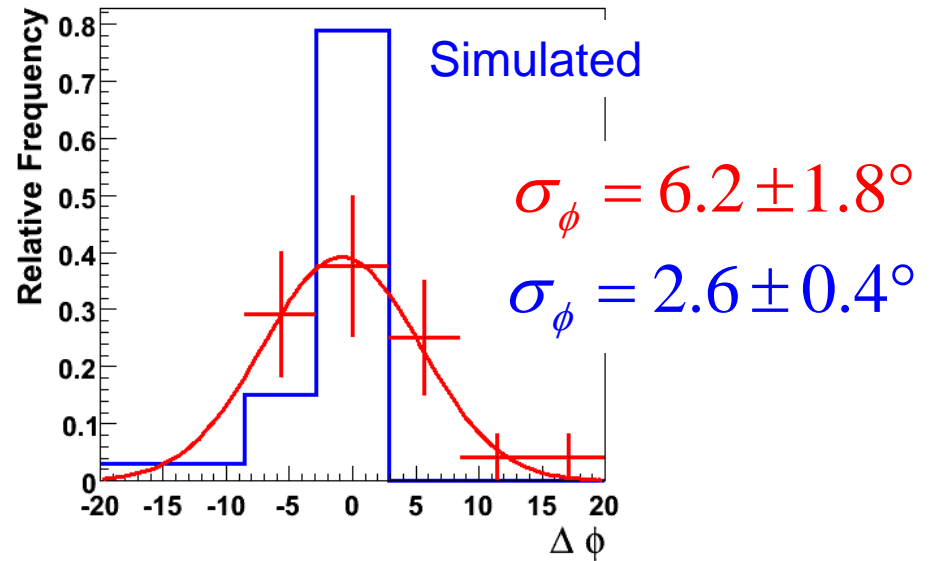
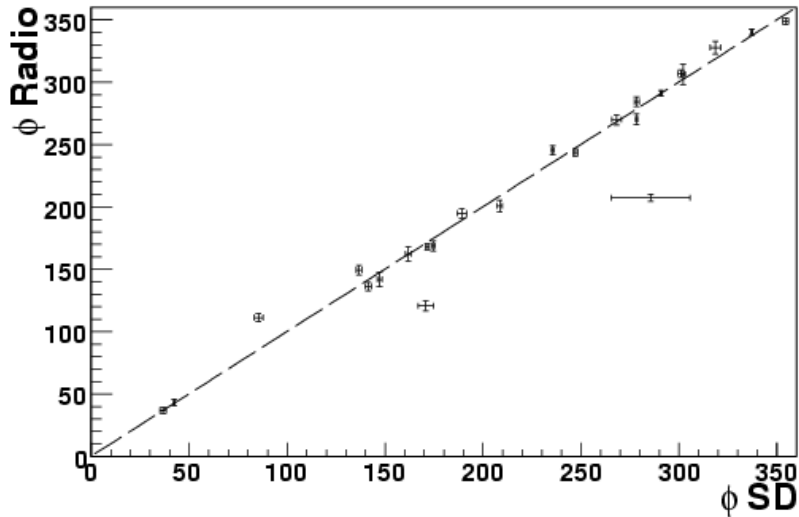
Angular Resolution

Measured:



