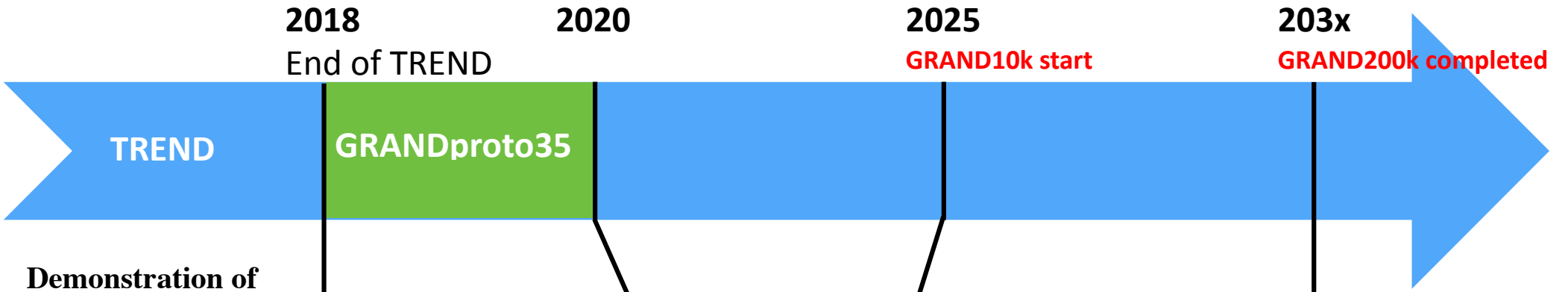
Nicolas Renault-Tinacci
On behalf of GRAND collaboration

GRANDproto300
(GP300)

May 25th 2018
11th FCPPL workshop
Marseille

GRAND project timeline



Demonstration of EAS autonomous detection [see S. le Coz's talk]

To improve background rejection & EAS detection efficiency

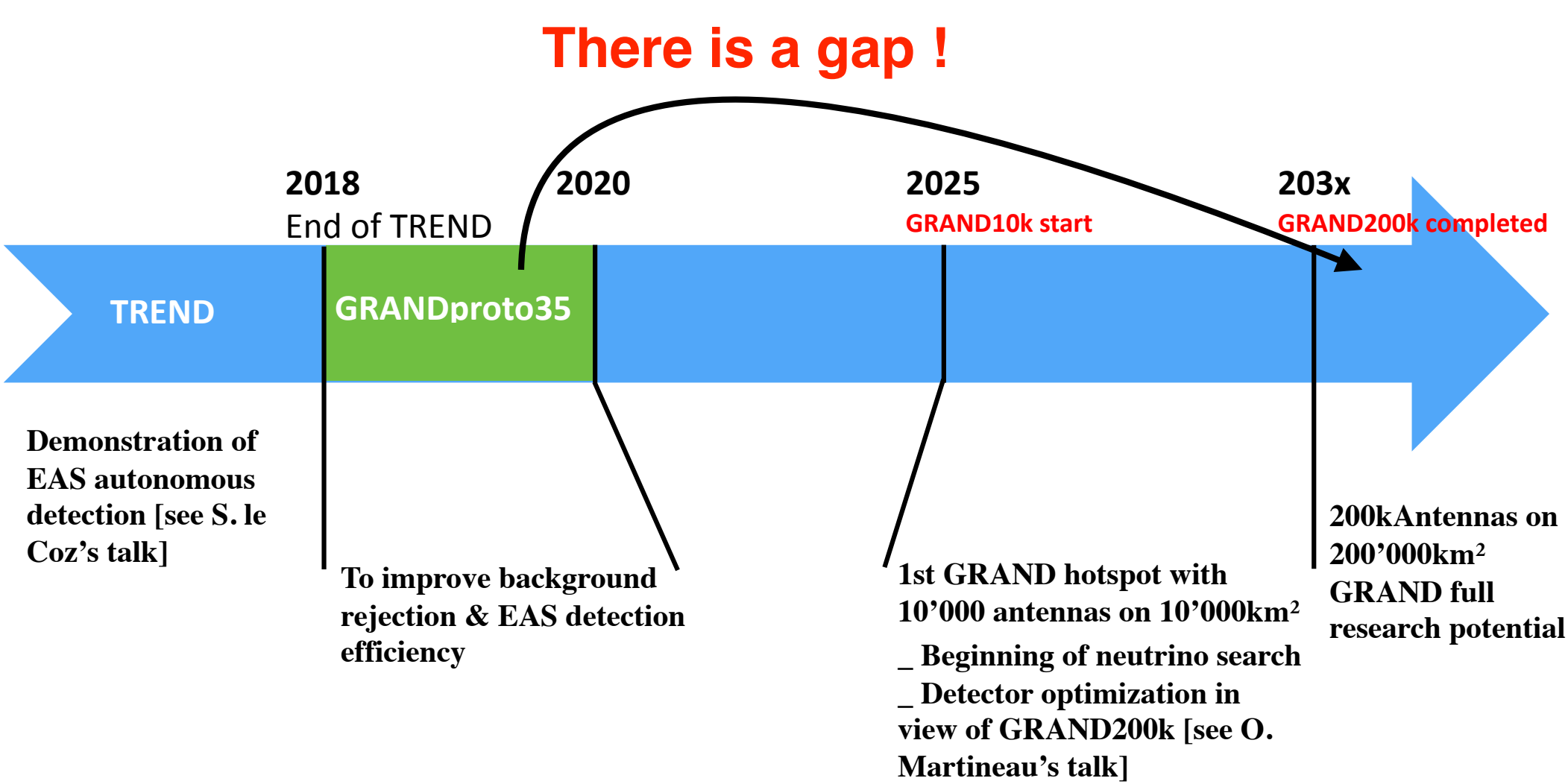
1st GRAND hotspot with 10'000 antennas on 10'000km²

