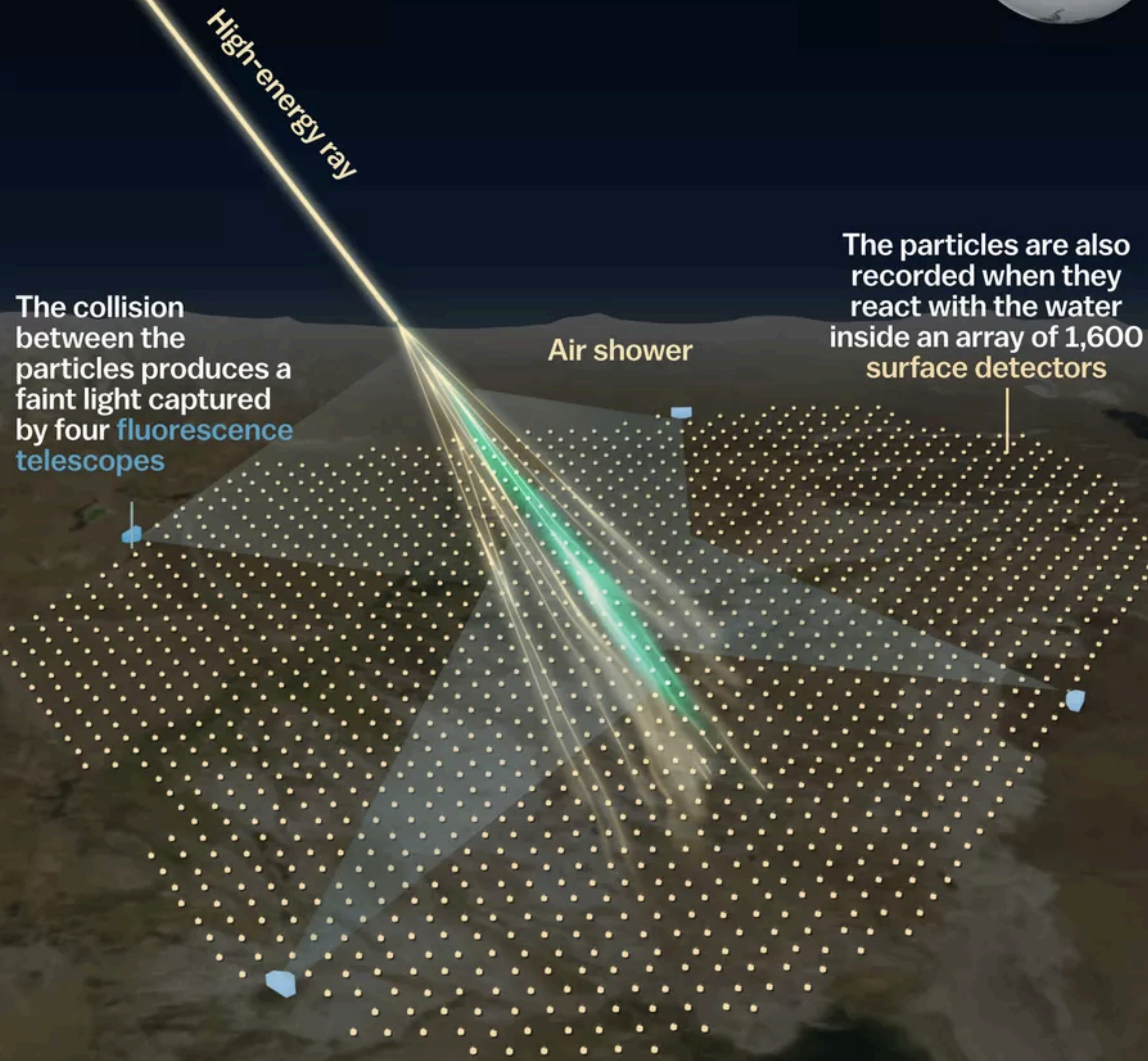


# Pierre Auger Observatory

The observatory is a detector of high-energy cosmic rays that uses two different techniques



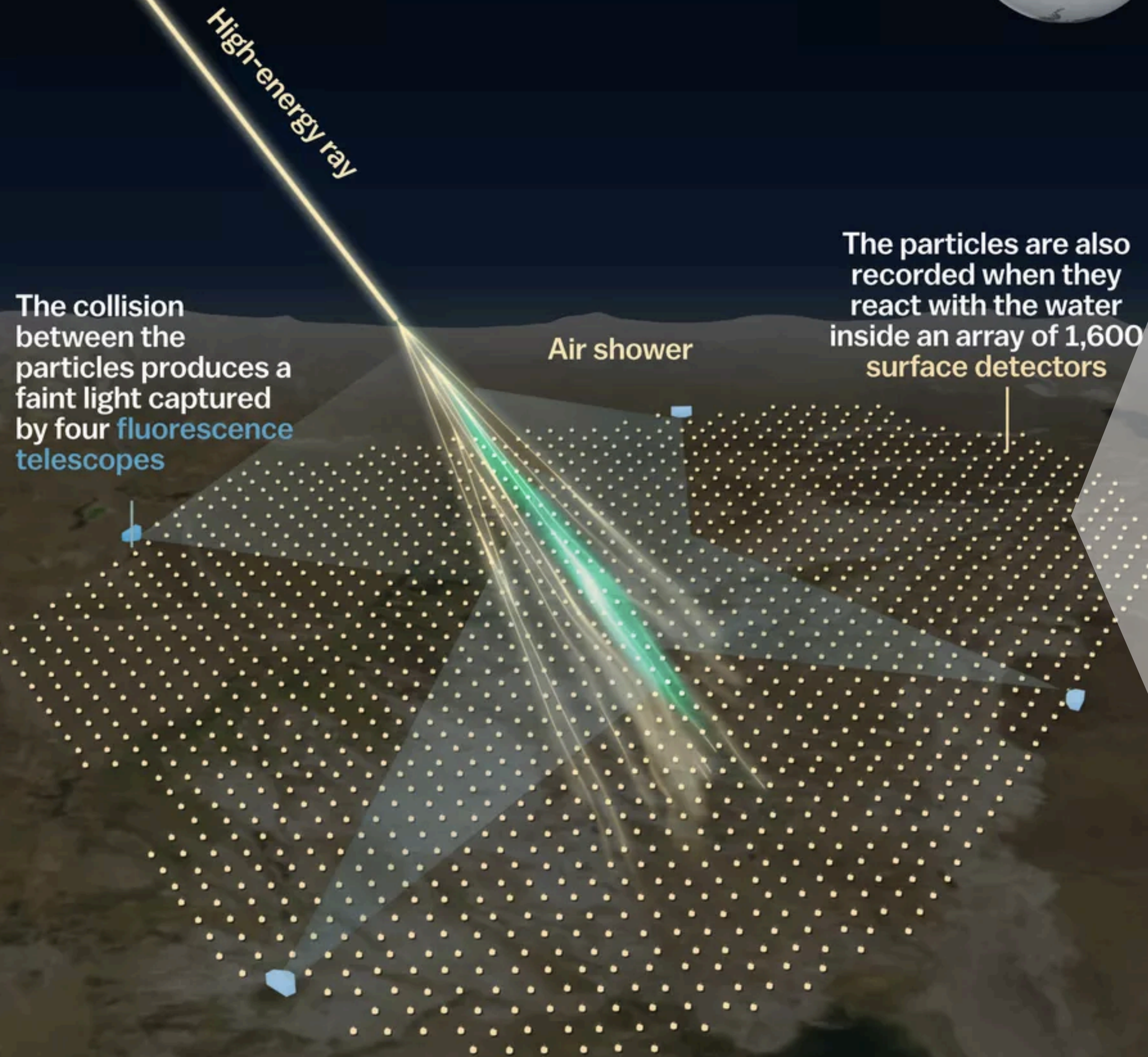
Source: Pierre Auger Observatory

Vex



# Pierre Auger Observatory

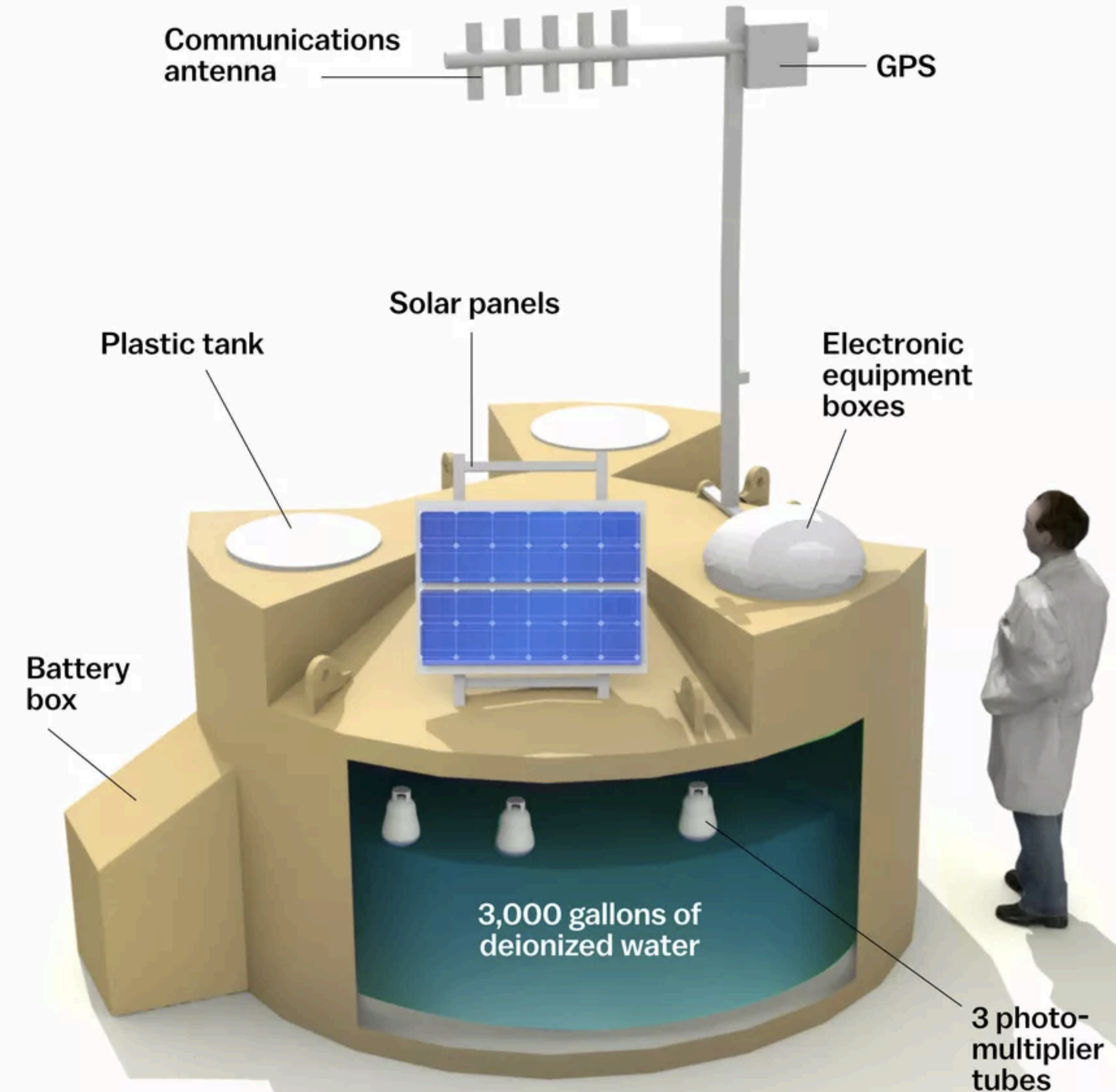
The observatory is a detector of high-energy cosmic rays that uses two different techniques



