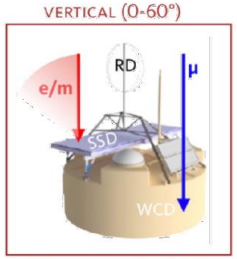
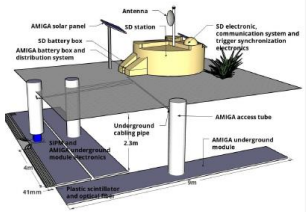
Neutrino Strategy Germany

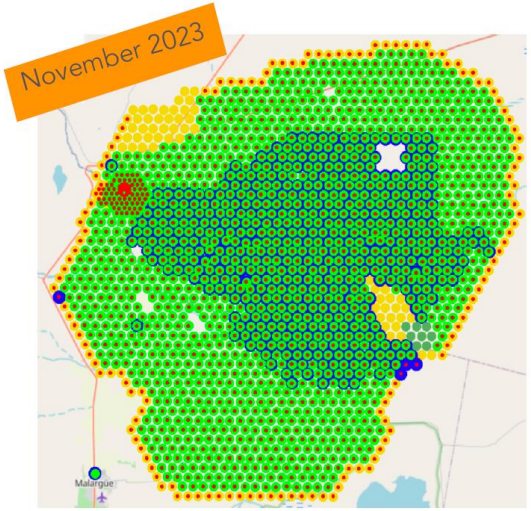
Meeting (virtual) Zeuthen
10 January 2024

Andreas Haungs

Pierre Auger Observatory => AugerPrime







- stations with a UUB installed (+SSD-PMT and SPMT) - completed
- stations with a SSD - completed
- stations with a RD antenna ~30%
- UMD ~58%

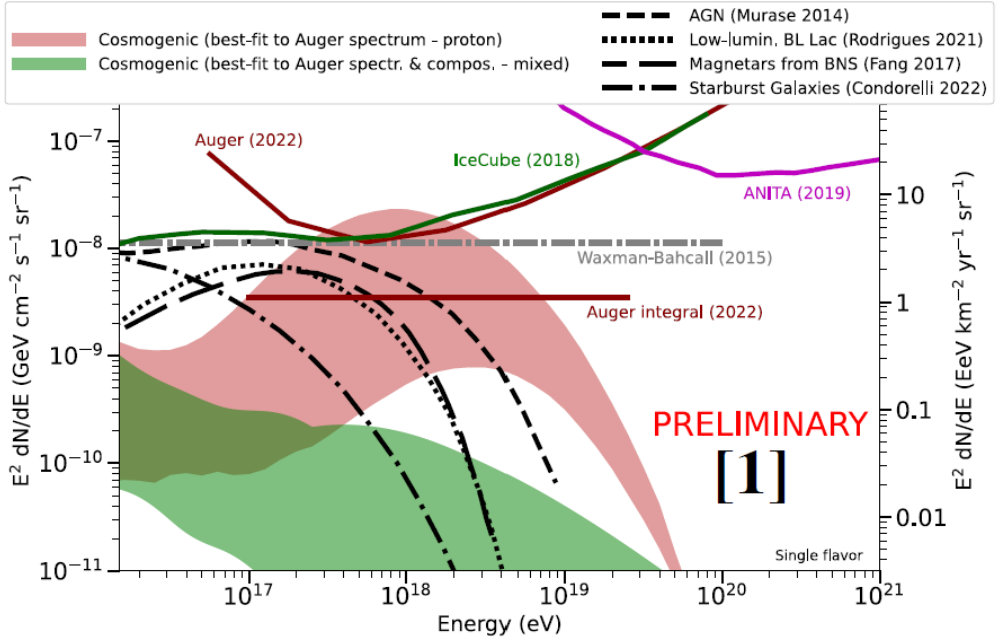
PHASE I: (ended in 2021)
- Exposure: 80,000 km² sr yr (<60°)

PHASE II (8 years of operation starting 2022/23):
- Projected exposure: 40,000 km² sr yr (<60°)
- Use SD more effectively for mass composition information on event by event basis

PHASE II detector upgrade:
- Two detector additions to every SD station:
  - Scintillator detector (SSD) — (<60°)
  - Radio antenna (RD) — (>60°)
- **In adddition**
  - New electronics (faster, more channels)
  - Small PMT (1" diameter) to increase dynamic range of each WCD
  - Buried muon counters in the in-fill array

