Giant Radio Array for Neutrino Detection

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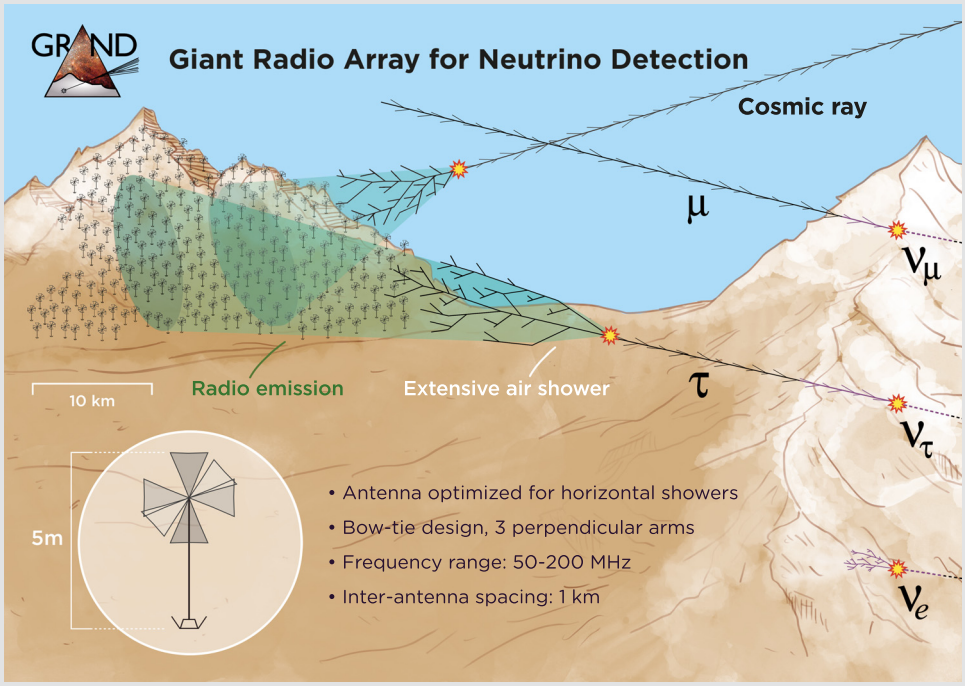
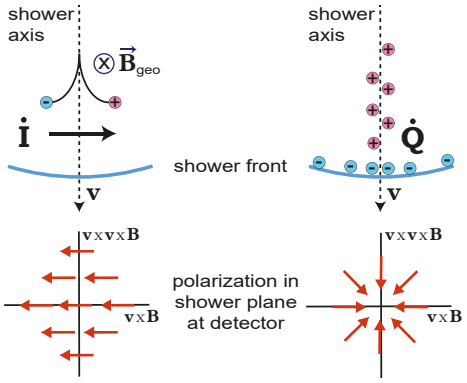
http://grand.cnrs.fr/



Radio Emission by Particle Cascades

- Air-showers initiated by neutrinos will emit radio pulses by the same mechanisms experimentally confirmed for cosmic-ray protons and nuclei.



Geomagnetic emission

dominant in air showers, negligible in dense media

Askaryan emission

dominant in dense media, weak in air showers

Further reading, e.g.: *Prog. Part. Nucl. Phys.* 93 (2017) 1, arXiv:1607.08781

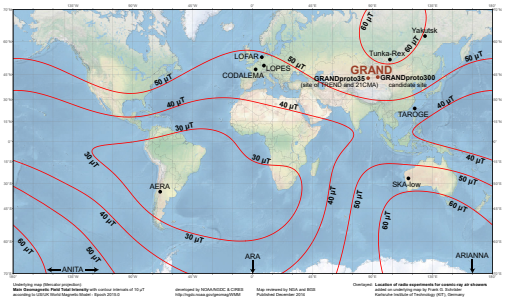
The GRAND Project

- Huge array of self-triggering, autonomous antenna stations
- Radio-quiet site in China, final phase can be distributed over several sites in the world
- Prototype phases will demonstrate technical feasibility and contribute to cosmic-ray science and astrophysics
- Final size of array will enable detection of astrophysical and cosmogenic (GZK) neutrinos above 10^{17} eV, and provide the world-largest aperture for extragalactic cosmic rays