Source: Pierre Auger Observatory

Vex

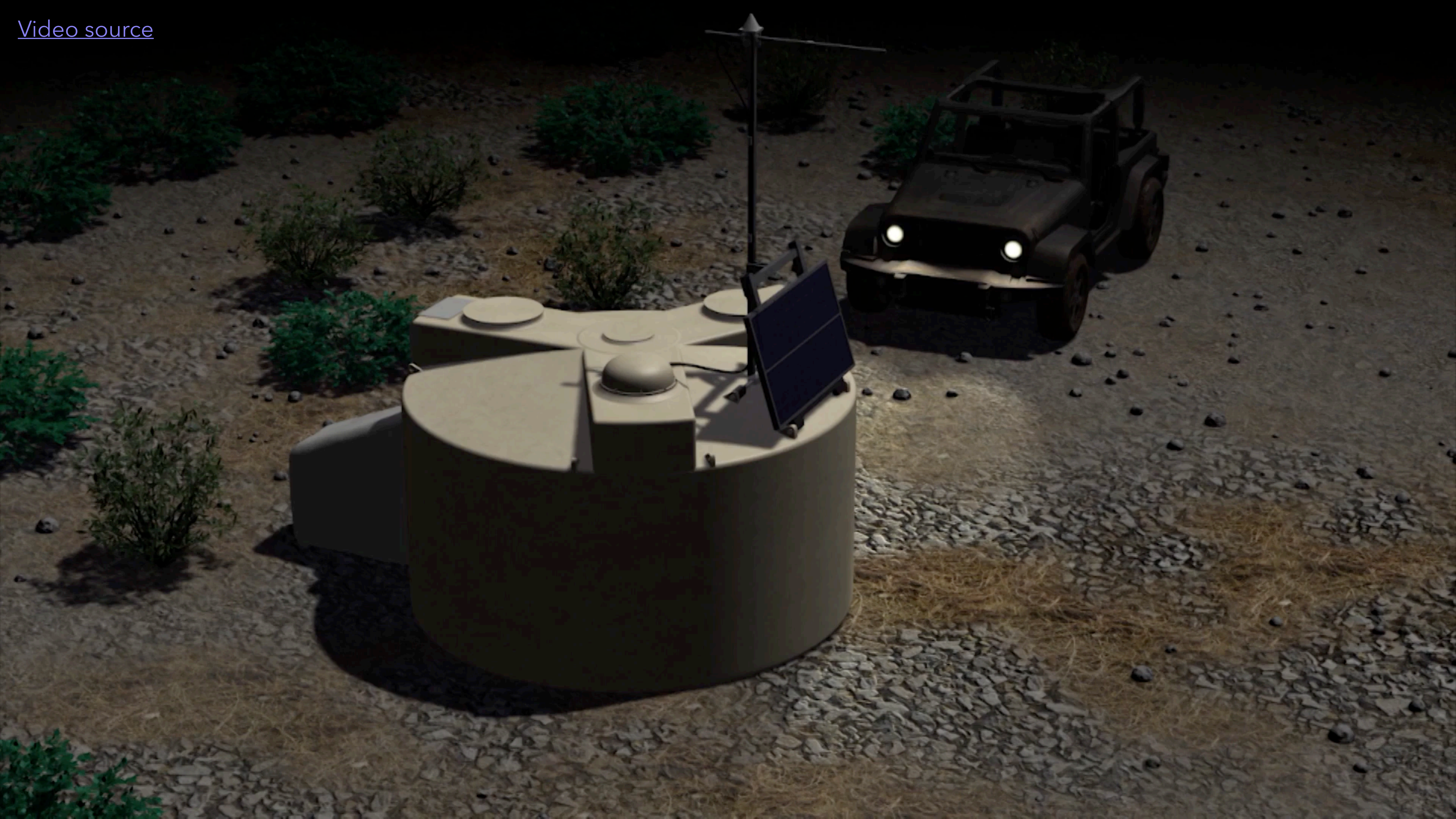
# Auger Observatory surface detector



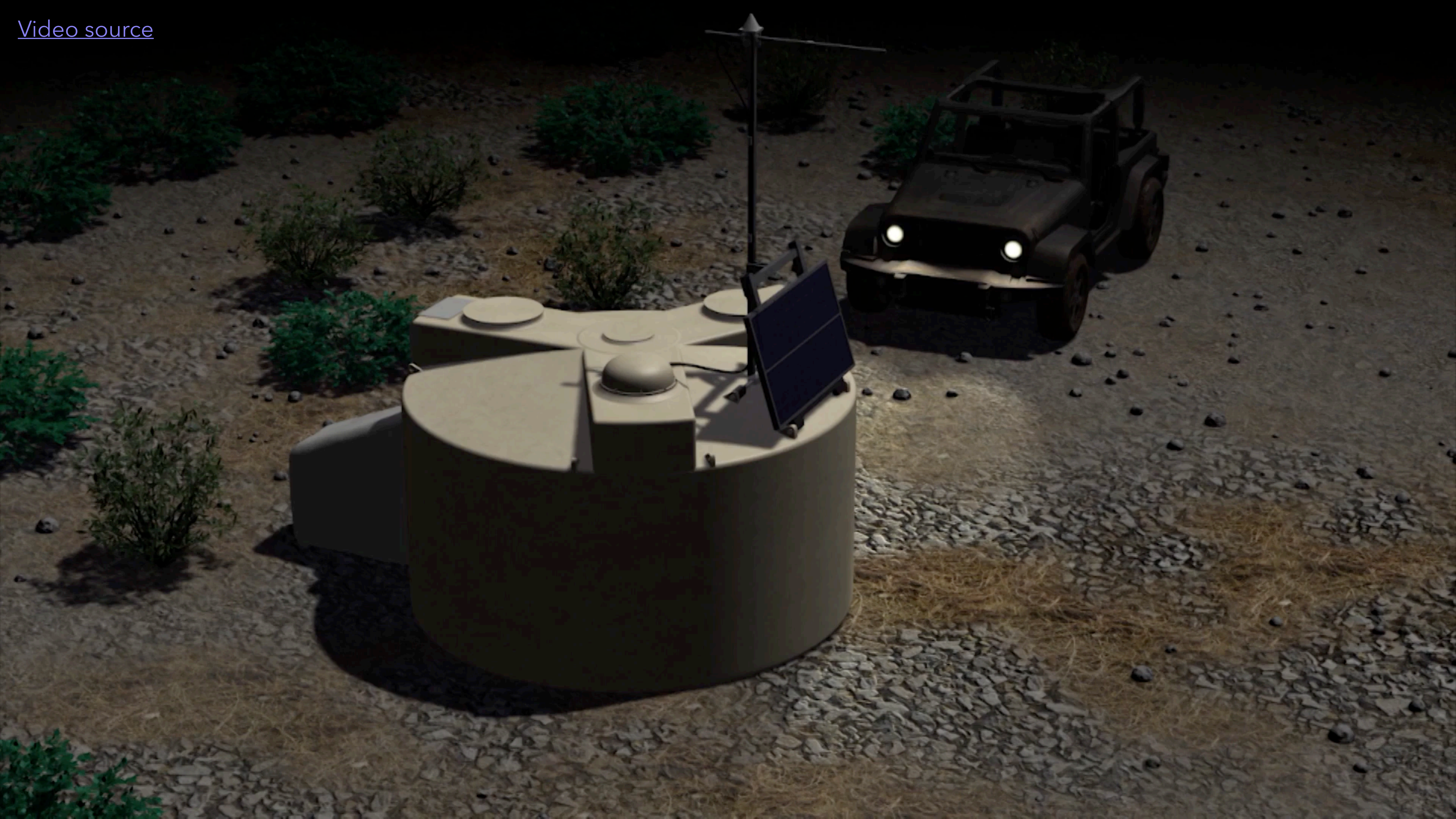
Source: Pierre Auger Observatory

Vex

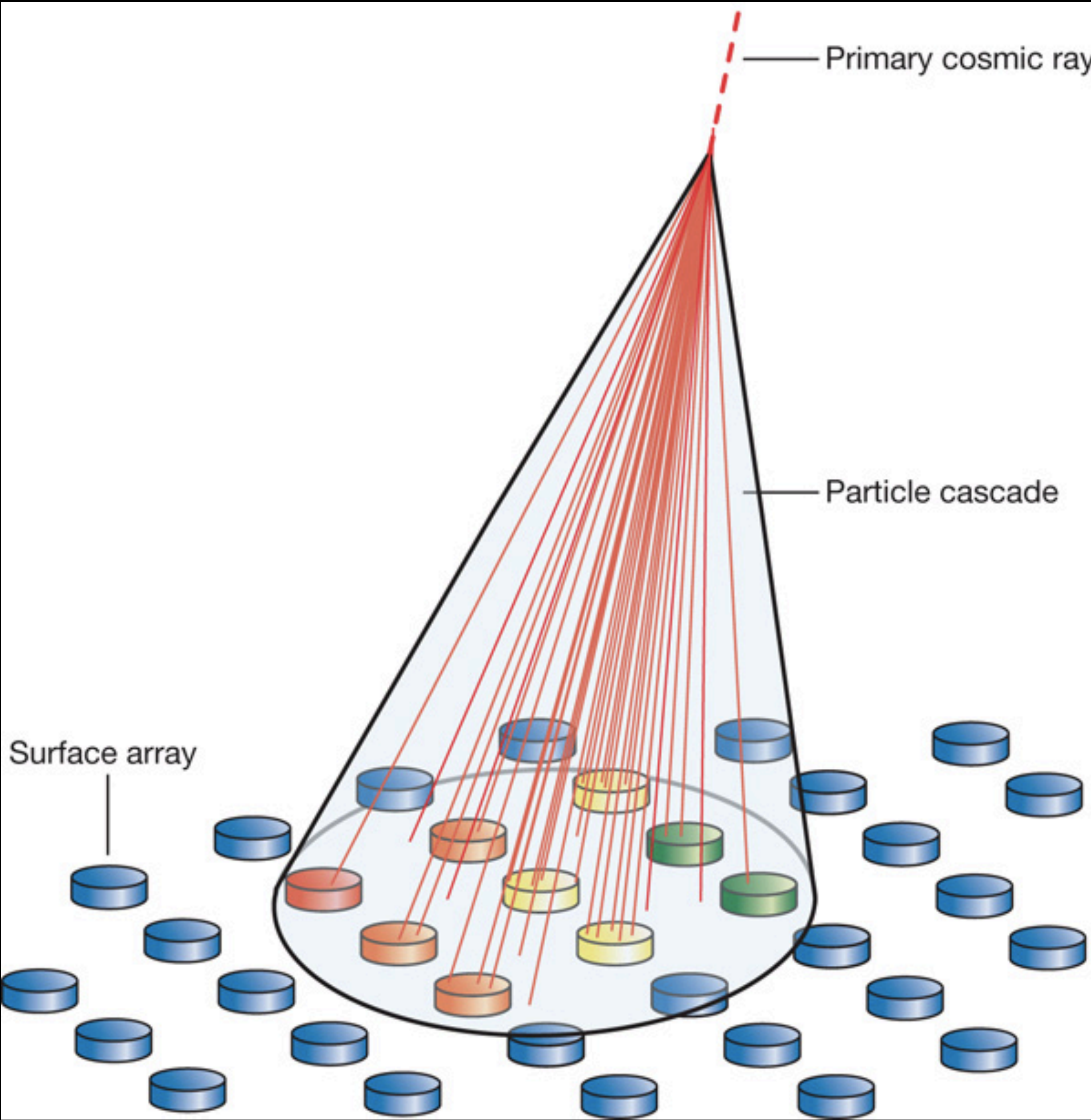
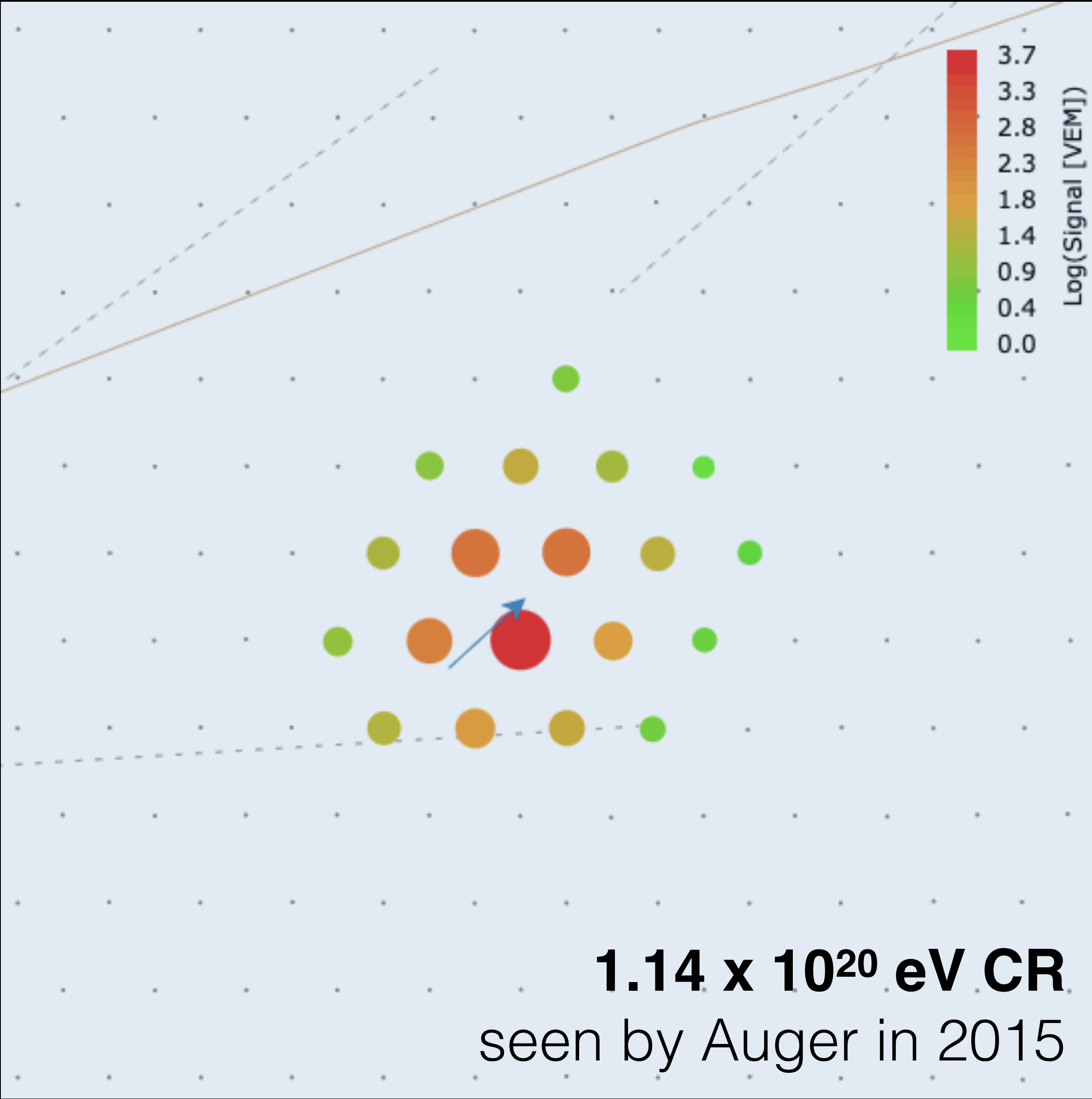