- Collaboration > 450 authors, 17 countries, ca 90 institutes
- Final results of Phase I are/will be published
  - Spectrum, composition, anisotropy and combined information
  - Multimessenger increasingly important
  - Measurement published as open data

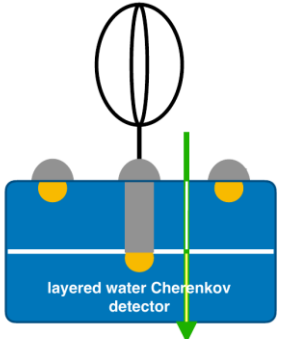
Pierre Auger Observatory – EHE Neutrinos

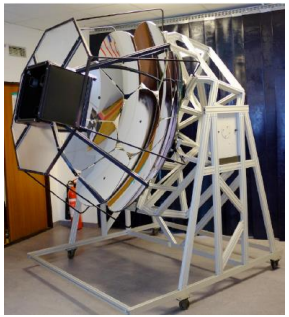


Timeline: Milestones and dates [6]	AugerPrime review	Commissioning	Data taking	
	11/2023	12/2024	Till 2035	
KAT constituencies [7]	Cosmic rays	High-energy neutrino astrophysics	Gamma-ray astronomy	

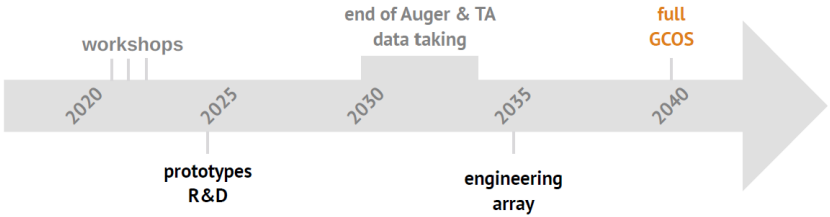
GCOS -- The Global Cosmic Ray Observatory

charged-particle astronomy, multi-messenger studies and fundamental physics at ultra-high energies

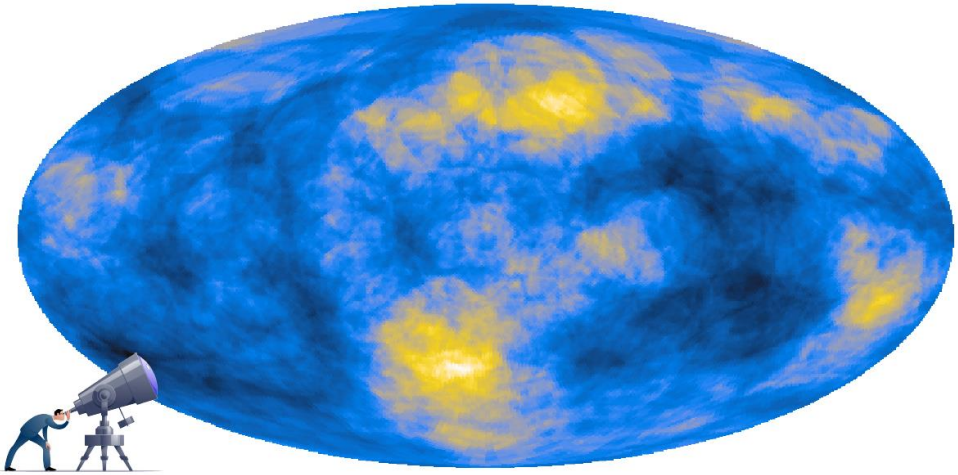




2018 “Future” session at UHECR (Paris)
2021 1st GCOS workshop (online)
2022 2nd GCOS workshop (Wuppertal)
2023 3rd GCOS workshop (Brussels)
two layered WCD prototypes running in Auger
FAST (FD) prototypes running in Auger and TA



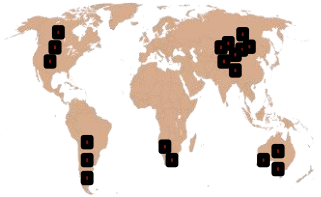
full-sky by 2 sites; 60.000 km^2
20k layered WCDs; RD, FD
➔ high quality E and A at 30 EeV