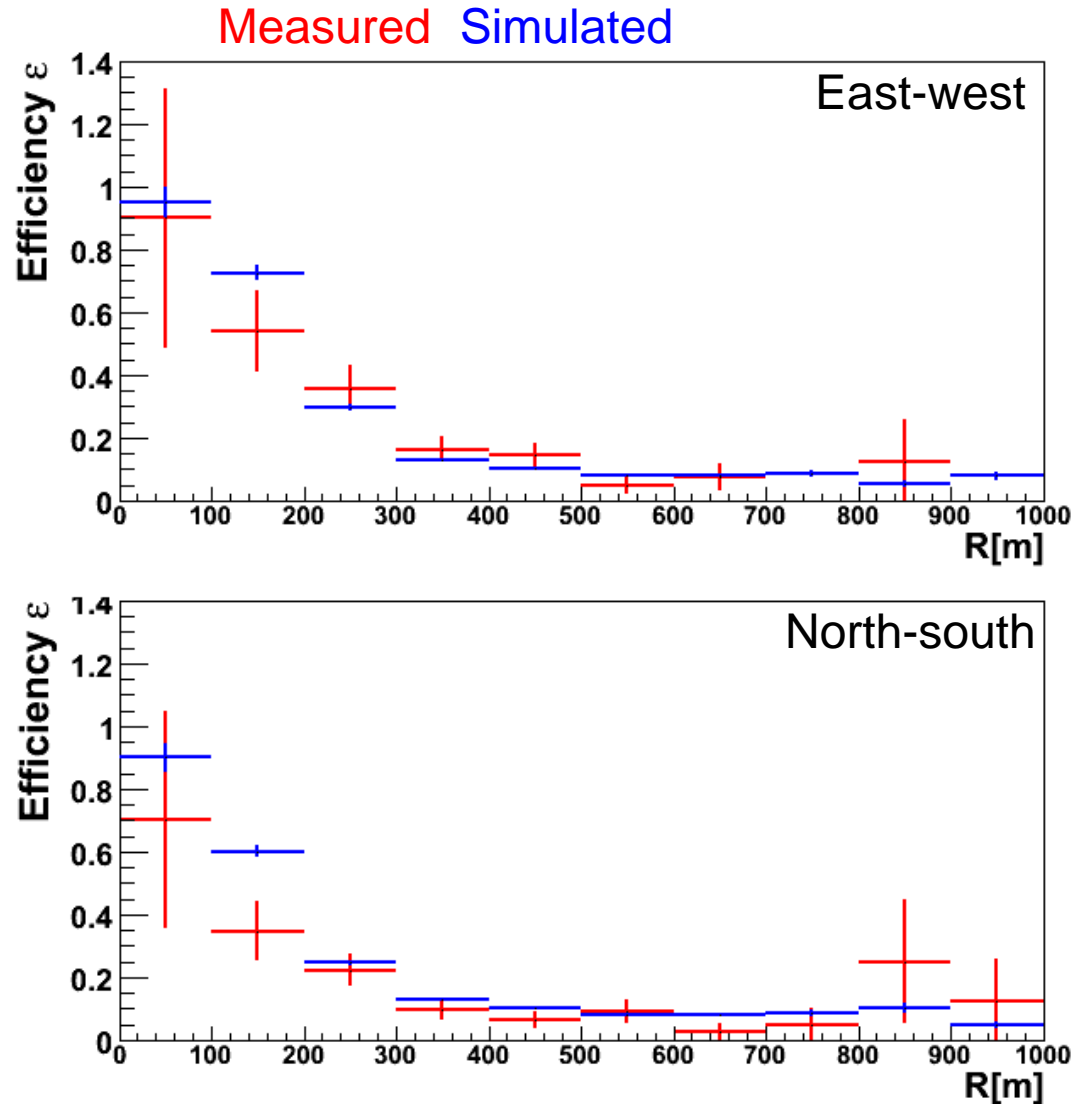
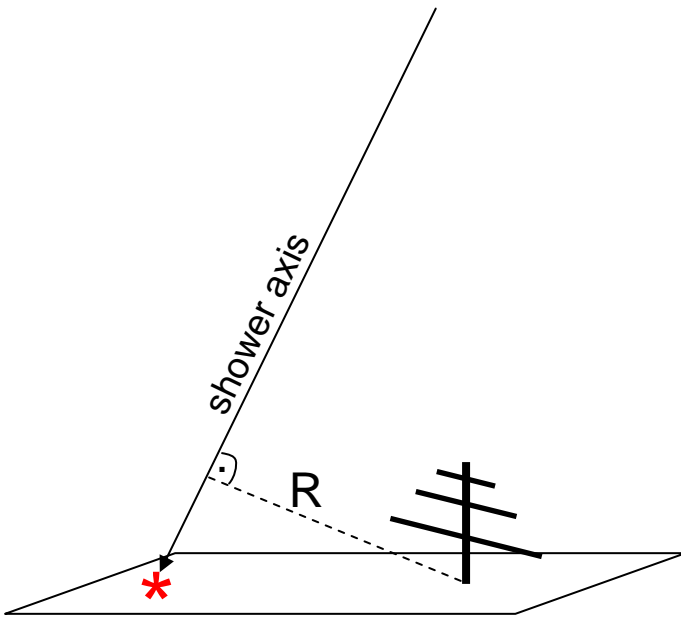
Angular Resolution

Measured:



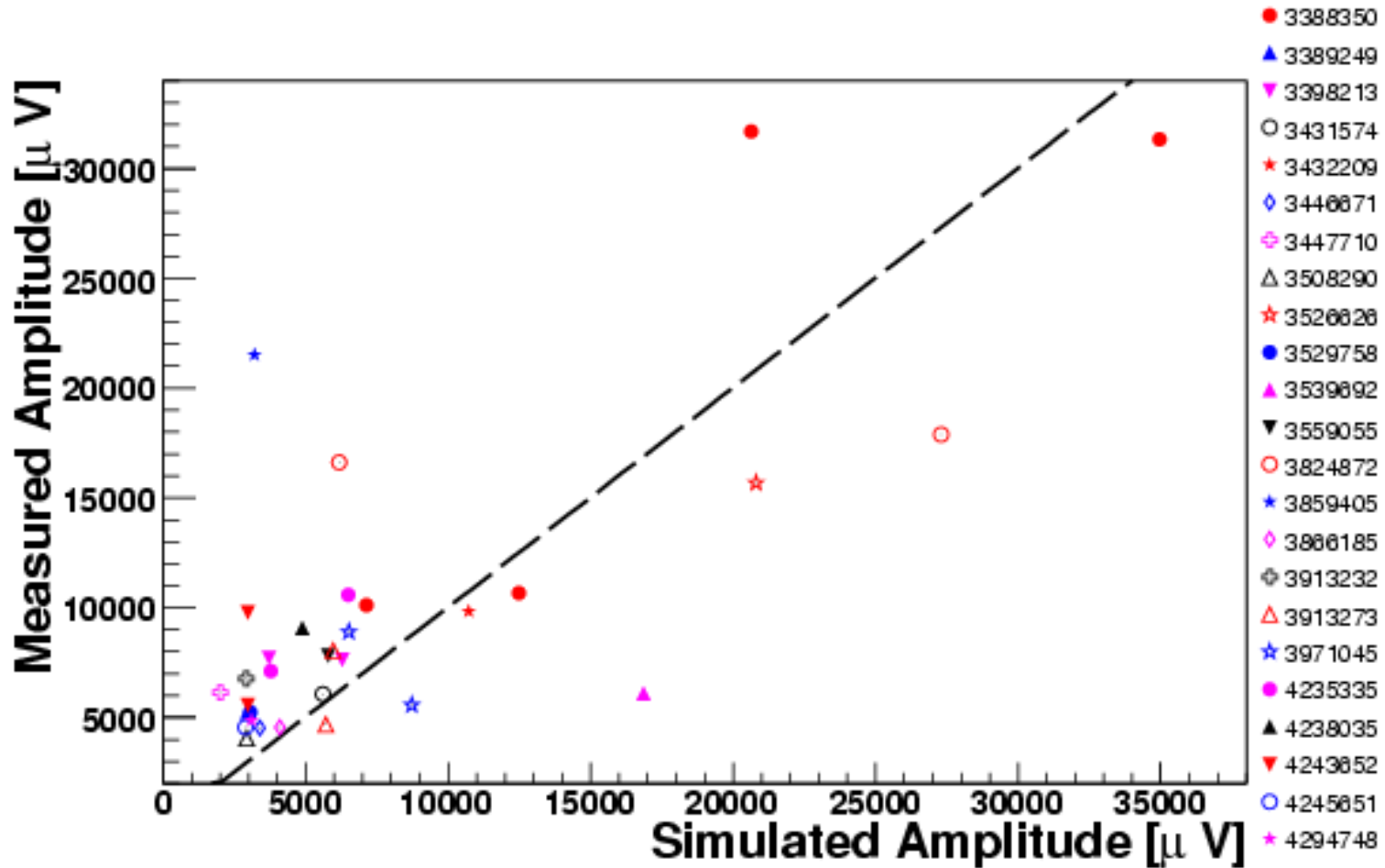
Detection Efficiency

Efficiency: probability to see an amplitude with $S/N > 14$ in a single LPDA, when the Radio Setup is triggered in coincidence with SD



With our selection criteria we see signals up to 500m

Radio Amplitude Comparison



Requirements
to data :