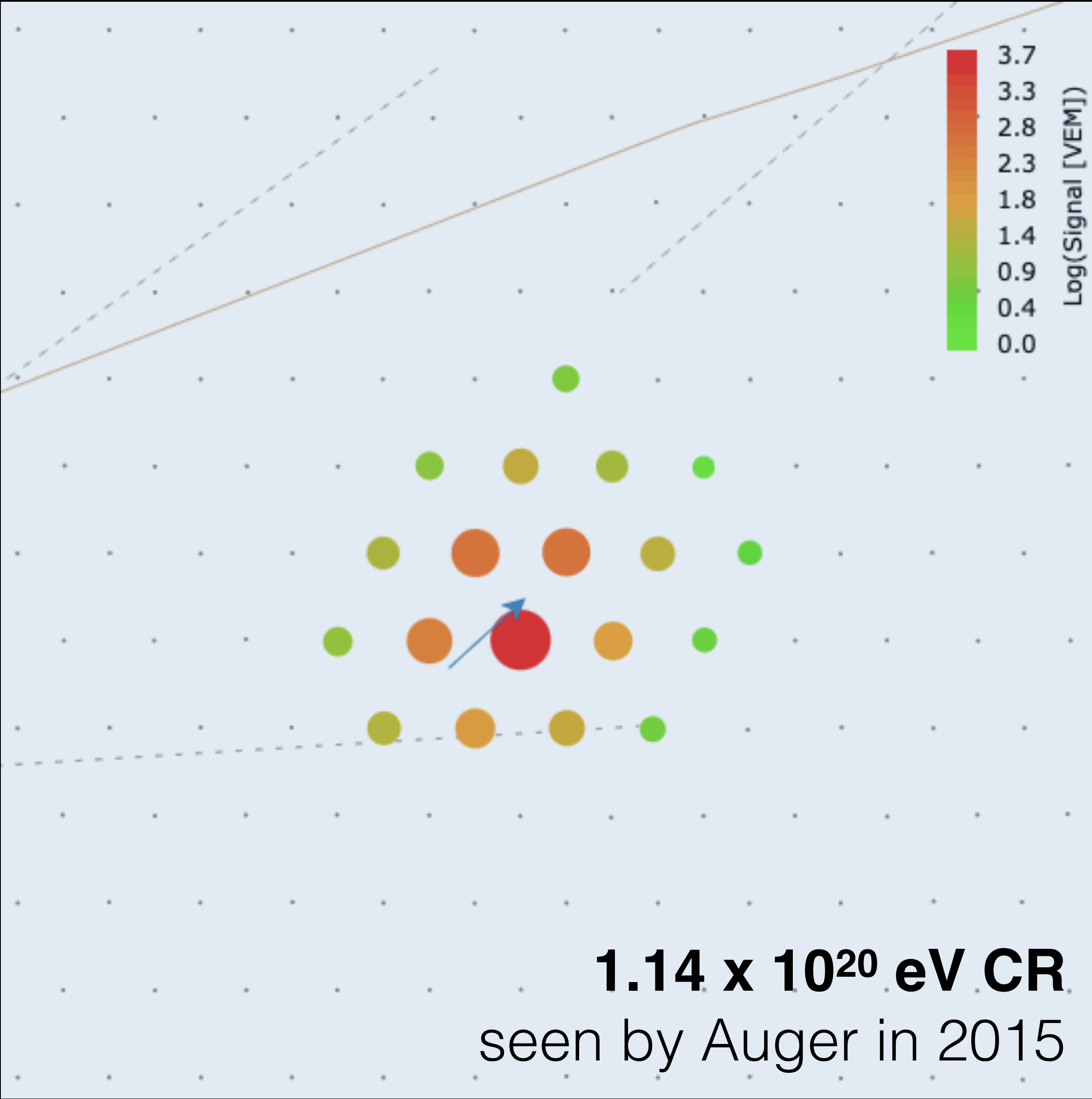














# Fluorescence detectors



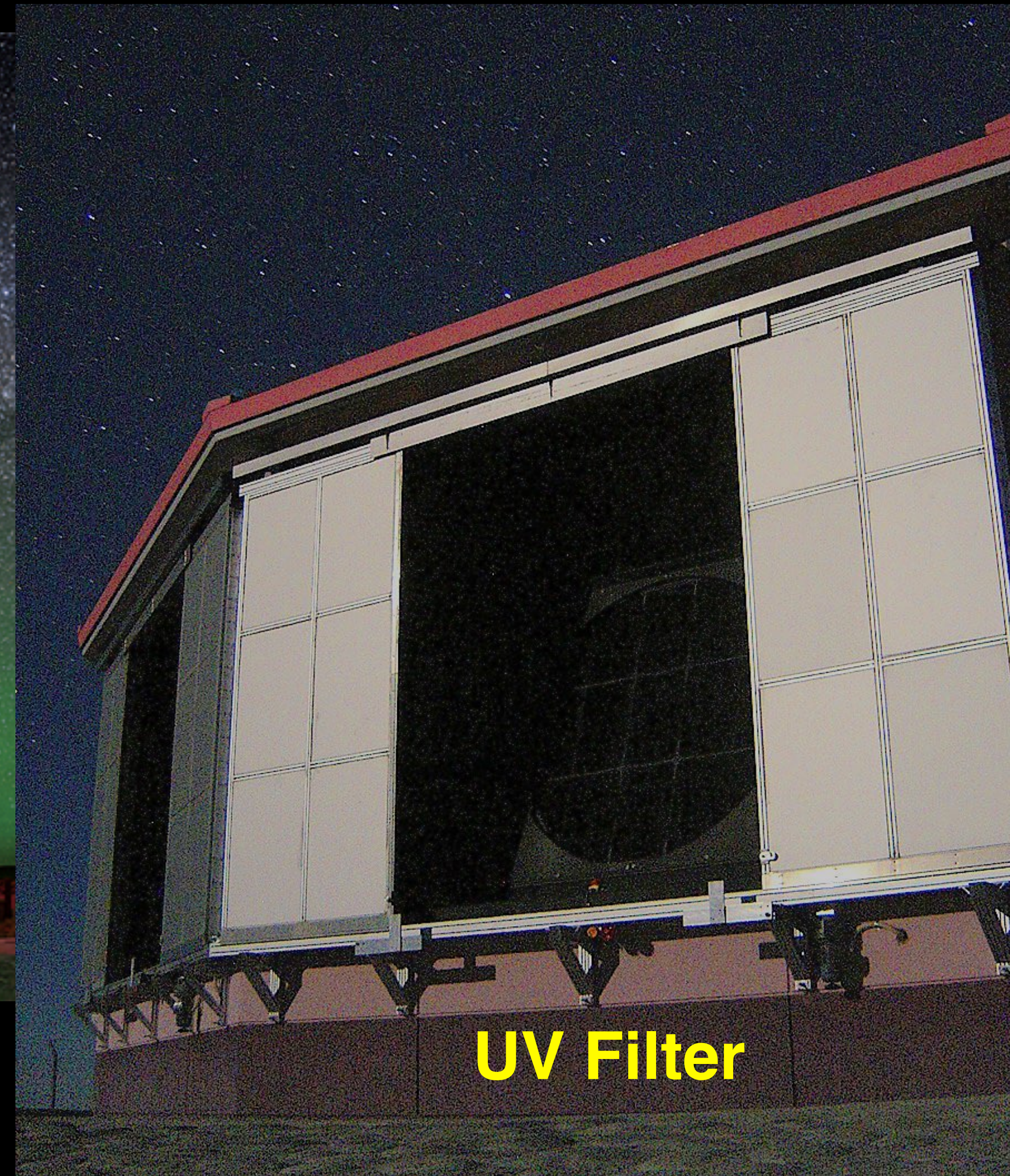


# Fluorescence detectors



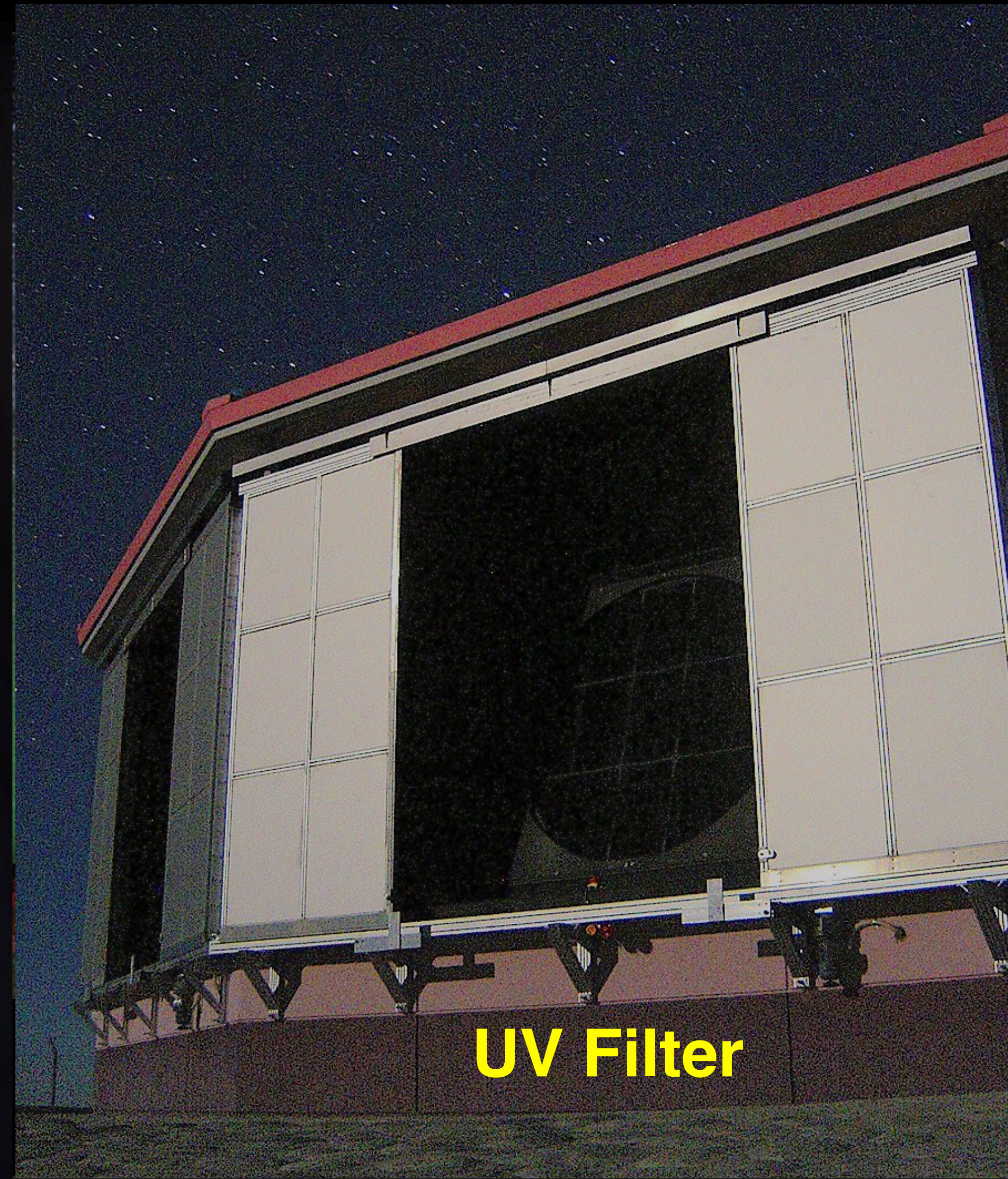
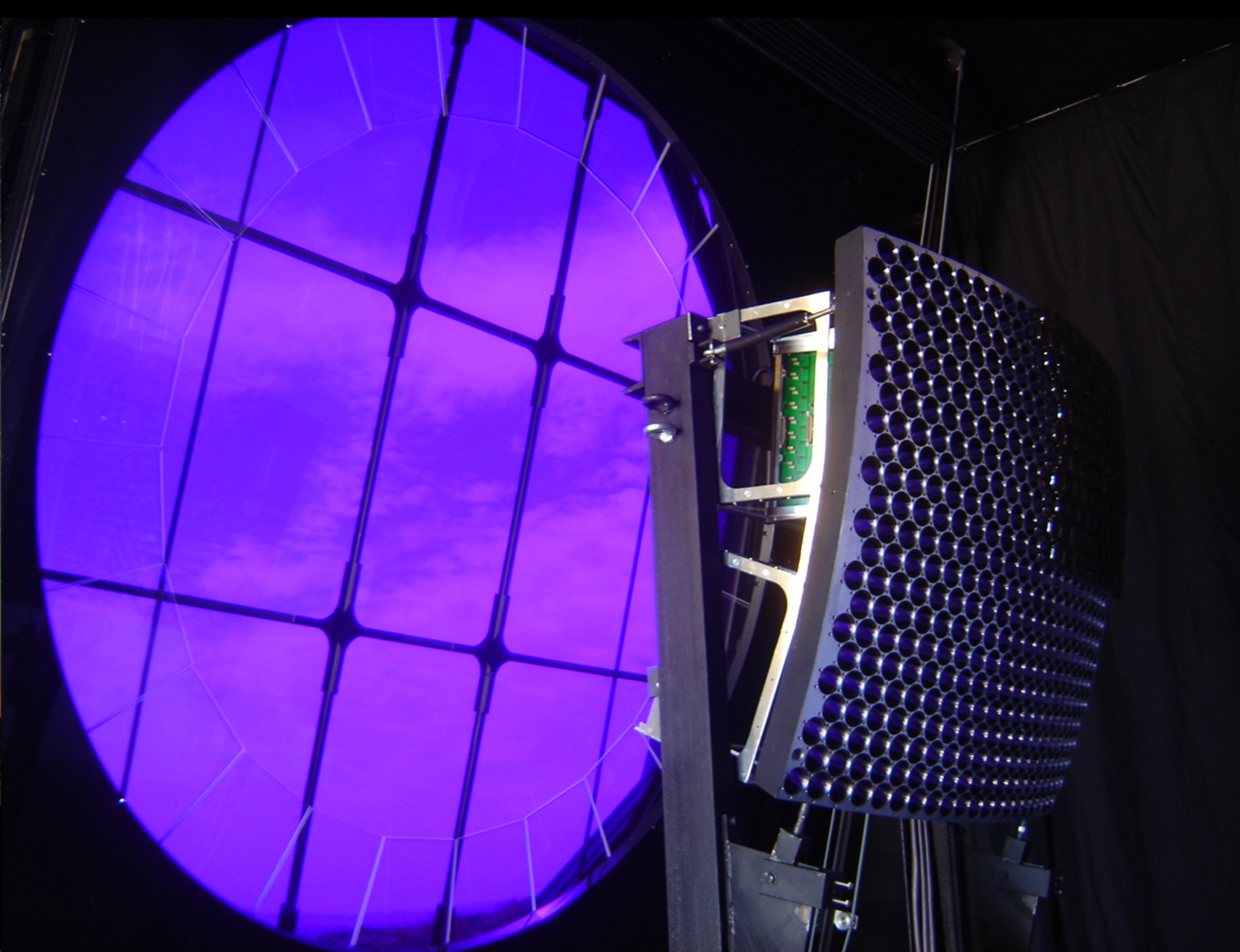