Auger >38EeV: (local) significances of -4.3 (dark blue) to +4.3 sigma (white)

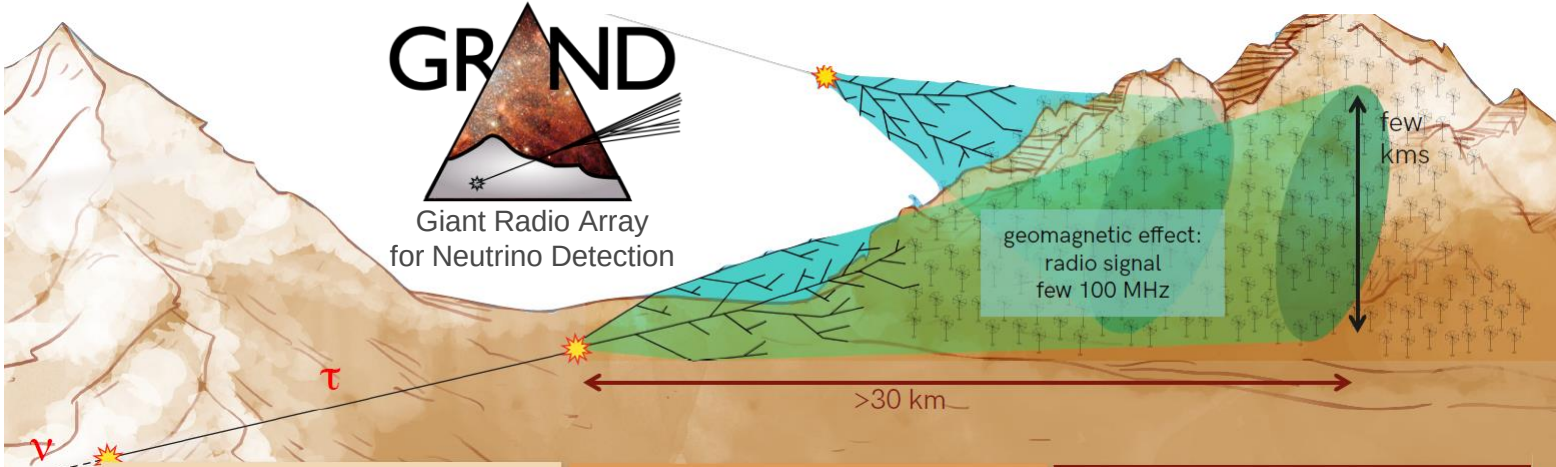
PoS ICRC2021 (2022) 027
PoS ICRC2023 (2023) 281

GRAND



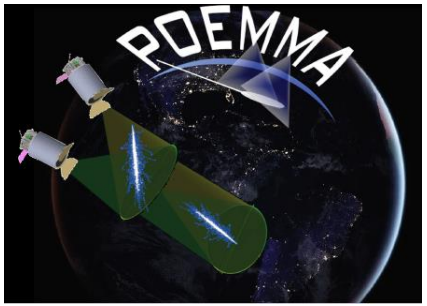
~20 sub-arrays of 10'000 antennas worldwide totalling 200'000 radio antennas over 200'000 km²