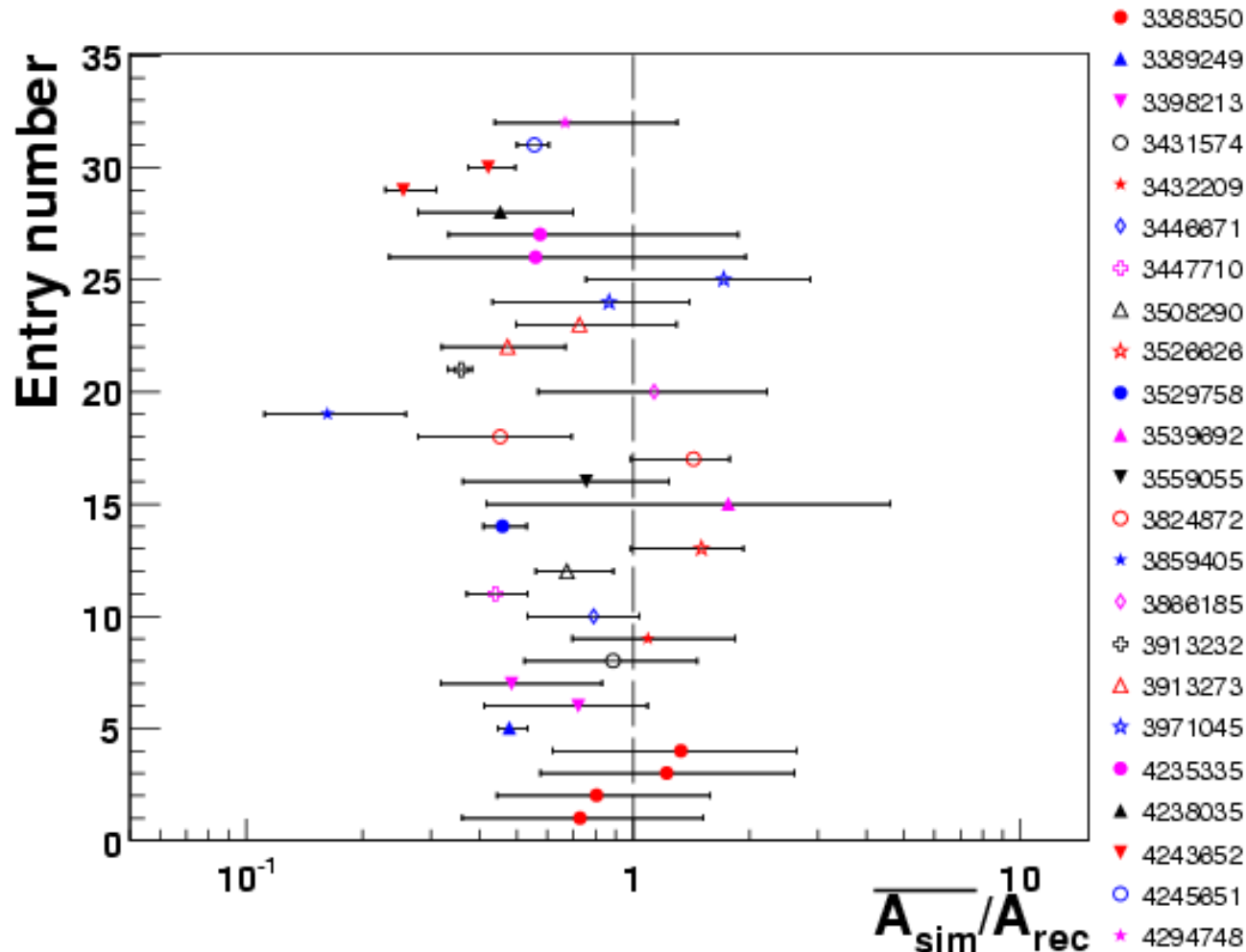
Signal to Noise ≥ 14 ,
 $\theta < 60^\circ$,
 Distance to Core $> 200\text{m}$

} Direct comparison
of 32 amplitudes

Relative Amplitude Comparison

Uncertainties due to SD core reconstruction: $\sigma_{x,y} \approx \pm 80m$ (low energy events)

⇒ Simulate each event 25x with core position shifted due to uncertainties:



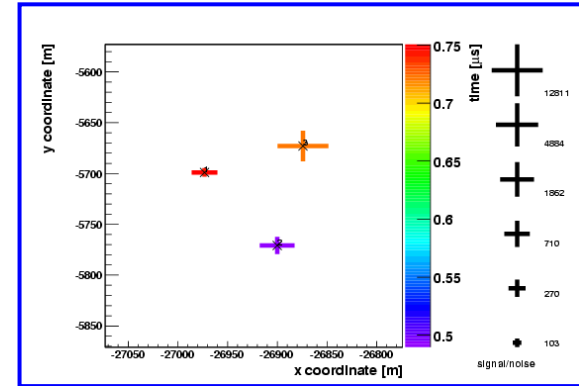
Simulated Amplitudes
in the correct order
of magnitude

Summary

Providing full simulation chain for Auger Radio

Benchmarking with real events

Probing Array Setups & Antenna Configurations



Simulation and Measurements agree within a factor 2

Excellent angular resolution

Radio promising technique to measure air showers of UHECRs

