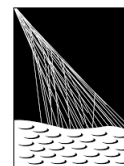
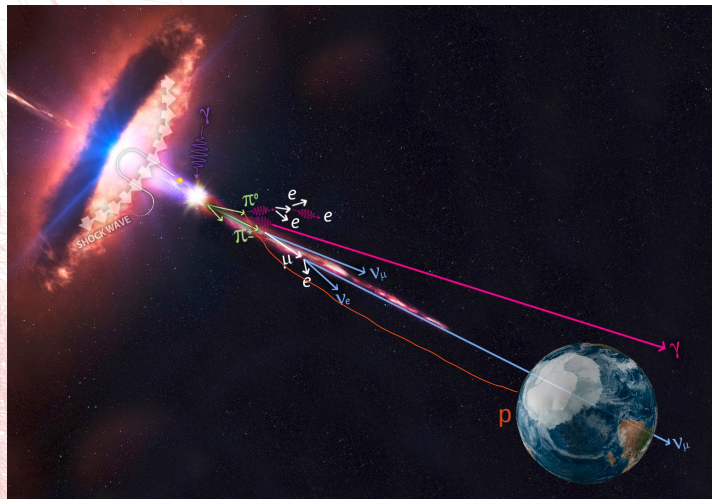
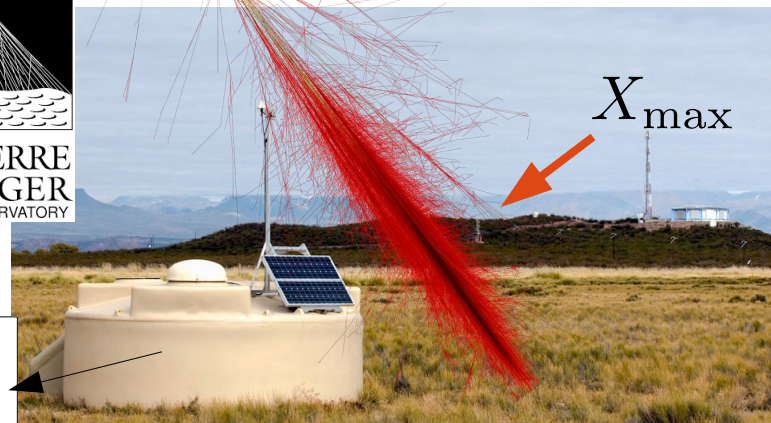


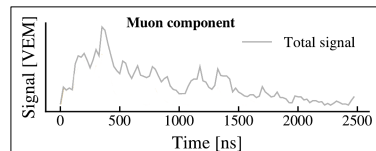
Pierre Auger Cosmic-Ray Observatory



PIERRE
AUGER
OBSERVATORY



Measure signal traces



[1] The Pierre Auger Collaboration, NIM-A, 798 (2015) 172-213

Ultra-high energy cosmic rays

- measure cosmic-ray-induced air showers (10^{17} to $>10^{20}$ eV)
- investigate nature & origin of UHECRs
 - unknown for more than 100 years

The Pierre Auger Observatory

- world's largest cosmic ray observatory
- Size: $3000 \text{ km}^2 \rightarrow 15\text{x}$ size of Amsterdam
- **hybrid detection** of air showers
 - 1,660 water-Cherenkov detectors 100% duty cycle
 - 27 fluorescence telescopes

Mass Composition Studies using DNNs

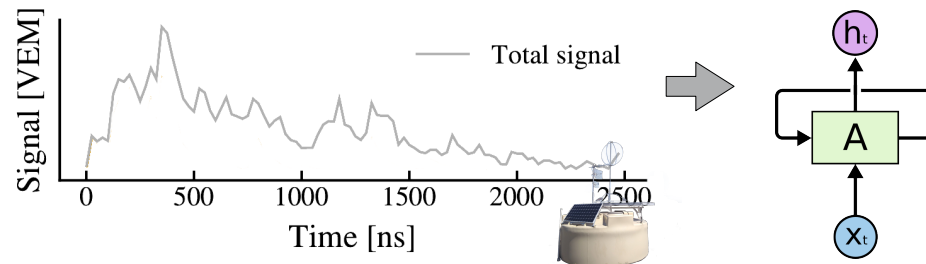
- Xmax is estimator for primary mass
- Directly observed by fluorescence telescopes
- Reconstructed by DNN using detector traces
- Calibrated and crosschecked with telescopes

→ new insights in cosmic ray composition!