# Fluorescence detectors



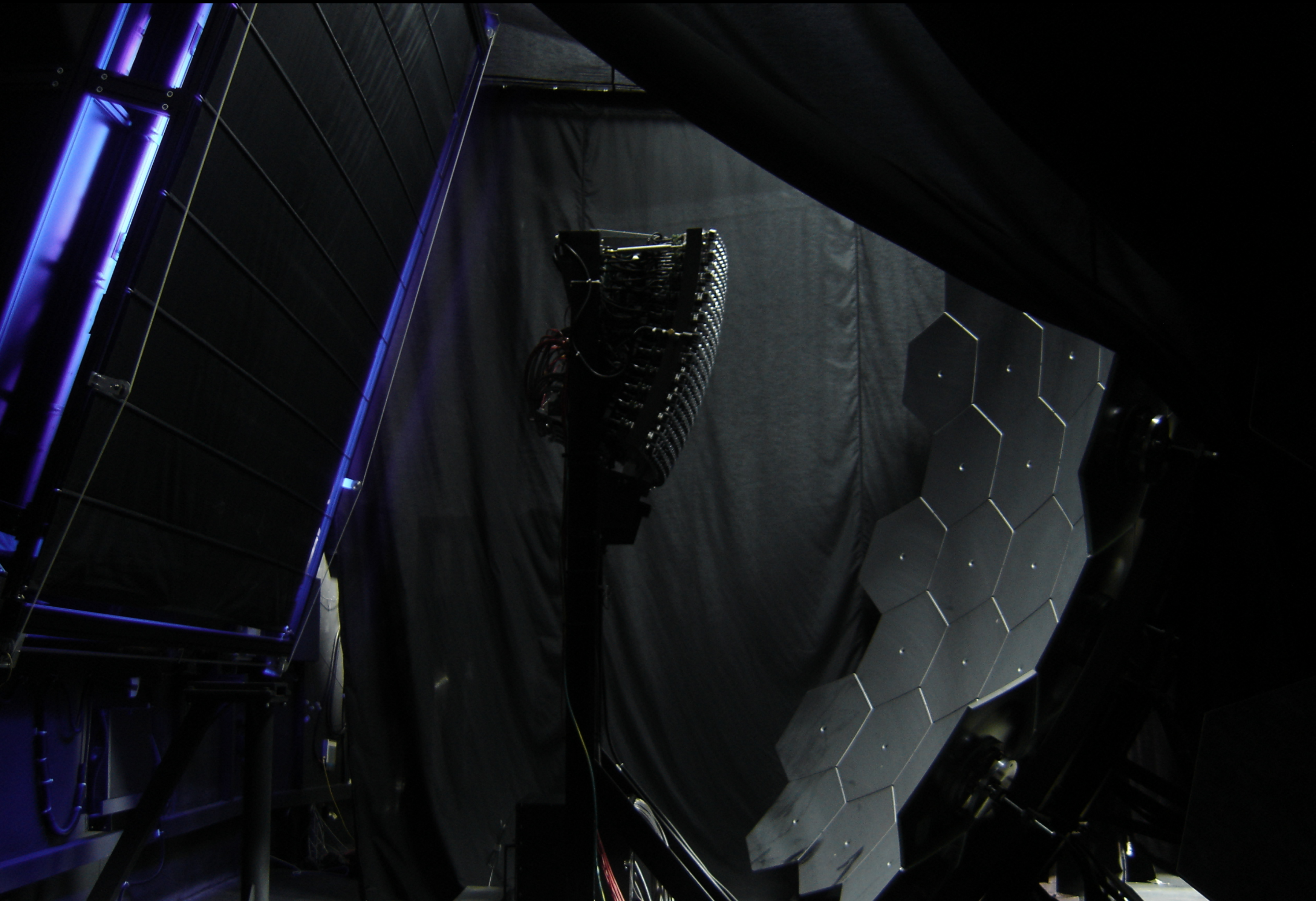


# Fluorescence detectors





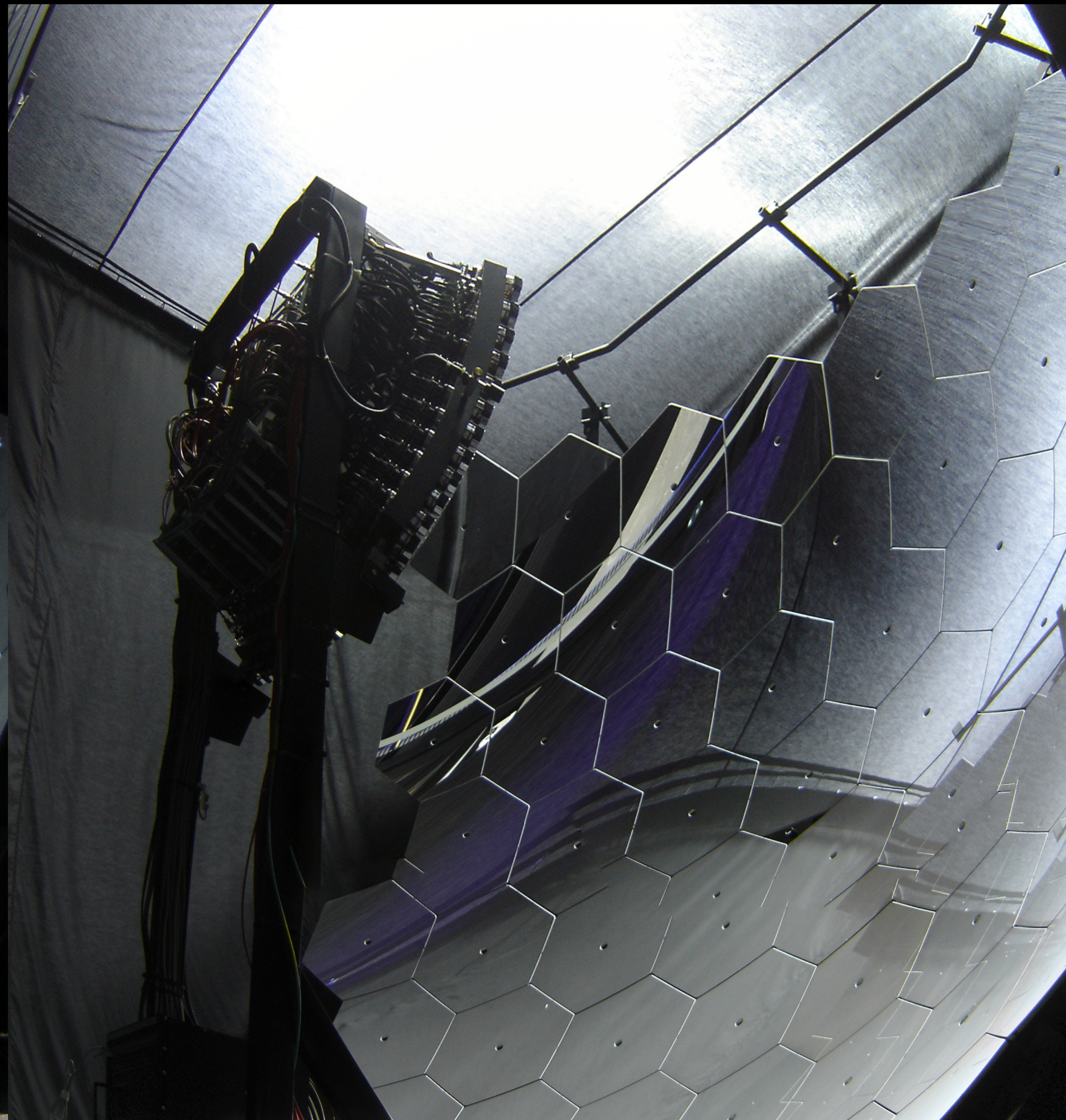
# Fluorescence detectors



**UV Filter**



# Fluorescence detectors











