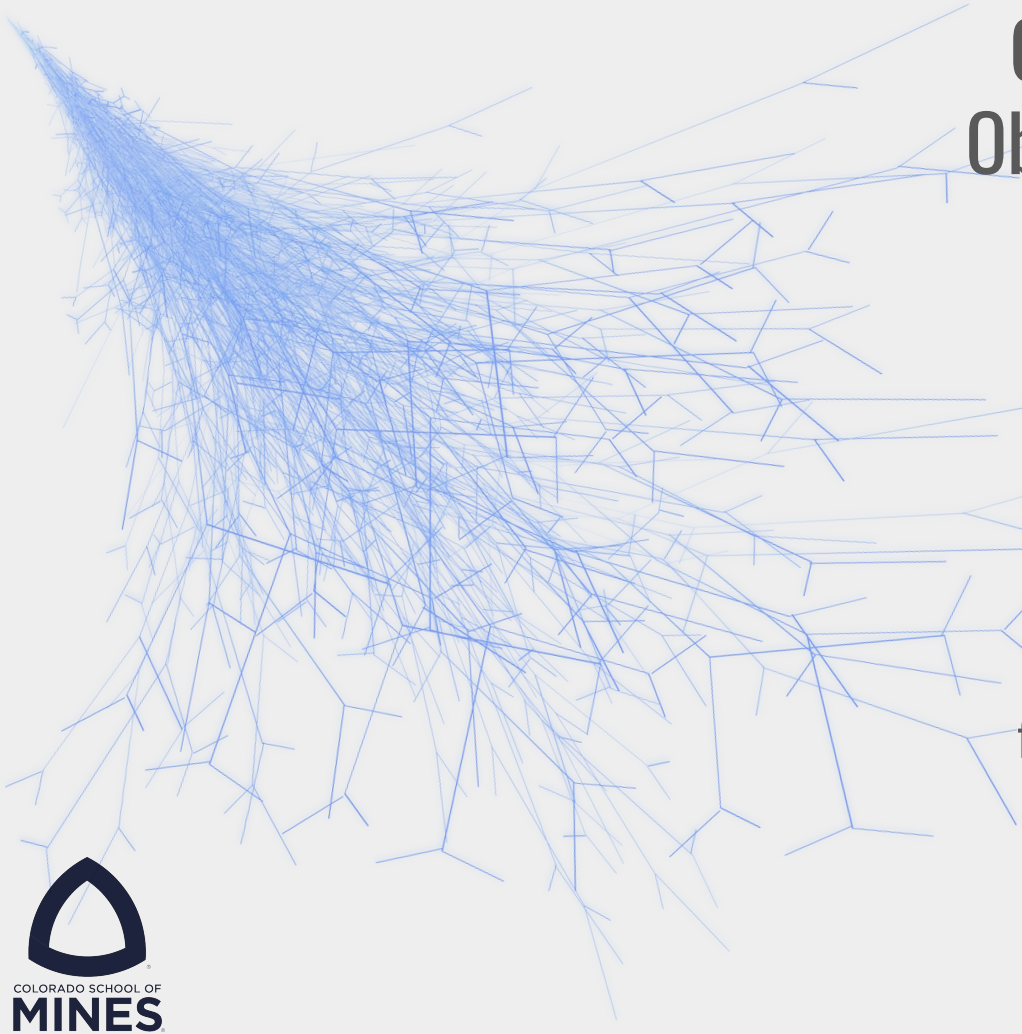


Comment: The Pierre Auger Observatory and the Telescope Array Project need to be supported into the 2030s.

P5 Town Hall at Fermilab and Argonne
Thursday, March 23rd

Eric Mayotte
for the conveners and contributors of the
Snowmass UHECR White Paper*