_ Beginning of neutrino search

_ Detector optimization in view of GRAND200k [see O. Martineau's talk]

200kAntennas on 200'000km² GRAND full research potential

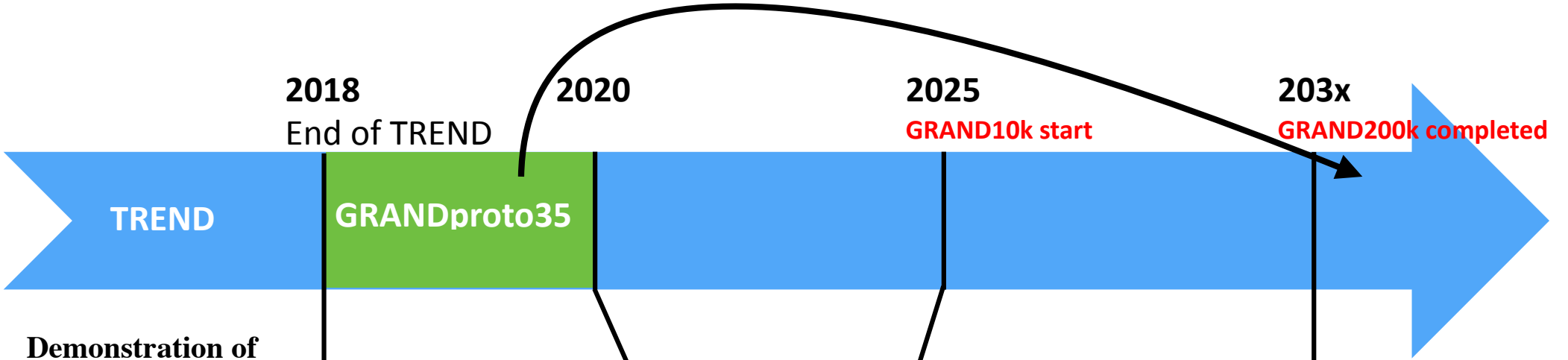
GRAND project timeline



GRAND project timeline

Two major experimental issues to solve for (full) GRAND:

- **Autonomous radio-detection with self-standing/unwired units**
  - **Major challenge for trigger & data collection**
- **Neutrino induced showers associated with very inclined trajectories (theta>85°)**
  - **Additional challenge for background rejection & shower reconstruction.**



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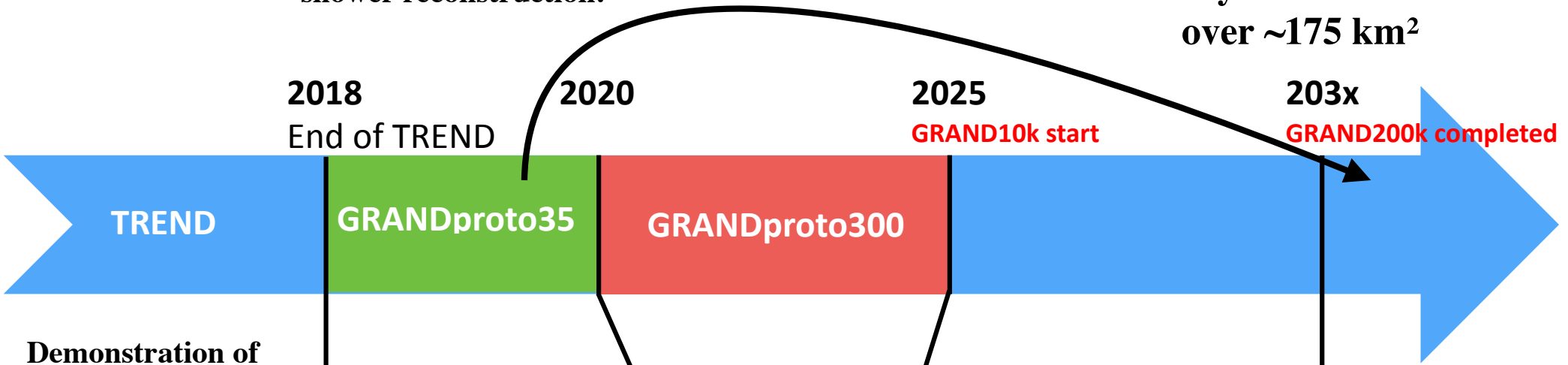
An engineering array is needed to study & tackle these challenges