Giant Radio Array for Neutrino Detection

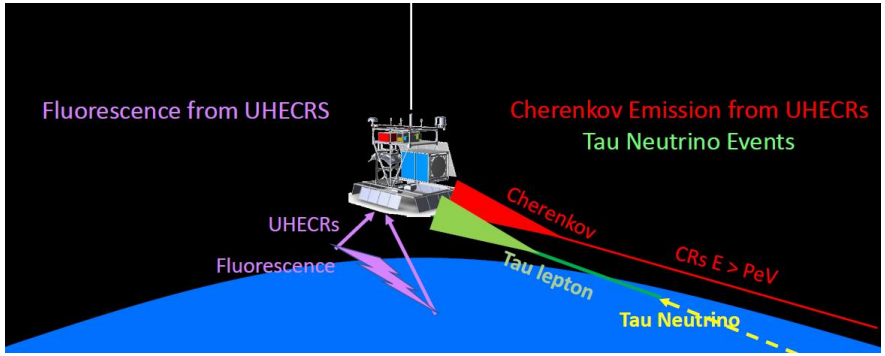


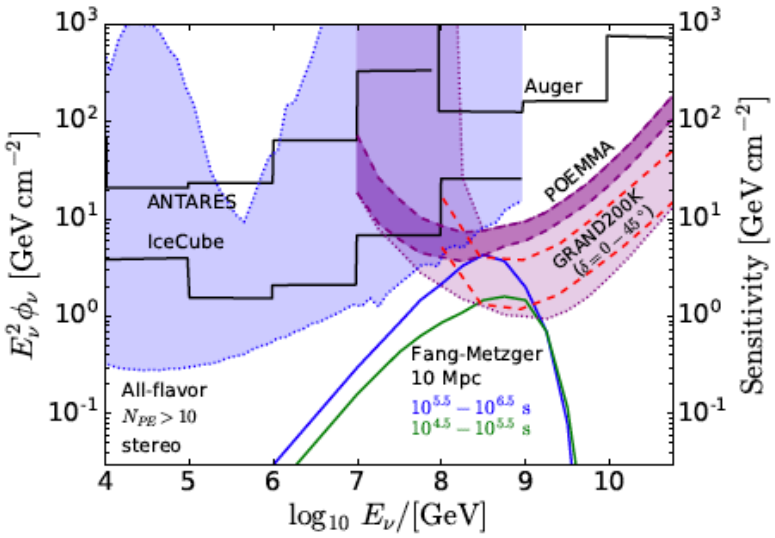
	Prototypes	GRAND10k x2 (North/South)	GRAND200k
	2023	2028	203X
Goals	**autonomous** radio detection of **very inclined** air-showers **cosmic rays $10^{16.5\text{-}18}$ eV** • **GRAND@Nançay**: 4 antennas for trigger testing • **GRAND@Auger**: 10 antennas for cross-calibration • **GRANDProto300**: 13/300 HorizonAntennas over 200 km²	• **discovery of EeV neutrinos** for optimistic fluxes **2 GRAND sub-arrays** • 2x10,000 radio antennas over 2x10,000 km² in China + Argentina • 13 M€ x2	sensitive **all-sky** detector **1st EeV neutrino detection and/or neutrino astronomy!** • 200,000 antennas over 200,000 km² • 20 sub-arrays of 10k antennas • 300 M€

POEMMA -- SPB-PBR



POEMMA, PoS (ICRC2023)1159





- POEMMA, 2 satellites, 4 m mirror, design study funded by NASA, launch foreseen mid 30ies
- Detection of UHECR and neutrinos
- SuperPressureBalloon-POEMMABalloonRadio flight foreseen 2027 as POEMMA testbed

Timeline: Milestones and dates [6]	SPB-PBR: construction	SPB-PBR field-tests	SPB-PBR: launch	POEMMA
	2024-25	2026	2027	2030ies
KAT constituencies [7]	Cosmic rays	High-energy neutrino astrophysics		select here

BEACON ??

Sensitivity of BEACON to Point Sources of Ultrahigh Energy Neutrinos

Andrew Zeolla on behalf of the BEACON Collaboration

PoS(ICRC2023)1020

The BEACON Concept

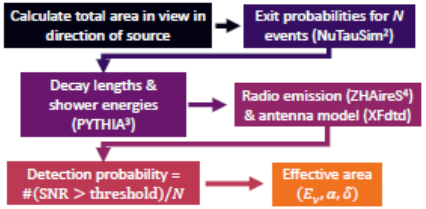
Beamforming Elevated Array for Cosmic Neutrinos

- $O(1000)$ radio interferometers placed on mountains around the world[1]
- Detects the radio emission of upgoing EAS created by Earth-skimming ν_τ
- Phased array trigger → greater sensitivity
- High elevation + radio + multiple stations → huge detector volume
- Prototype (Talk: NU8-01, PoS(ICRC2023)1019)

Q: Could BEACON detect UHE astrophysical neutrinos?

Method

- Accounts for overlapping detector areas
- Monte Carlo: Multiple Antenna Arrays on Mountains Tau Simulation (Marmots)
- Calculates the effective area of BEACON to neutrino point sources
- Any station configuration can be input



Results

Simulation: 100 stations, 3 km apart, oriented East, 120° FoV, 3.8 km altitude, along line of equal longitude