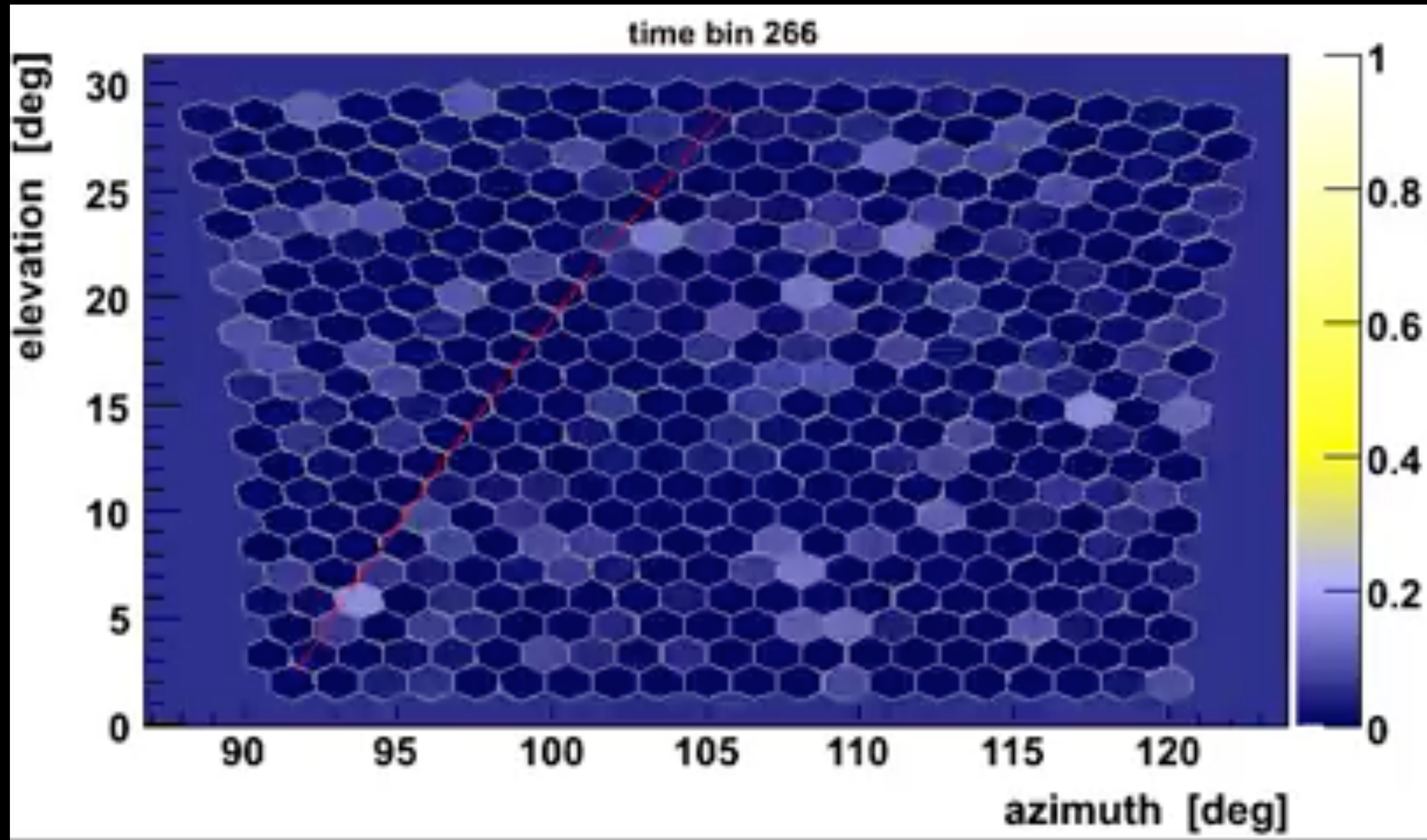








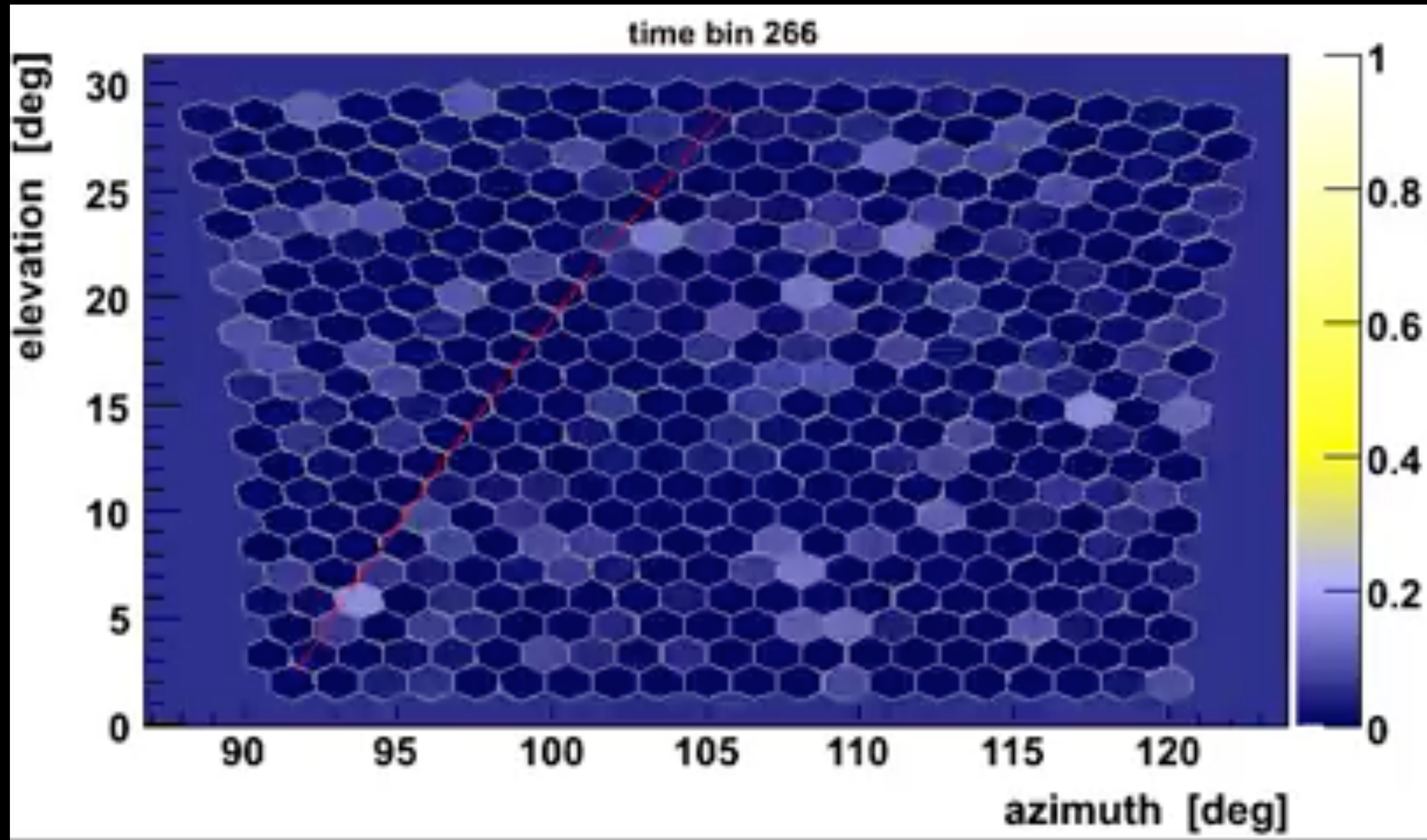




- Each frame in this image is 25 ns long

[Video source](#)





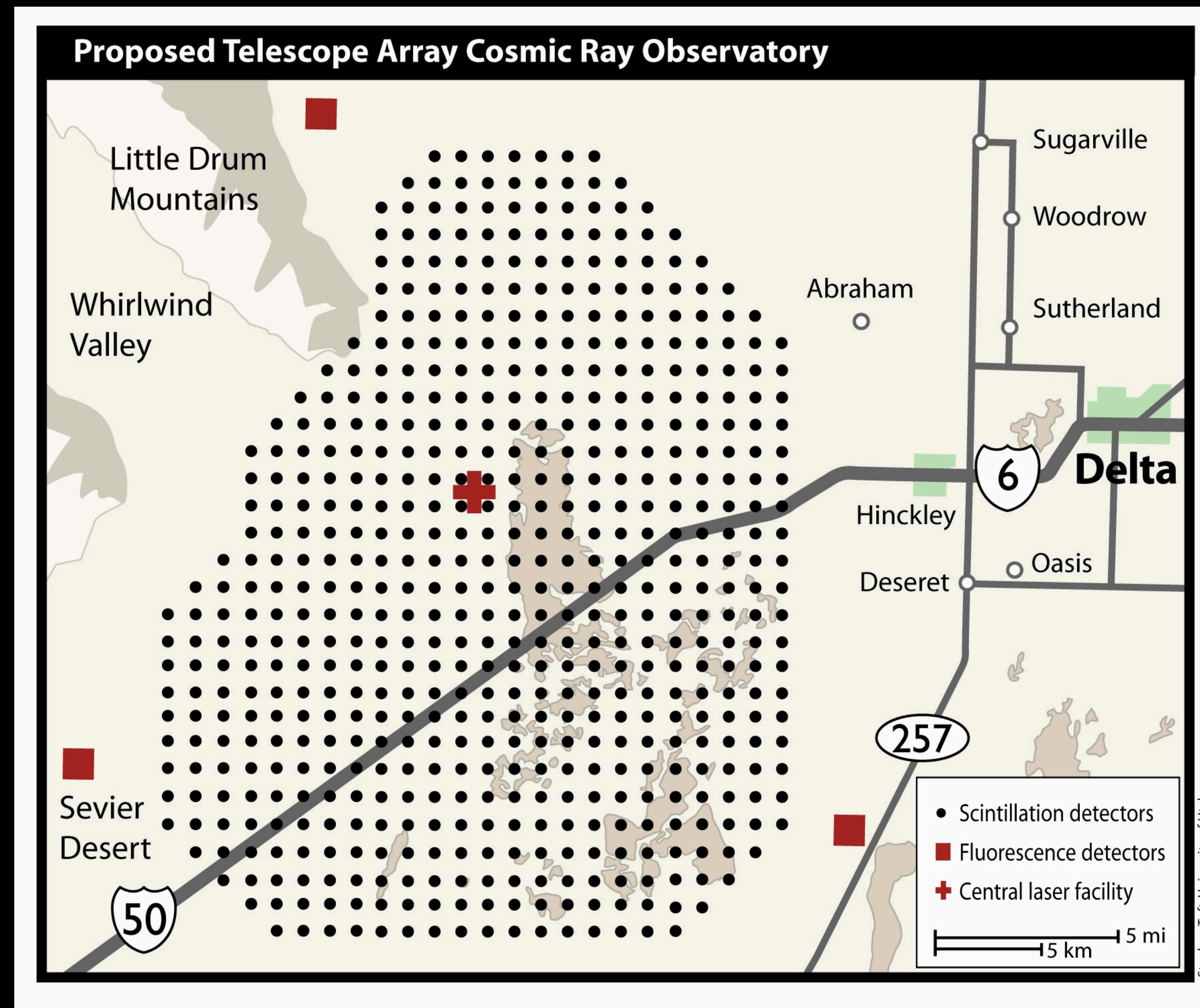
- Each frame in this image is 25 ns long