→ GRANDproto300: an array of 300 antennas over ~175 km²



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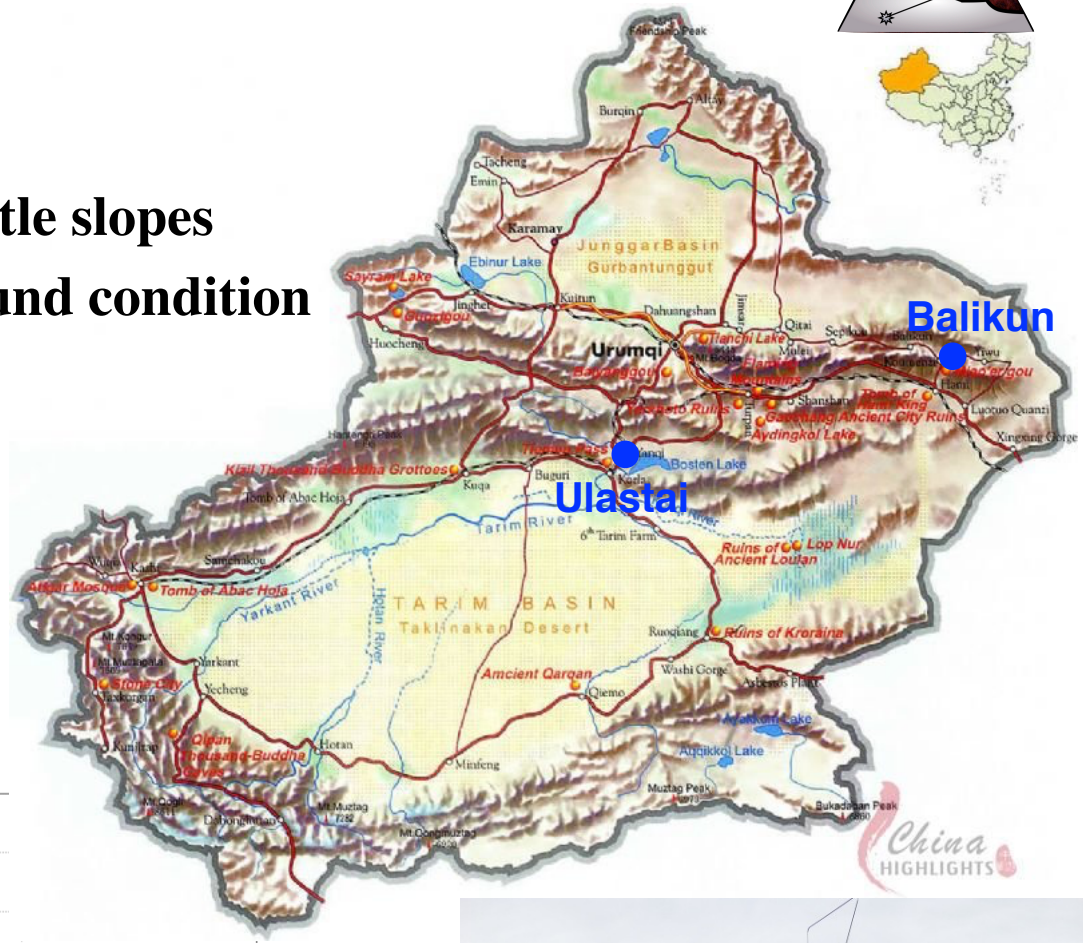
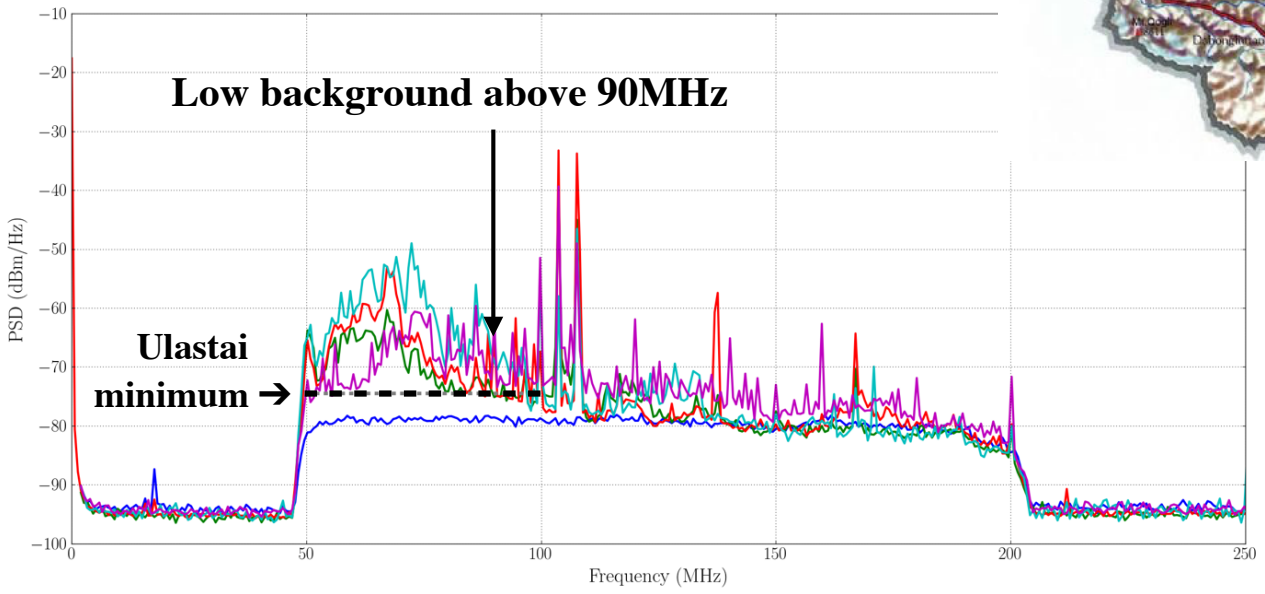
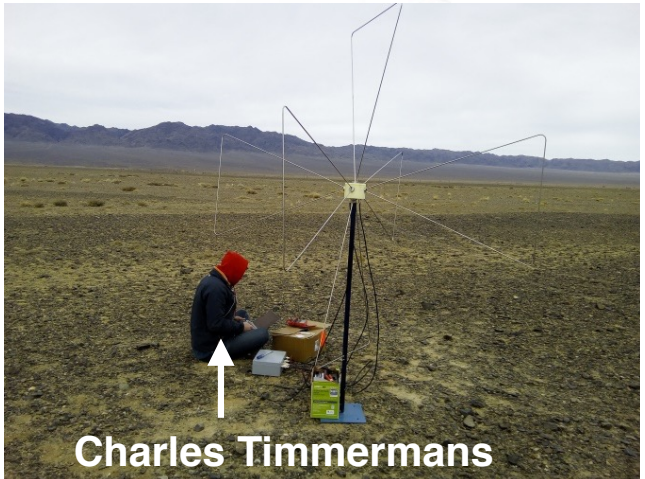
Site of GP300

