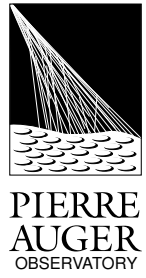
Radio Detection at the Pierre Auger Observatory

Sven Querchfeld

BERGISCHE
UNIVERSITÄT
WUPPERTAL



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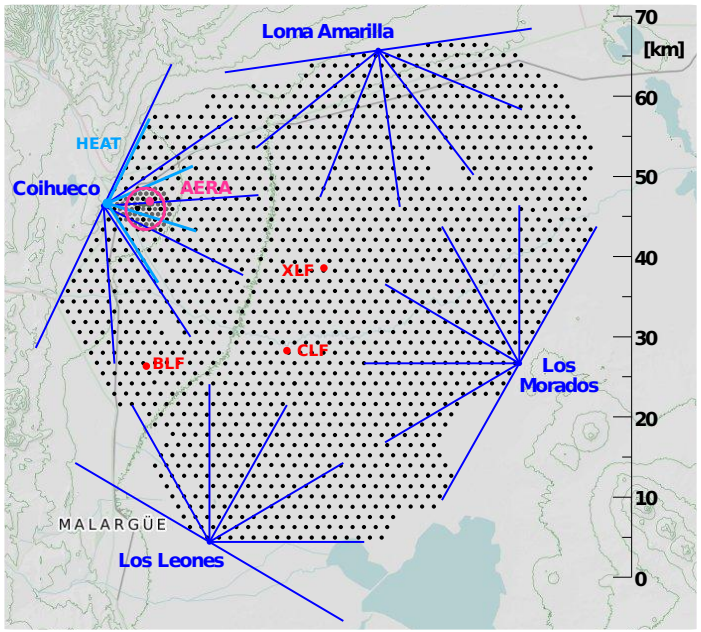
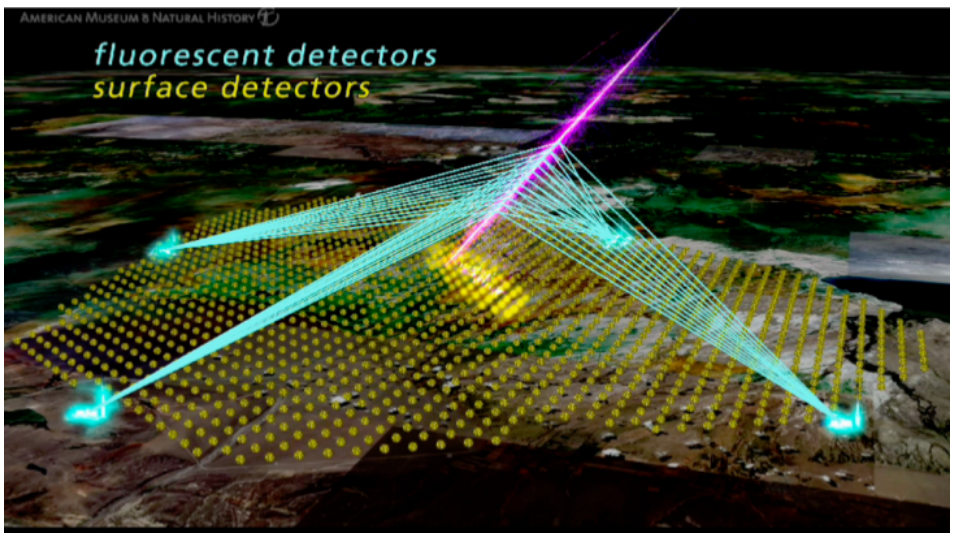
s.querchfeld@uni-wuppertal.de

The Pierre Auger Observatory

- largest experiment to detect cosmic rays at highest energies
- 3000 km^2, hybrid detector
  - 1660 surface detectors
  - 27 fluorescence telescopes
  - radio array
  - muon detectors