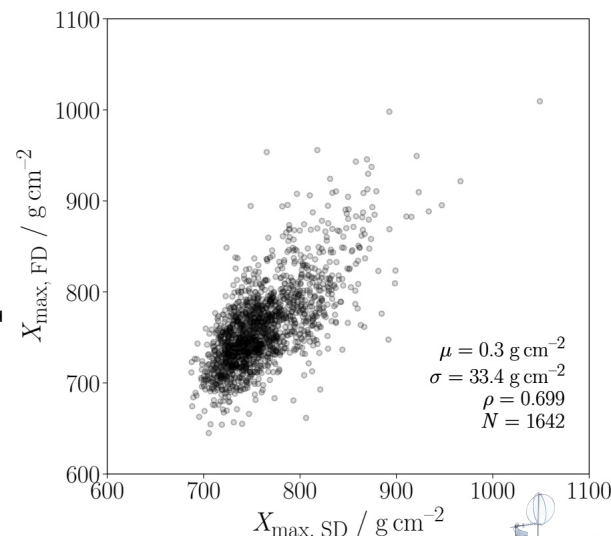
Would need to operate telescopes for >100 years to collect similar statistics

[2] A. Aab (Pierre Auger Collaboration) et al., JINST 16 P07019 (2021)

[3] A. Aab (Pierre Auger Collaboration) et al., JINST 16 P07016 (2021)



telescopes

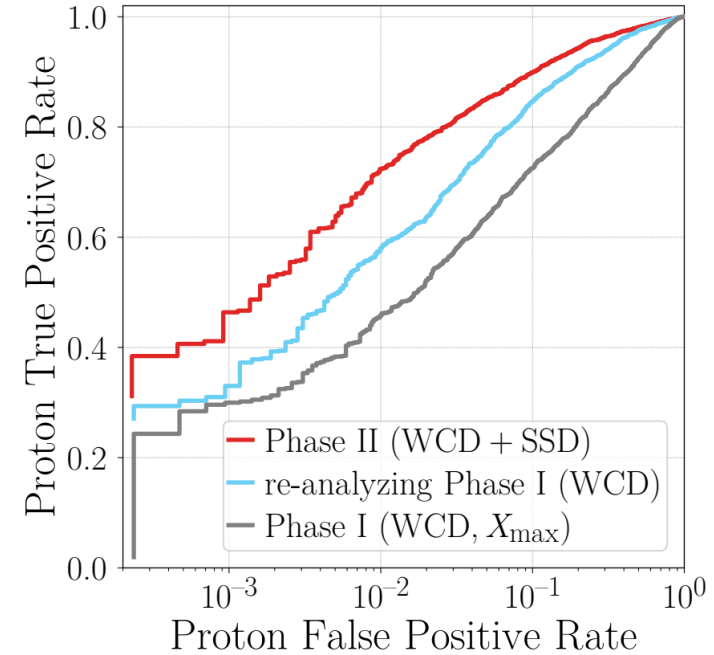
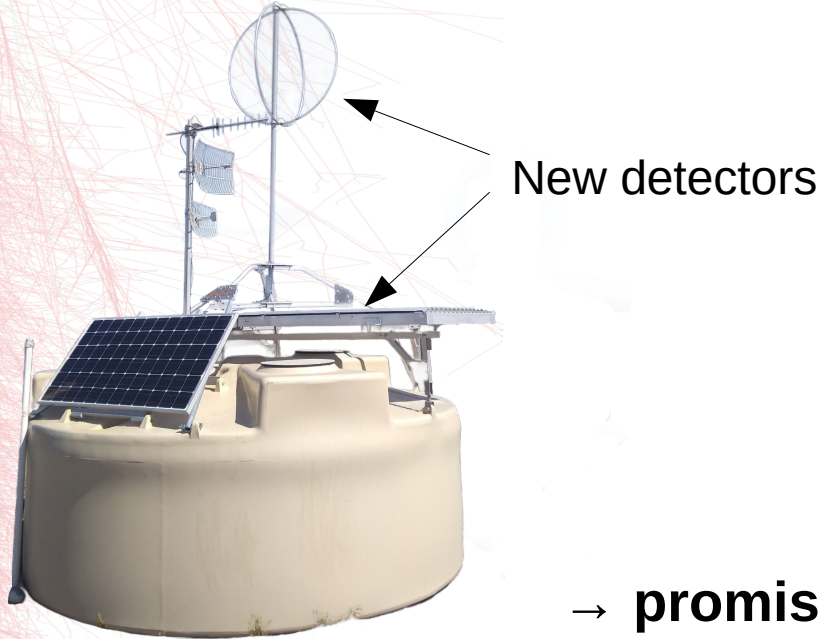


Detector stations



Machine Learning in the AugerPrime era

- Ongoing upgrade
 - ♦ add radio antenna & plastic scintillator
- improved sensitivity



→ **promising potential to re-analyze previous data with improved sensitivity**

[4] A. Aab (Pierre Auger Collaboration) et al., ArXiv:1604.03637

[5] N. Langner on behalf of the Pierre Auger Collaboration, PoS(ICRC2023)371