- **Best candidate site: Balikun, XinJiang**
  - **Large area with easy access and gentle slopes**
  - **Very good electromagnetic background condition**
- **Further tests starting in August 2018**
- **Request official approval → final decision before end 2018**

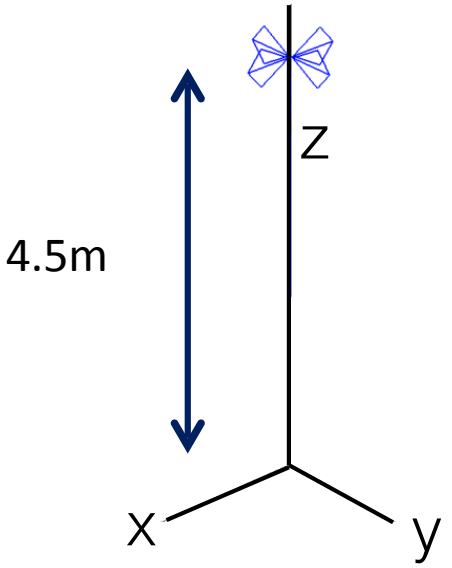


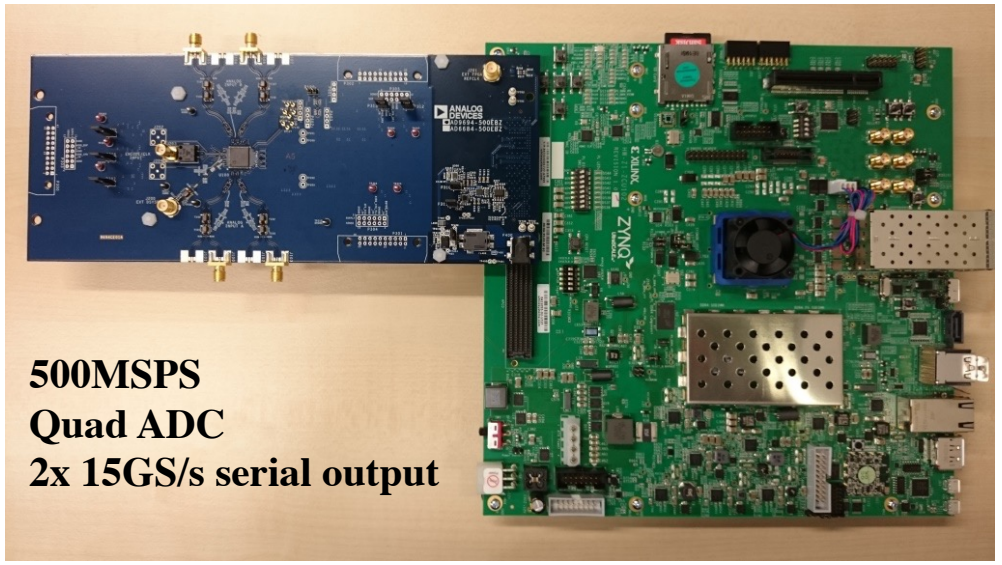




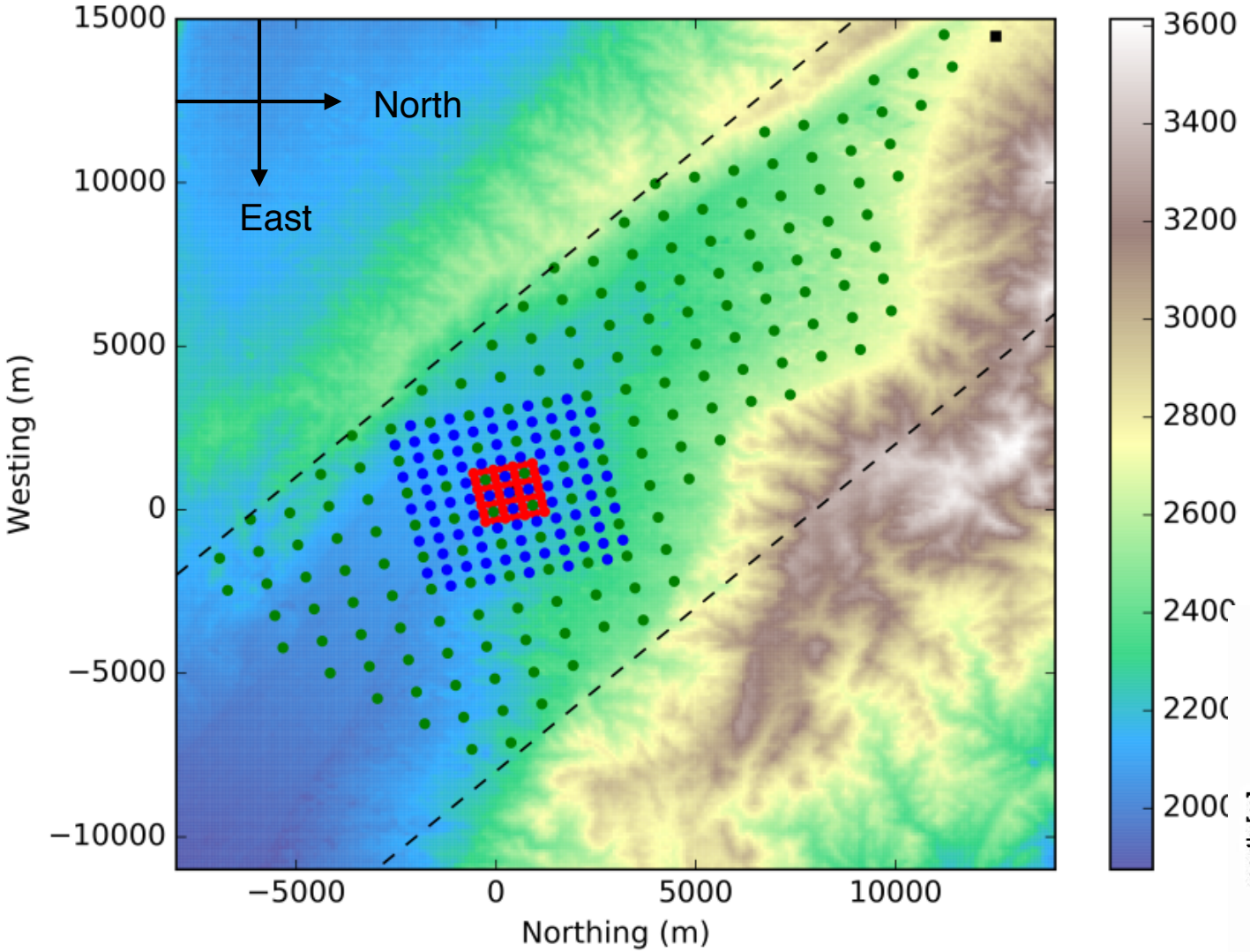
Antenna & Electronics

- **Antenna design optimised for very inclined radio waves (D. Charrier, Subatech) ➔ test summer 2018**