[Video source](#)



# Telescope Array in Utah (800 km<sup>2</sup>)

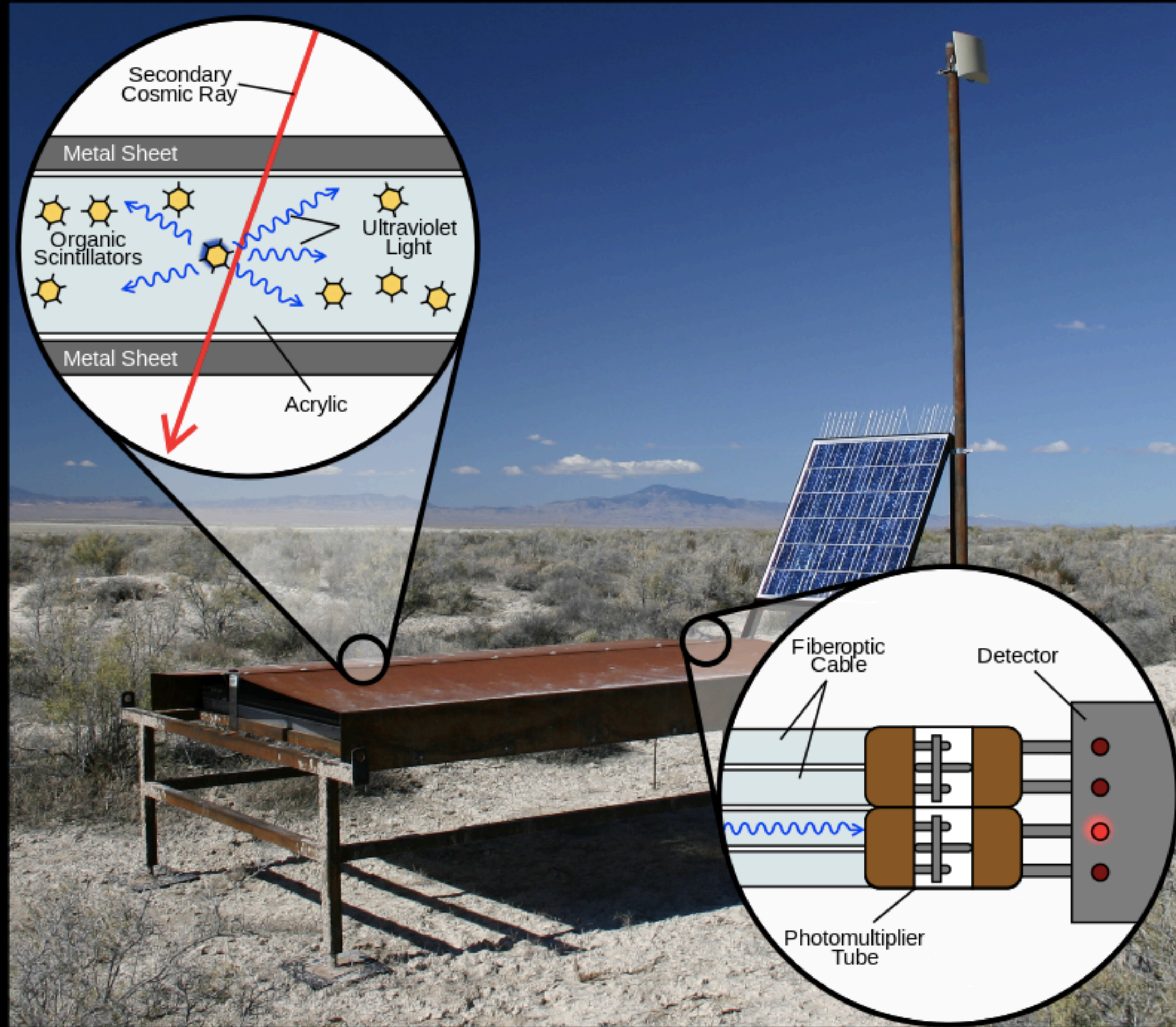
<http://telescopearray.org/>





# Telescope Array in Utah (800 km<sup>2</sup>)

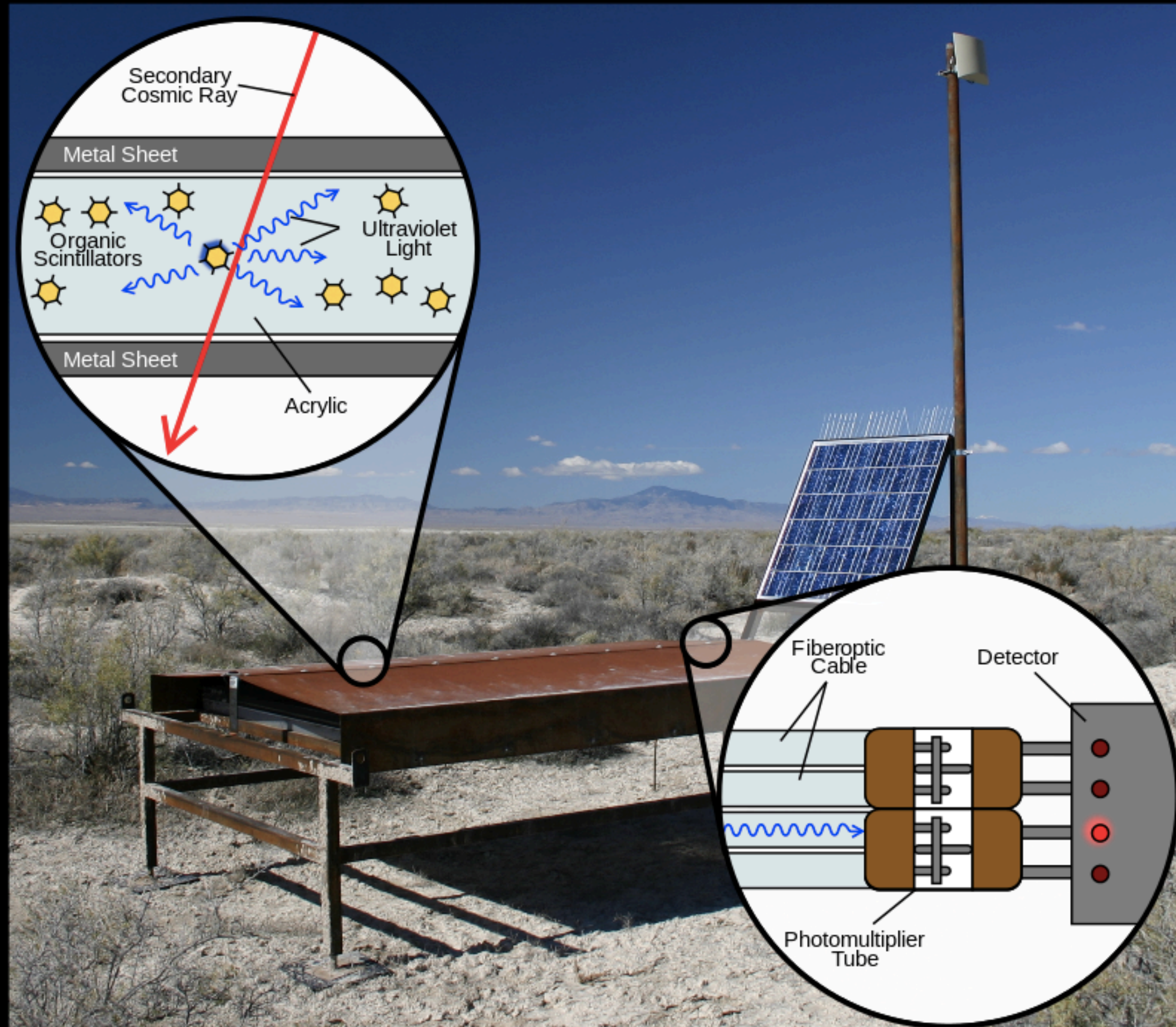
<http://telescopearray.org/>





# Telescope Array in Utah (800 km<sup>2</sup>)

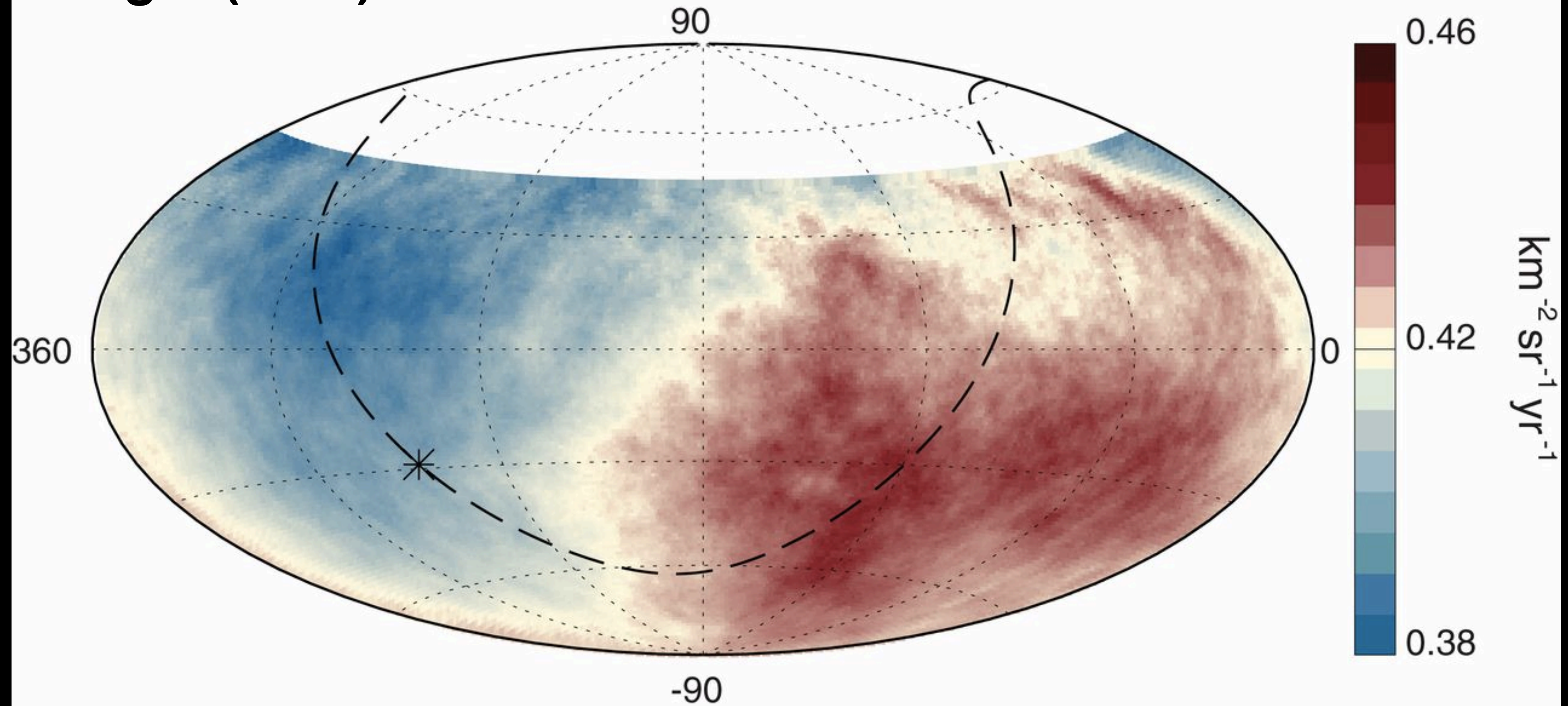
<http://telescopearray.org/>