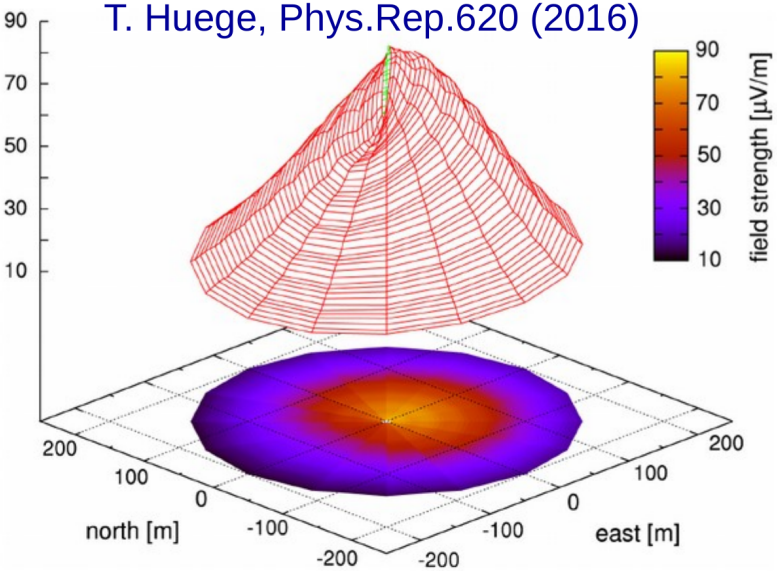


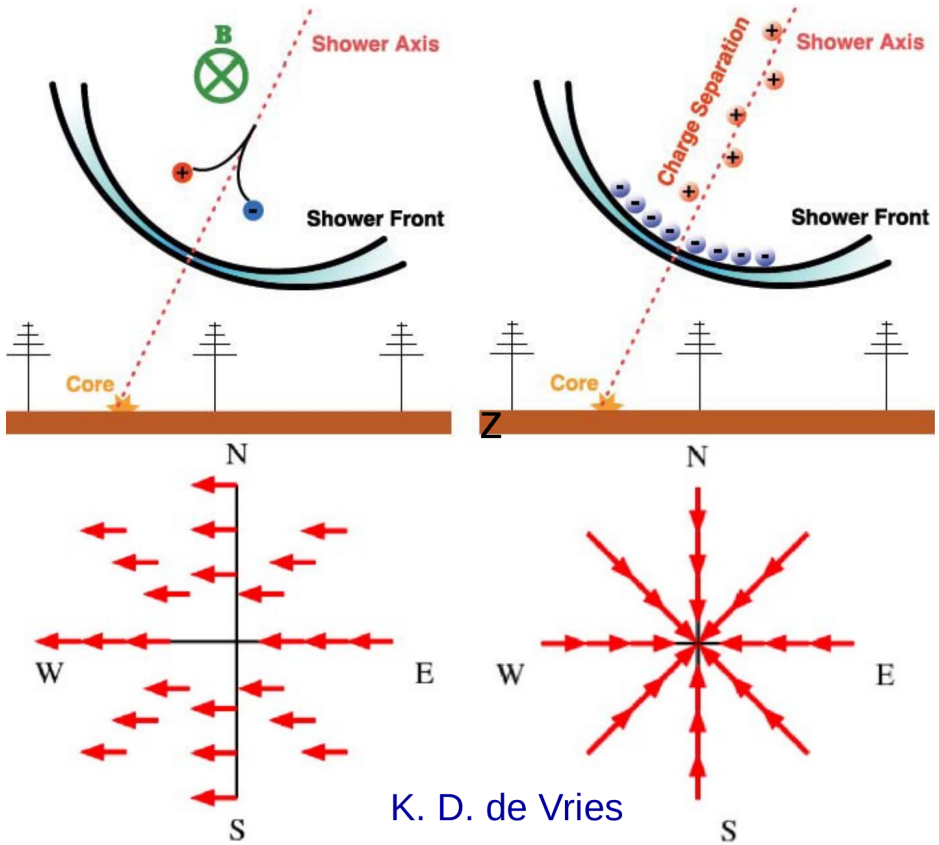


Radio Emission of Air Showers

- geomagnetic contribution
  - time variation of transverse current
- charge-excess contribution
  - time variation of charge access