- **Electronics (C. Timmermans, Nijmegen) ➔ first prototype for September 2018**
  - **500MHz+12bits digitizer**
  - **imbedded FPGA-CPU for clever trigger @ antenna level**
  - **Wireless data transfer**
- **Frequency band ➔ 50-200 MHz (A. Balagopal, KIT)**

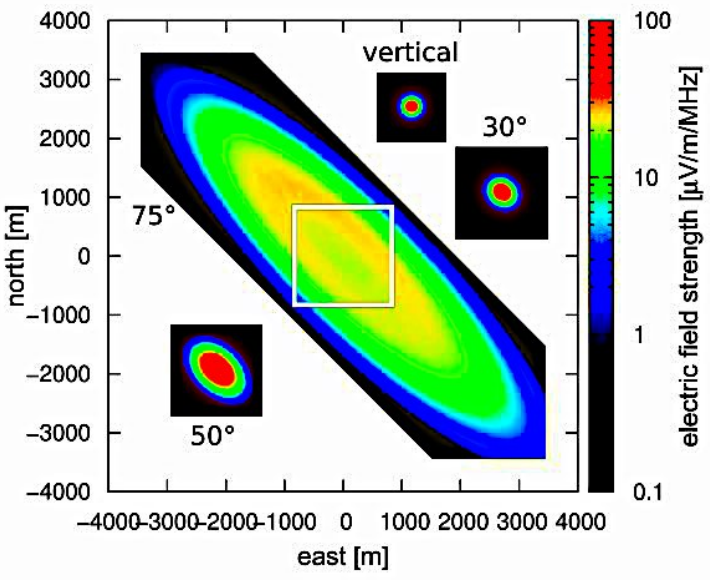




Layout of GP300



- **Antennas positioned on moderate slopes**
- **3-density layout:**
  - **250 m**
  - **500 m**
  - **1 km**