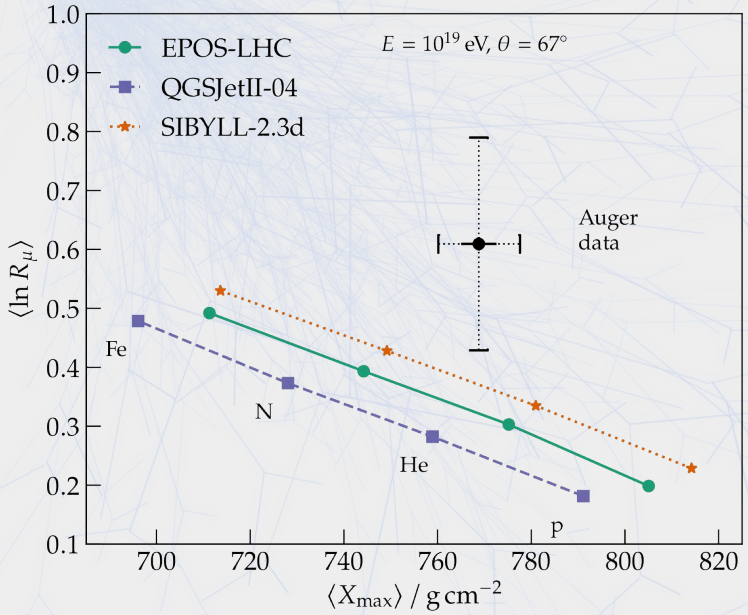
COLORADO SCHOOL OF MINES

*source for all figures

Astropart. Phys. 149 (2023) 102819

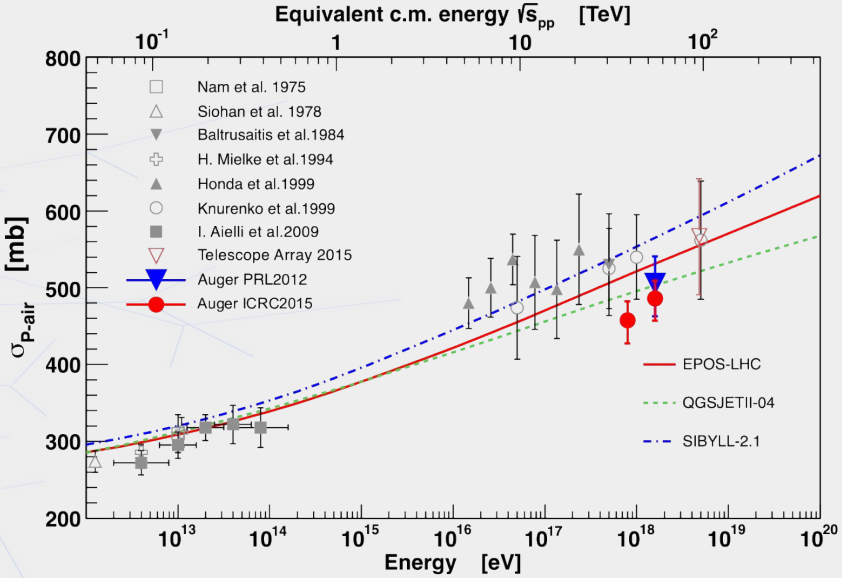
UHECR experiments contribute strongly to high energy physics.

Auger has made highest energy measurement of muon production in hadronic cascades



Significant tension found with the moun production expected from extrapolated LHC-based hadronic interaction models

UHECR experiments have provided the highest energy direct measurements of p-air cross section

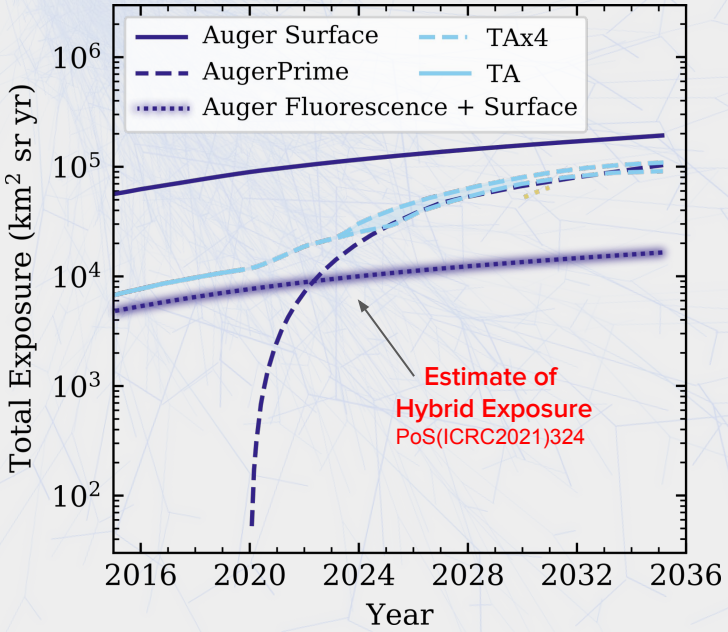


Updated cross sections coming in next year with 2x increase in statistics

➡ **Further improvements from upgrades**

10-years of data with upgrades will significantly improve measurements.