GRAND Phases	Start	Antennas	Size	Main Science Goal
GRANDproto35	2018	35	2 km²	technical prototype
GRANDproto300	2020	300	ca. 200 km²	galactic cosmic rays
GRAND10k	2025	10.000	10.000 km²	extragalactic CR + neutrinos
GRAND200k	2030's	200.000	200.000 km²	astrophysical + GZK neutrinos

Location of GRAND Prototypes

and selected radio experiments for high-energy cosmic rays and neutrinos overlayed on map of geomagnetic field



Phase 1: GRANDproto35

- Prototype array of 35 antennas on 2 km² under construction at the site of the former TREND experiment
- Antenna (right) and electronics will be tested and further developped
- Particle detectors enable cross-check of array performance and self-trigger efficiency and purity

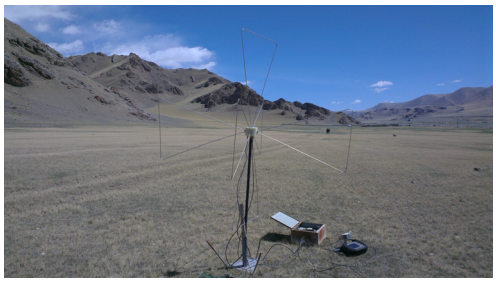
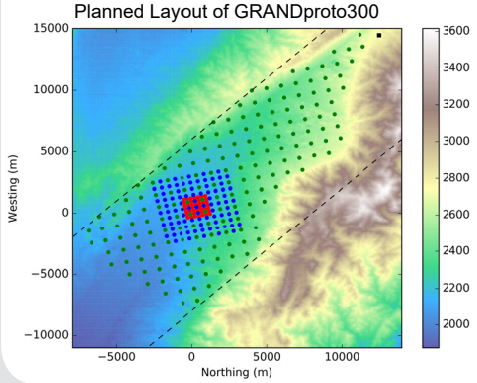


Photo: Background measurement with protoype antenna

Planned Layout of GRANDproto300

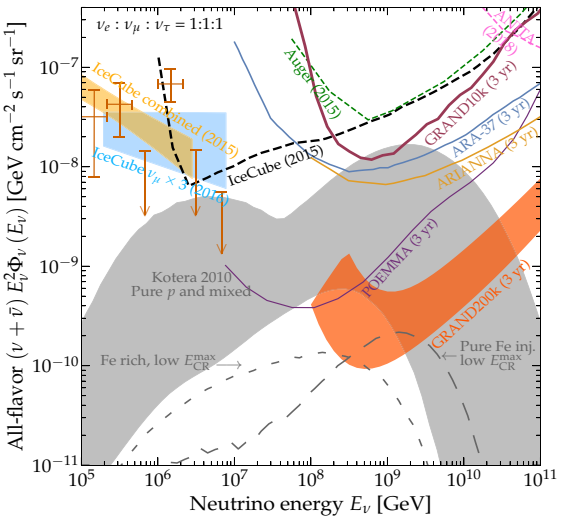


Phase 2: GRANDproto300

- Large 200 km² prototype consisting of 300 antenna stations planned for 2020
- Crosscheck of simulations of the radio signal against measurements for very inclined cosmic-ray air showers
- Experimental study of optimum design by use of graded antenna spacing
- Muon detectors deliver high precision for mass composition of cosmic-ray nuclei
- High statistics and accuracy for energy range of expected transition from Galactic to extragalactic cosmic-ray sources

Expected Sensitivity for Neutrinos

- GRAND will be the most sensitive of experiments planned in the energy range between 10^{17} eV and 10^{20} eV
- Neutrino signal expected in scenarios based on realistic, mixed cosmic-ray mass composition



Further reading: PoS(ICRC2017)388 and PoS(ICRC2017)996