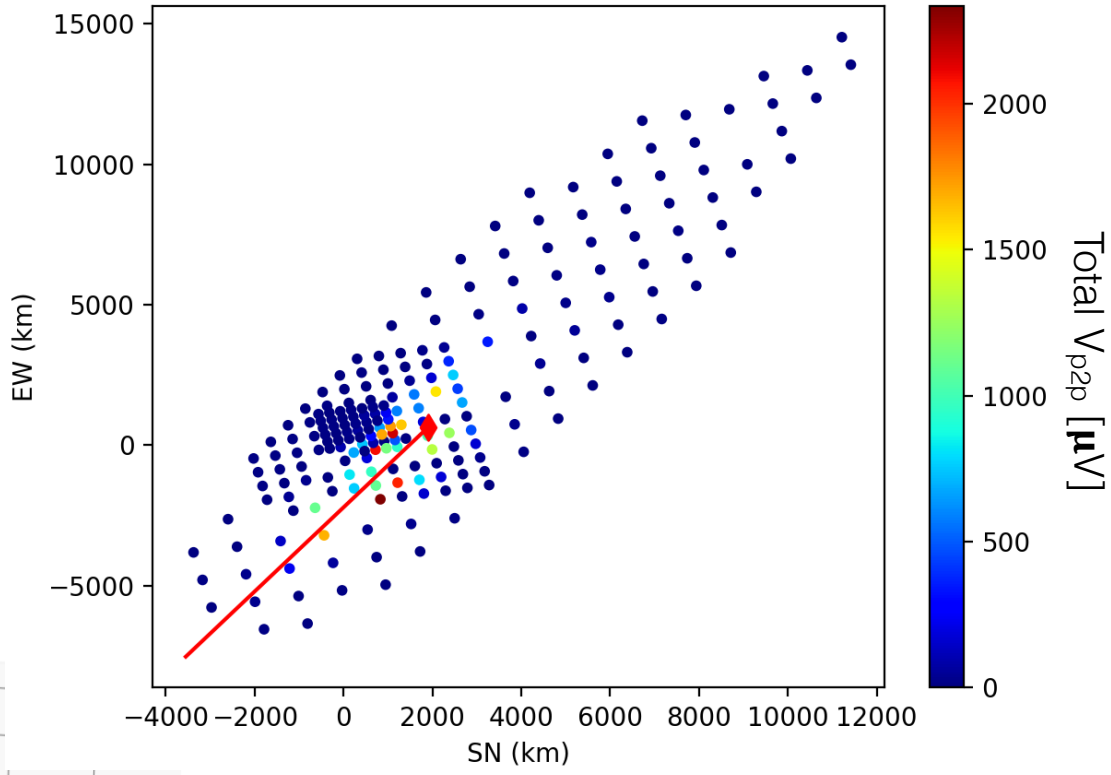
➔ **Large energy span**

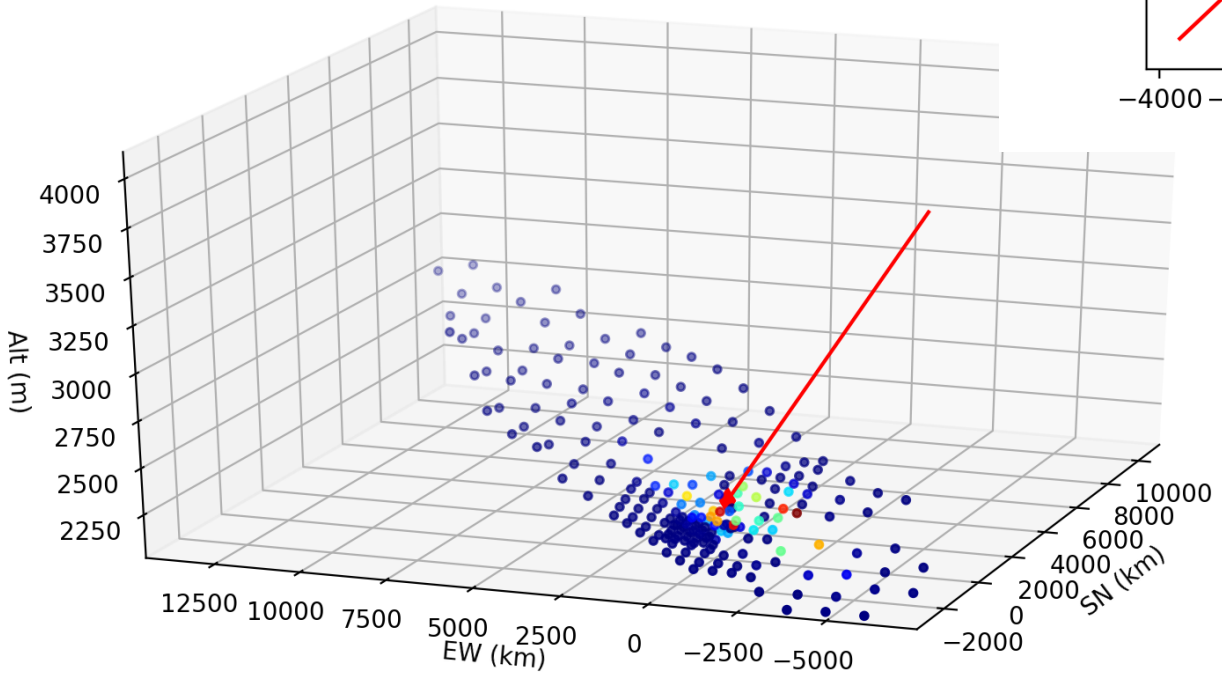
➔ **Large acceptance at large zenith values**

Simulations for GP300

- **Real antenna positions accounting for Balikun topography**

- **6 energy bands from 10^{17} to $10^{19.5}$ eV**
- **At the moment, 100 simulated showers for each energy**
- **zenith, azimuth and core positions randomly generated**