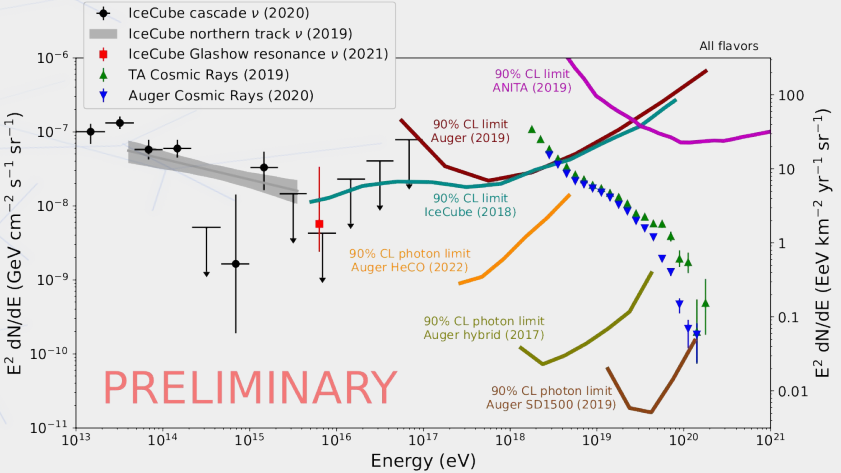
AugerPrime improves shower component sensitivity and will surpass hybrid statistics in next few years



- With 10-years of AugerPrime, statistics for μ-production and $\sigma_{p\text{-air}}$ measurements ~10x higher
- TA $\sigma_{p\text{-air}}$ measurement statistics ~5-10x higher

UHECR observatories are Multi-messenger observatories.

Auger has UHE neutrino exposure matching IceCube and currently world leading UHE photon exposure

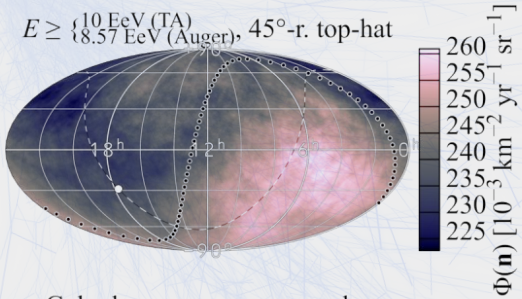


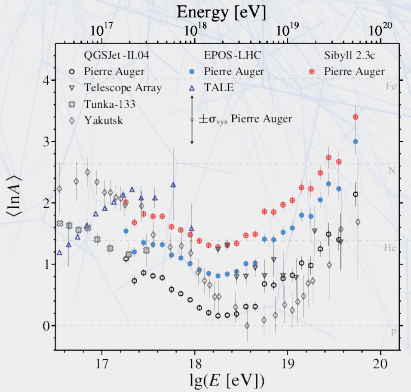
Exposures begin exceeding expected flux in many acceleration scenarios and sensitivities are improving

➡ First observations hoped for soon!

Preparing for the next generation

Upgrades will further understanding of UHECR Mass composition and anisotropies





Constraints on mass composition at highest energies critical to design of next generation

- **R&D activities for GCOS, GRAND and POEMMA already planned or underway at Auger/TA**
- **Simultaneous Auger/TA data-taking highly desired for GRAND, GCOS, POEMMA and IceCube-Gen2**
  ➡ Next-Gen data-taking not until 2030s

Experiment	Timeline
Pierre Auger Observatory	AugerPrime upgrade
Telescope Array (TA)	TAx4 upgrade
IceCube / IceCube-Gen2	Upgrade + surface enhancement → IceCube-Gen2 deployment → IceCube-Gen2 operation
GRAND	GRANDProto 300 → GRAND 10k → GRAND 200k multiple sites, step by step
POEMMA	EUSO program → POEMMA
GCOS	GCOS R&D + first site → GCOS further sites

2025 2030 2035 2040