# Recent highlights in UHECRs - Anisotropy

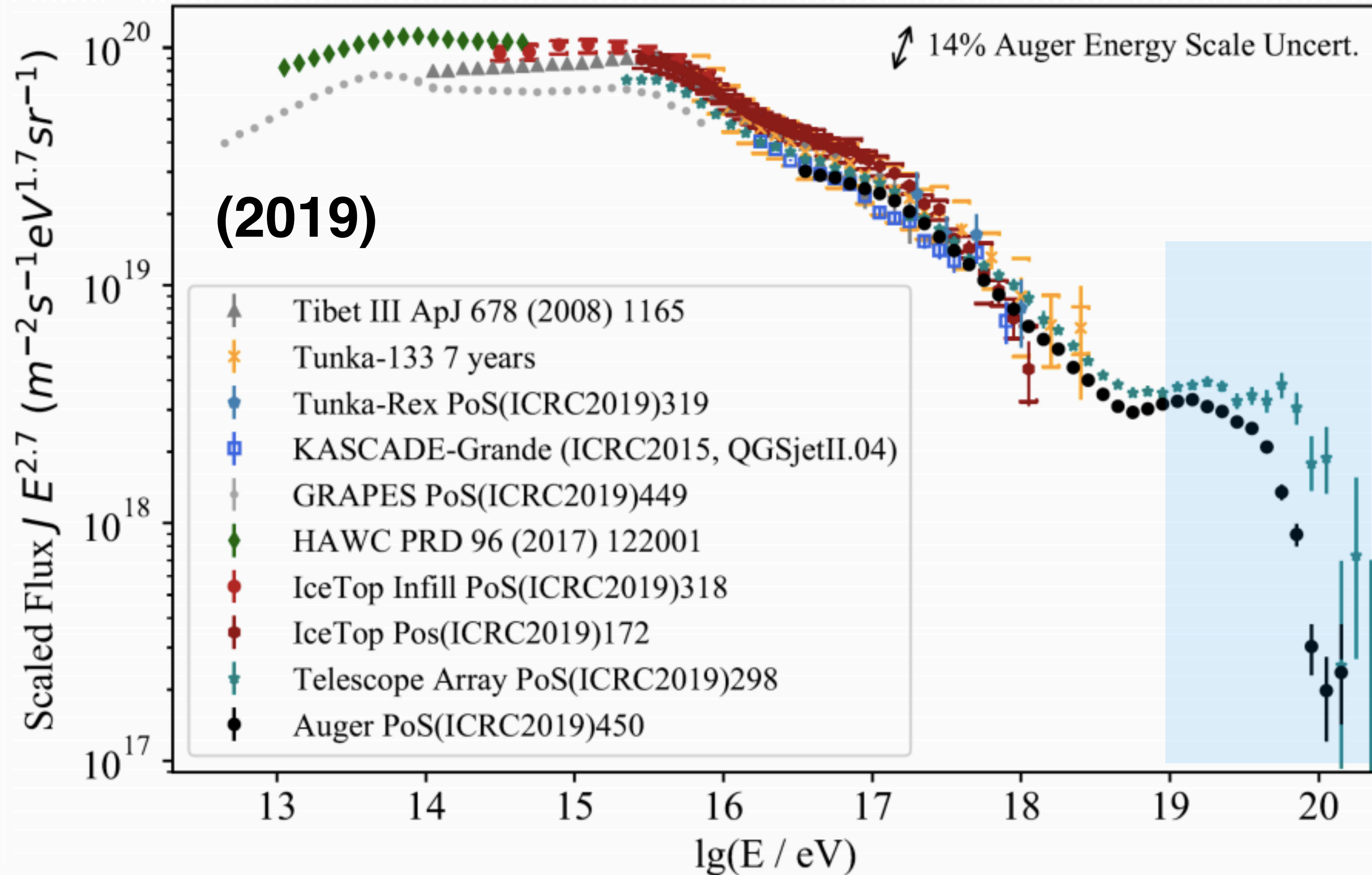
**Auger (2017)**



Discovery of anisotropy above  $\sim 10^{19}$  eV

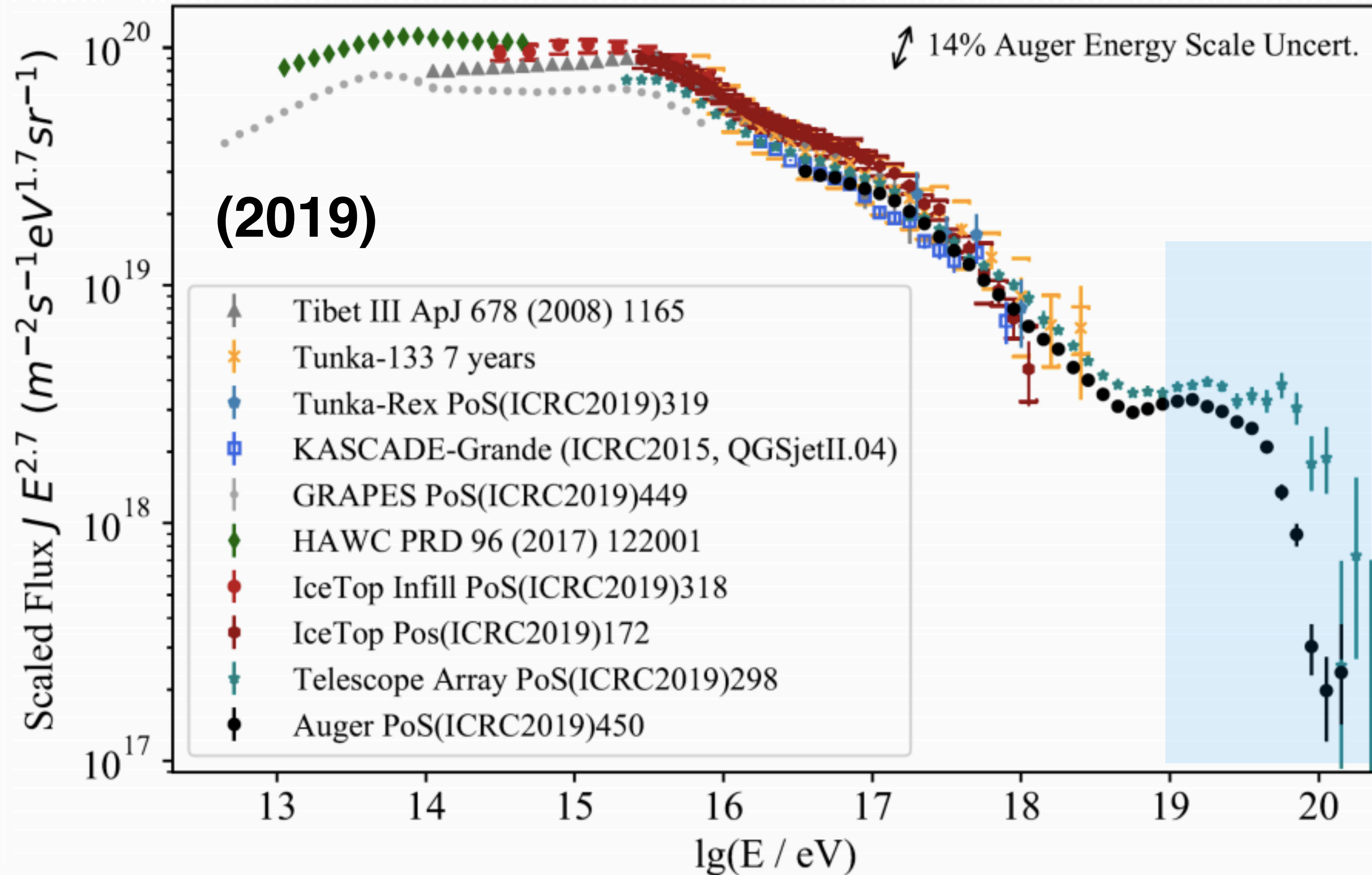


# Recent highlights in UHECRs - Spectrum





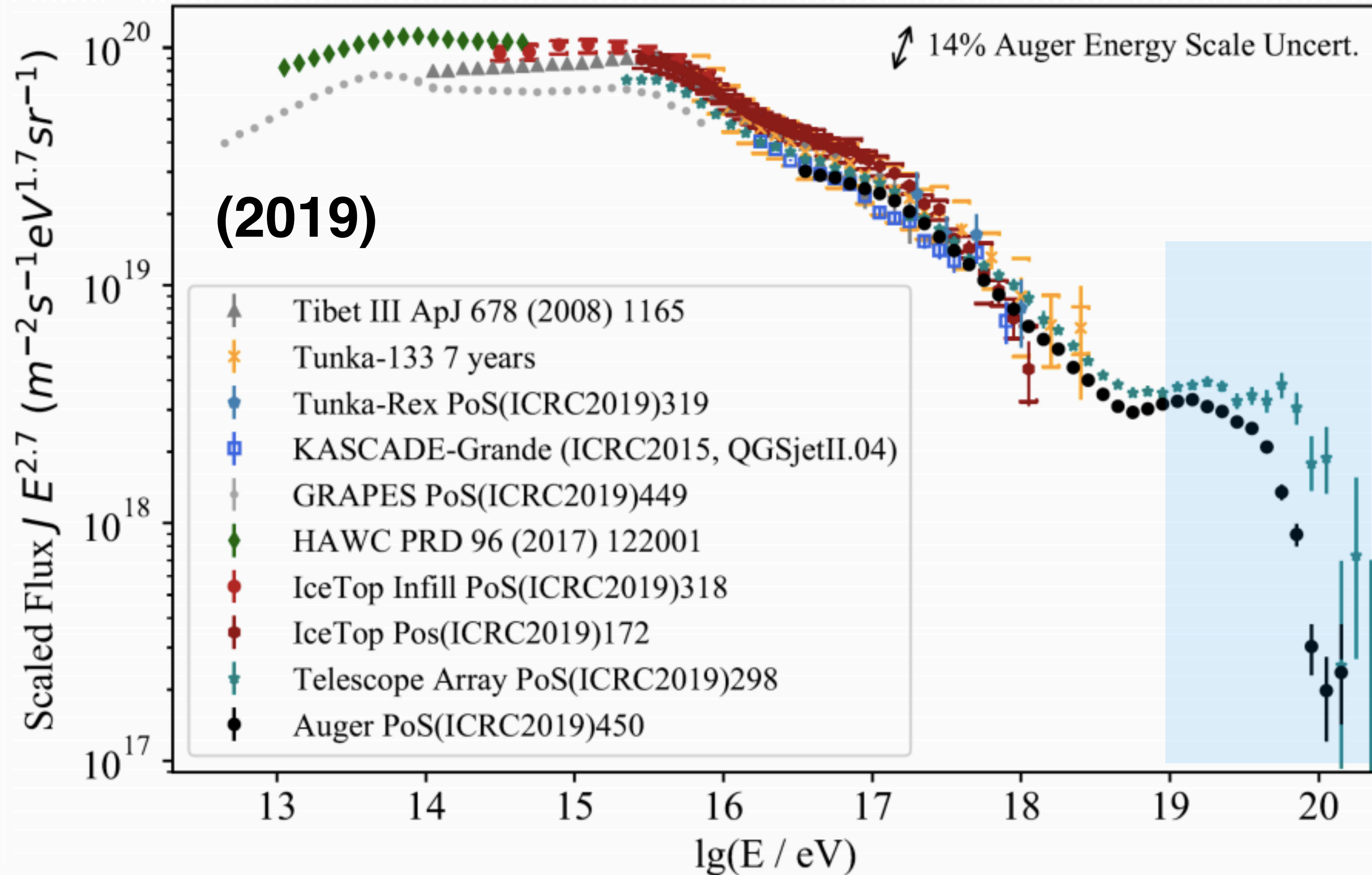
# Recent highlights in UHECRs - Spectrum



- Strong cutoff at highest energies.