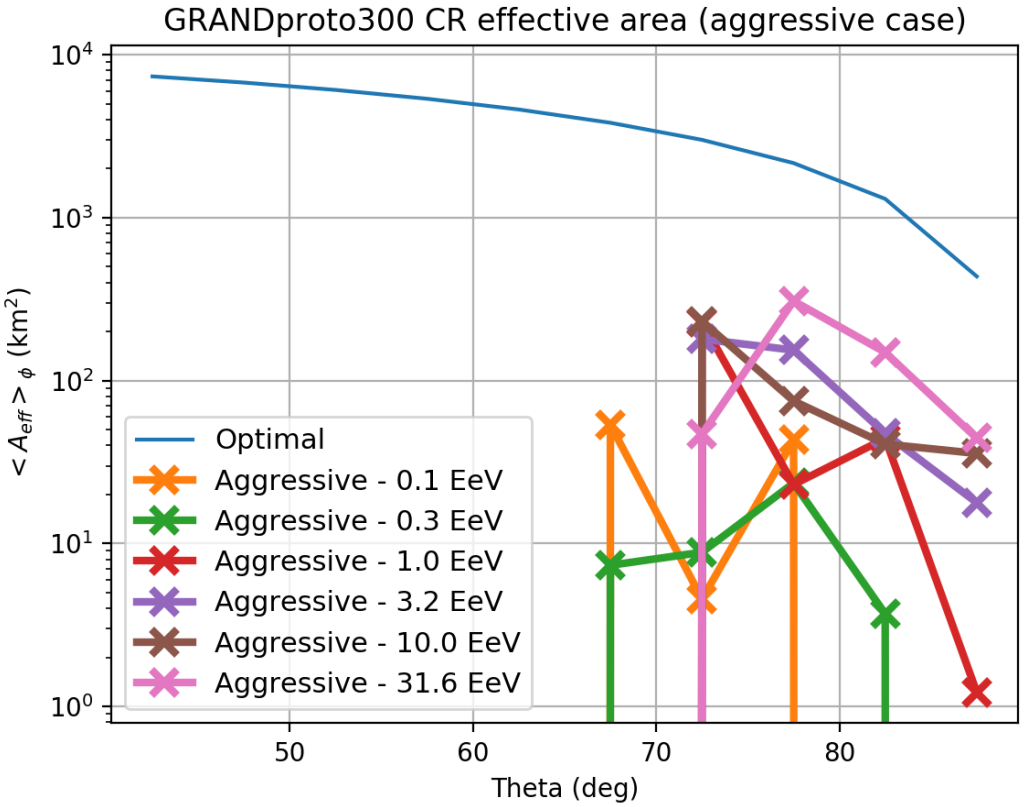


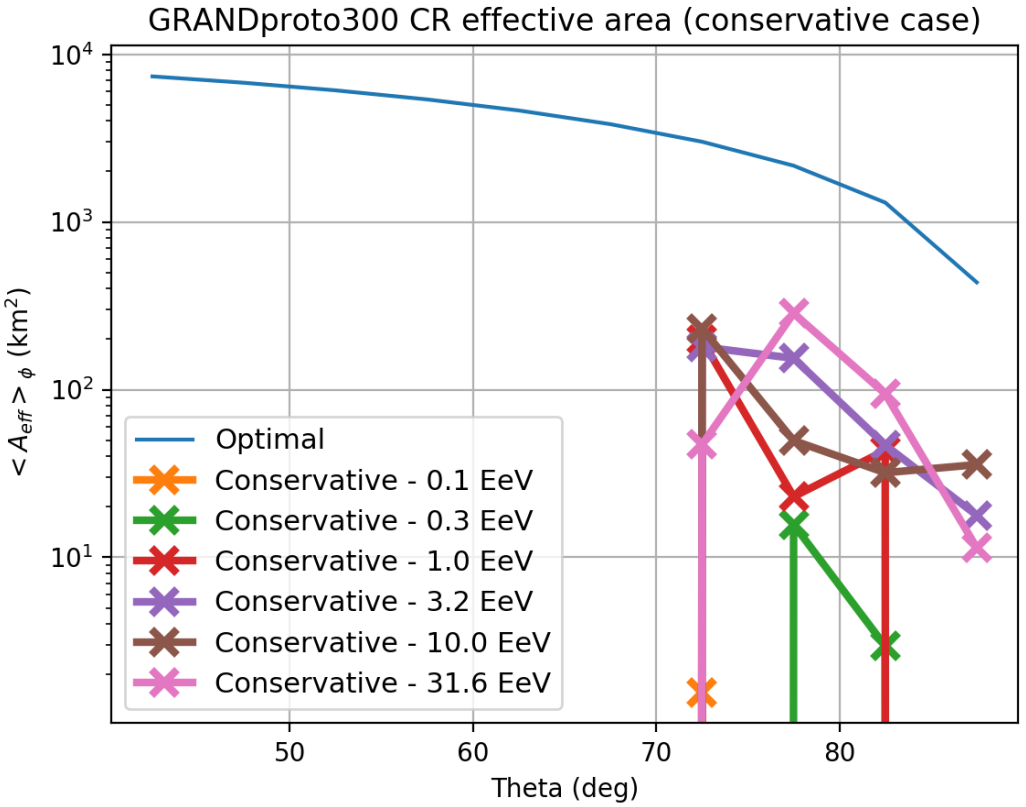


Example shower:
E = 1 EeV, zen ~ 79 deg,
az ~ -124 deg i.e. flying NW

Simulations for GP300

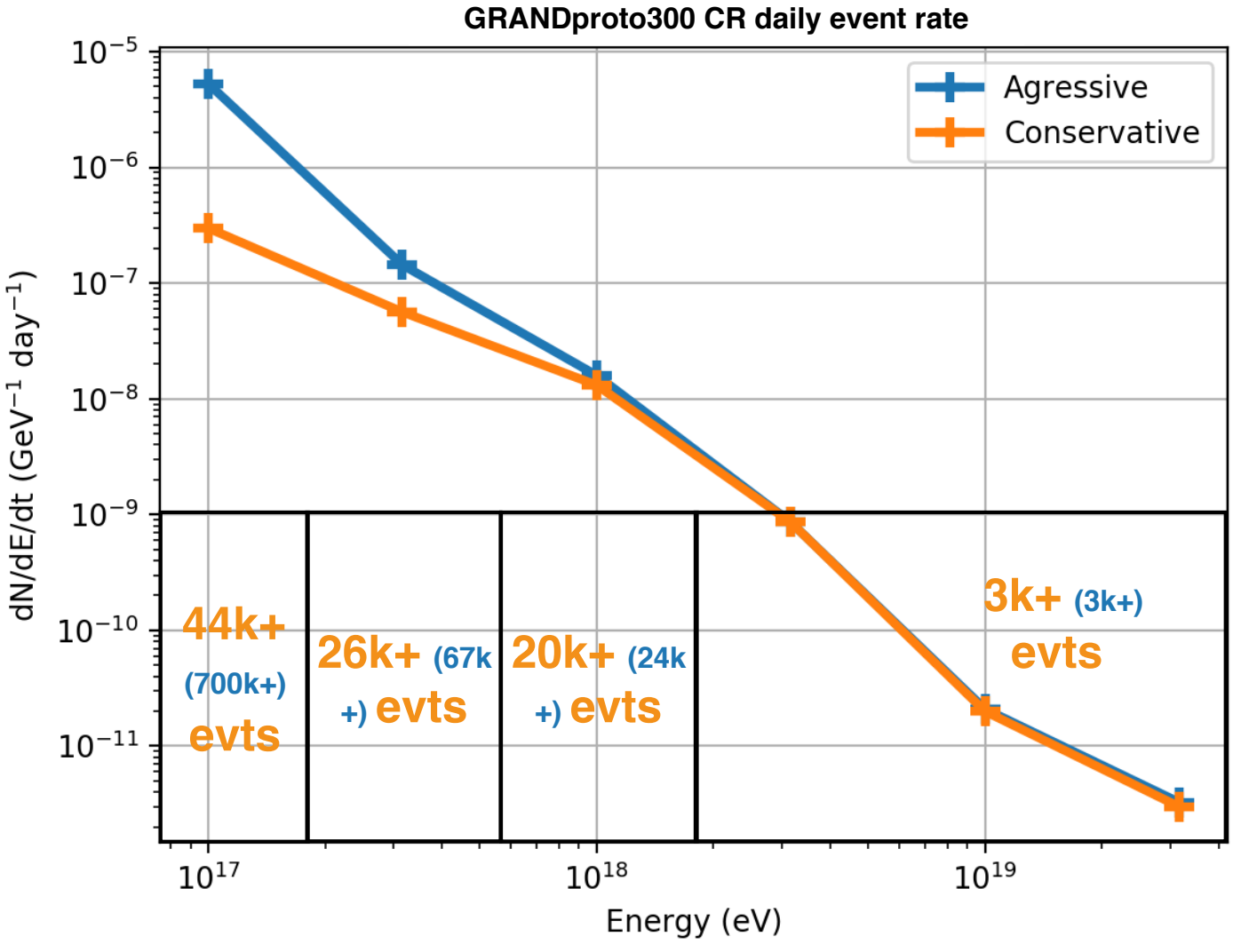
- **Lack of statistics (for now) in the simulations**
  ➔ No point at low theta
- **Capability to detect very inclined (θ>80 deg) CR showers with GP300**





Simulations for GP300

- **Large exposure providing large statistics**



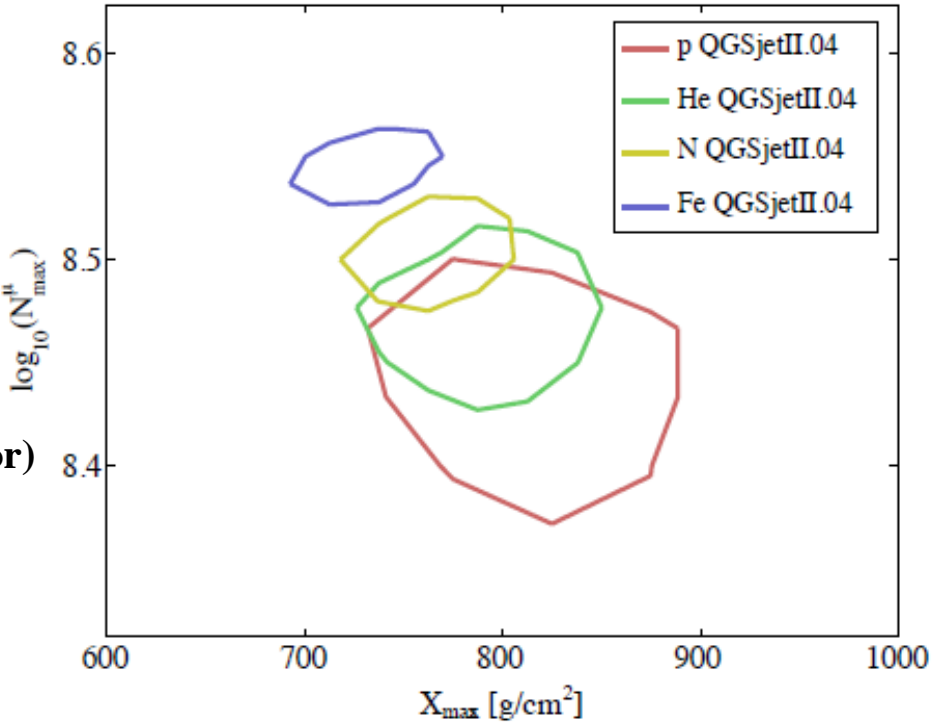
Computed using TA flux (astro-ph - 1511.07510)

Yearly event rate

Physics with GP300

- **If GP300 is completed by particle detector array:**
  - **Built-in discrimination between muon & electromagnetic components (sole experiment with direct independent measurements)**
  - **Large statistics over $10^{16.5}$ – 10^{18} eV**
  - **Great tool to study Gal-Extragal CR origin transition**

- **Also test alternative ideas:**
  see P. Billoir, M. Settimo, and M. Blanco, Astropart. Phys. 74, 14 (2016), arXiv:1508.04354
  - **Exploiting the geomagnetic distortion of the inclined atmospheric showers to set constraints on the hadronic models with an hybrid detector (radio + particle detector)**



Summary

- **Gap between GRANDproto35 and GRAND10k**
- **Two issues to tackle for GRAND (full scale):**
  - **Autonomous trigger & data collection with unwired units**
  - **Background rejection + reconstruction for Earth-skimming showers**

➔GRANDproto300 as an engineering array

- **Antenna and electronic systems design under progress**
- **Best candidate site found = Balikun, XinJiang**
  - **Further tests to perform, official approval request**

- **Proposed layout for GP300 @Balikun with 3 antenna densities**
- **Simulations performed, good CR exposure and statistics, capability to see very inclined showers**

➔GP300 also an array to do physics