T. Huege, Phys.Rep.620 (2016)

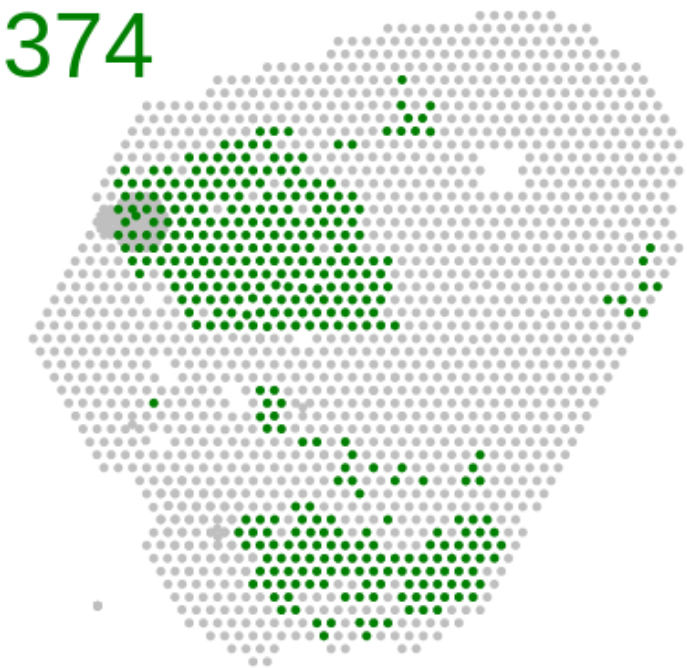




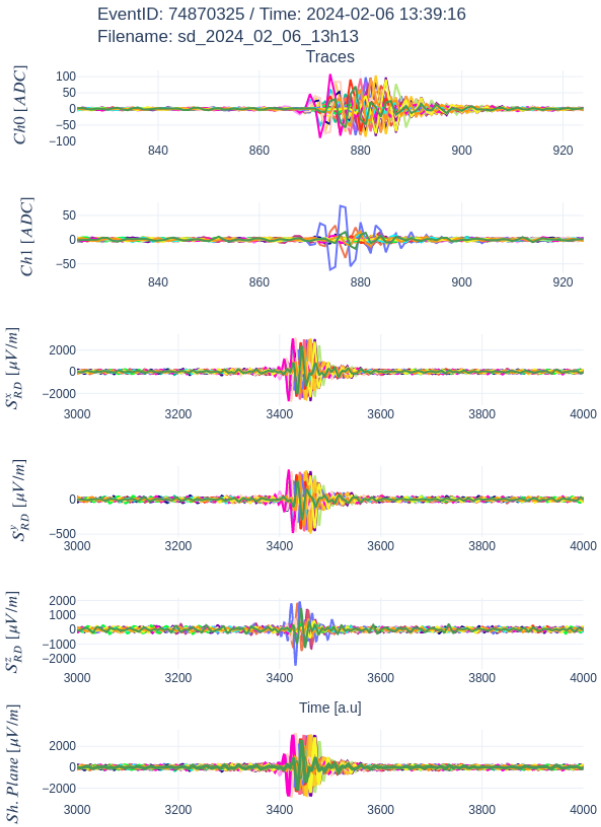
K. D. de Vries

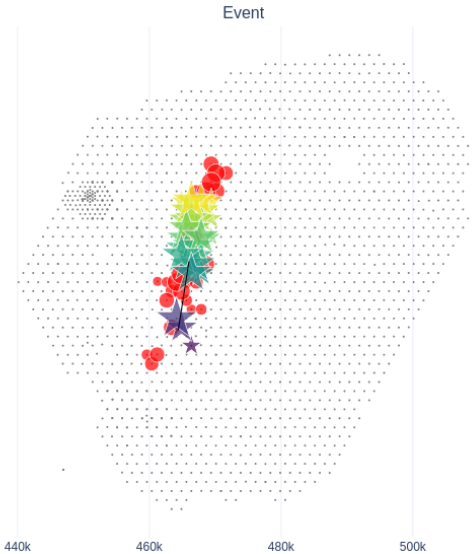
Radio Detection at Auger

- small engineering array (AERA: $\sim$ 157 antennas)
- radio upgrade (RD) of full SD array on 1.5 km grid
- 374 antennas installed (as of 24.02.)
- triggered by water-Cherenkov detector
- first events recorded



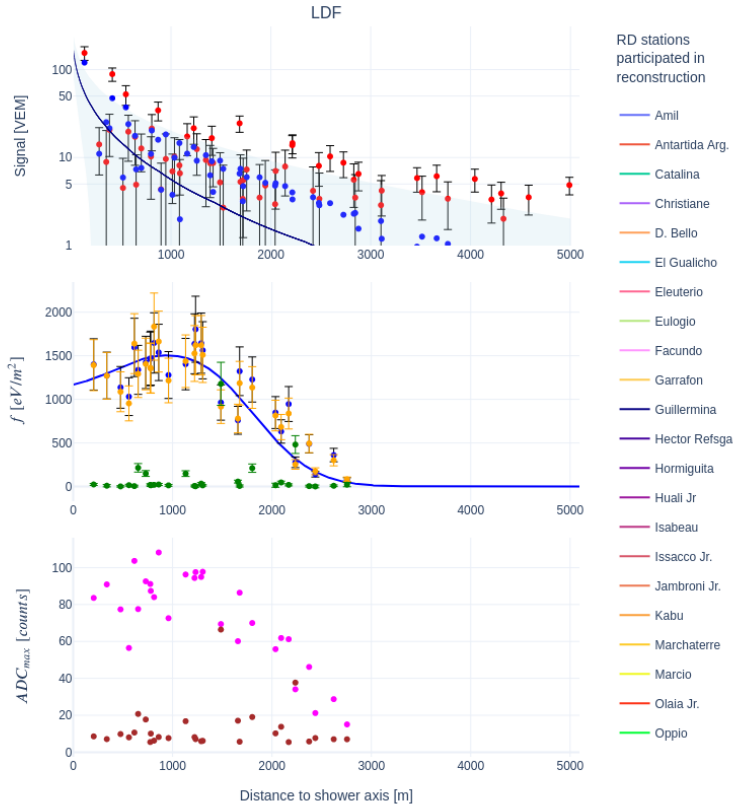
Radio Detection at Auger



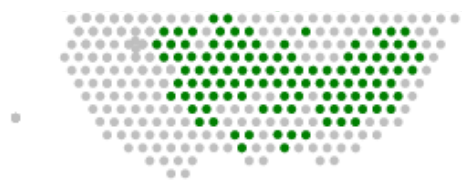


WCD Reconstruction (61 stations)
$E_{SD} = 21.13 \pm 1.7\ EeV$
$\theta_{SD} = 85.8 \pm 0.1\ deg$
$\phi_{SD} = 260.6 \pm 0.0\ deg$
$N_{19} = 3.6 \pm 0.3$

RD Reconstruction (29 stations)
$E_{RD} = 28.35 \pm 3.3\ EeV$
$\theta_{RD} = 85.8 \pm 0.0\ deg$
$\phi_{RD} = 260.6 \pm 0.0\ deg$
$TSFlag = 0, 0, 0, 0$



- first events recorded



Radio Simulations

- particle shower simulations using CORSIKA 7.7500
- COREAS extension for radio emission
- time consuming
  - scales with number of antennas
  - $\sim$ 3 days for event with 15 antennas
  - algorithm to determine optimal number of stations

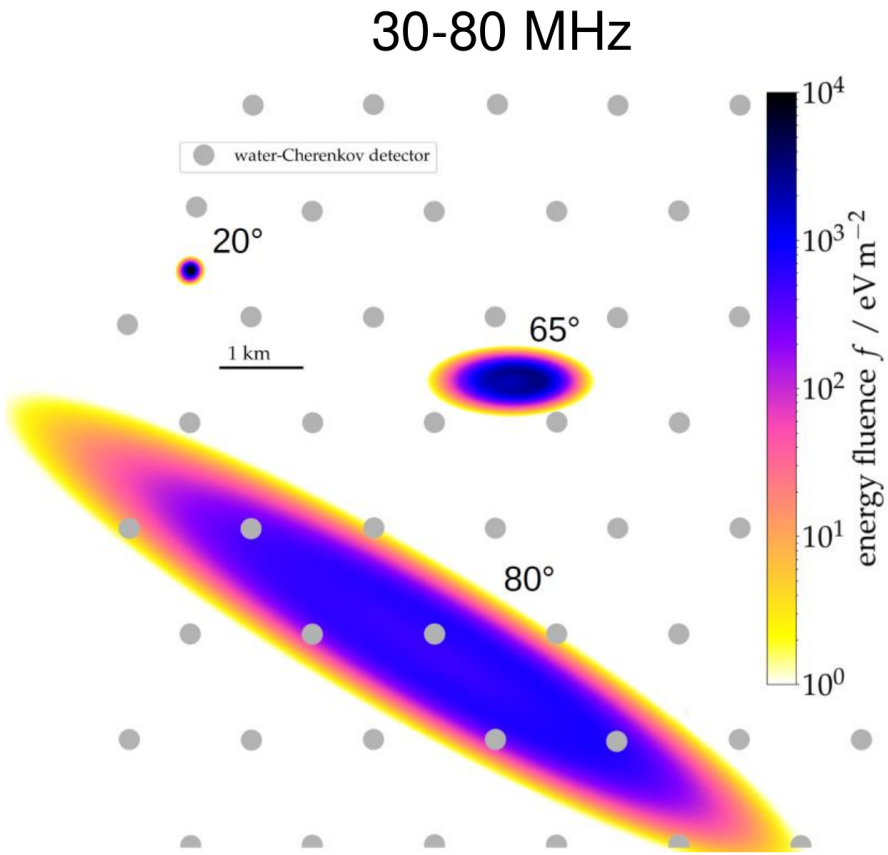
Parameters:

- Primary: Photon, Proton, Iron
- Energy: $10^{17.5} - 10^{20}$ eV
- Zenith: $65^\circ - 85^\circ$
- Malargue October atmosphere/ GDAS Yearly Average atmosphere

- only clean traces, no noise

Radio Noise Library

- AERA background was triggered every 30 s
- not feasible for large array
  - limited communication bandwidth
- two dedicated noise campaigns of only few stations
- idea: use outer stations of vertical showers



T. Huege