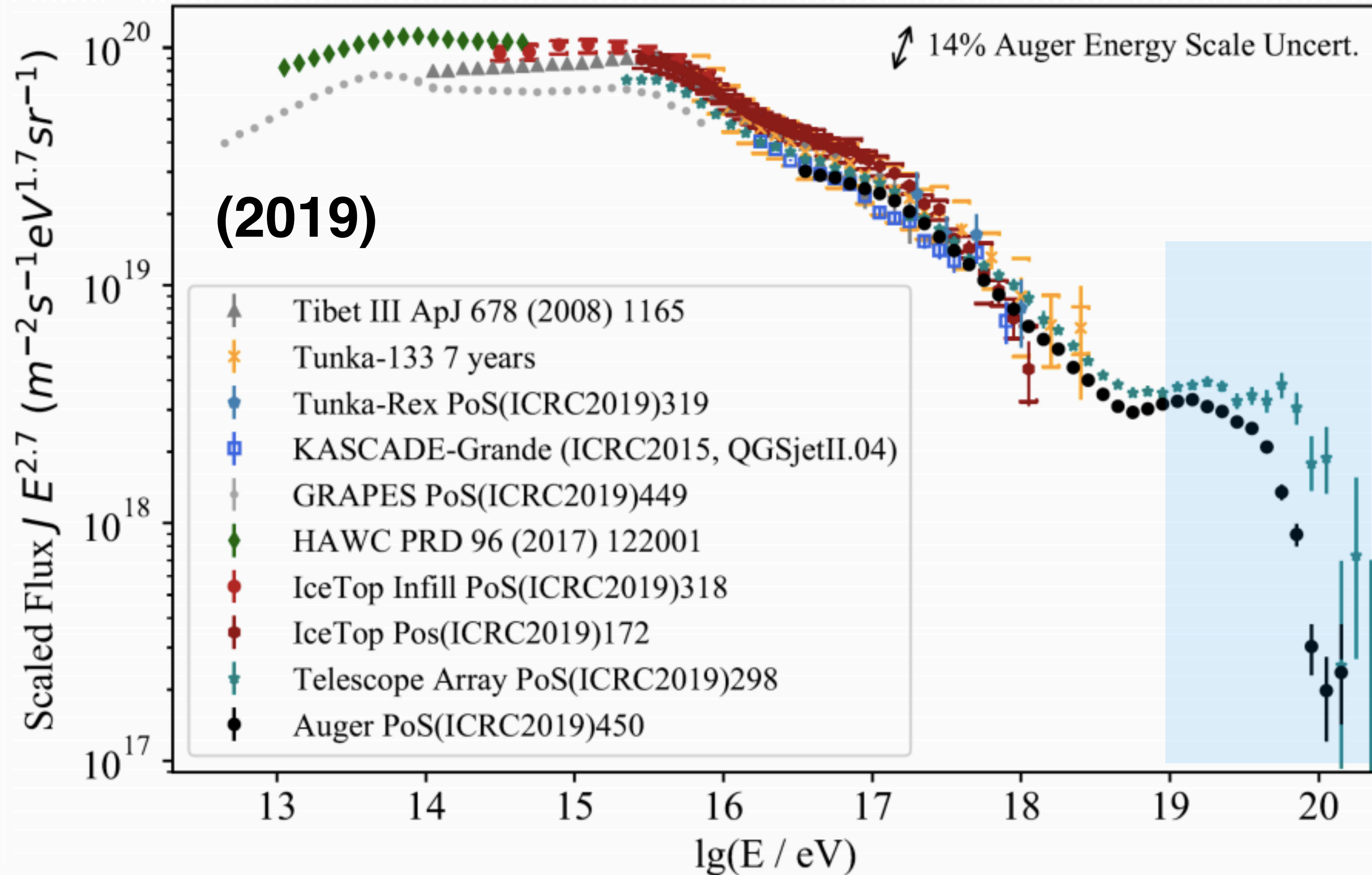
# Recent highlights in UHECRs - Spectrum



- Strong cutoff at highest energies.
- Absorption of cosmic rays in cosmic microwave background? (**GZK effect** limits UHECR horizon to 50 Mpc)



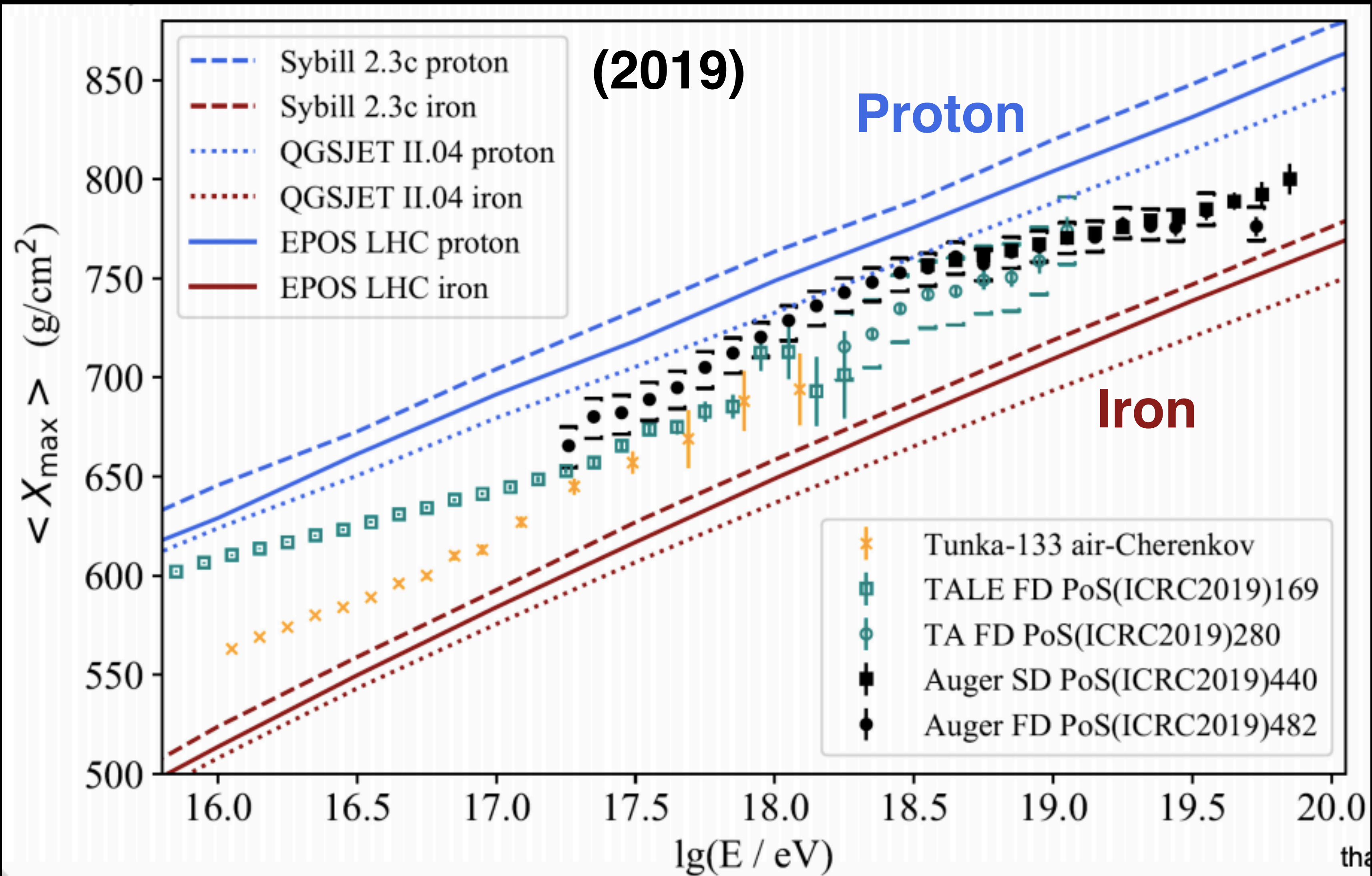
# Recent highlights in UHECRs - Spectrum



- Strong cutoff at highest energies.
- Absorption of cosmic rays in cosmic microwave background? (**GZK effect** limits UHECR horizon to 50 Mpc)
- Sources running out of steam?

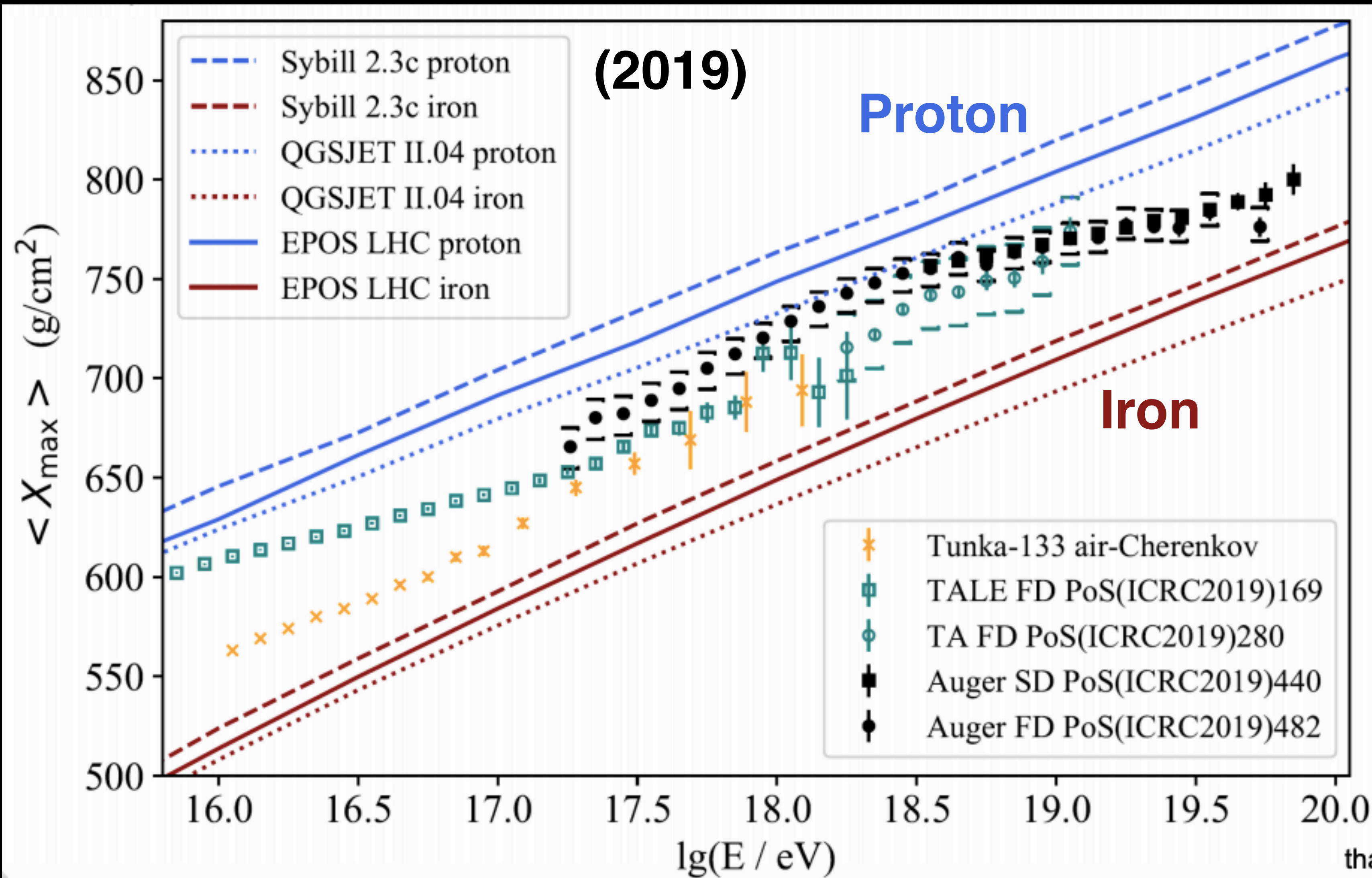


# Recent highlights in UHECRs - Composition





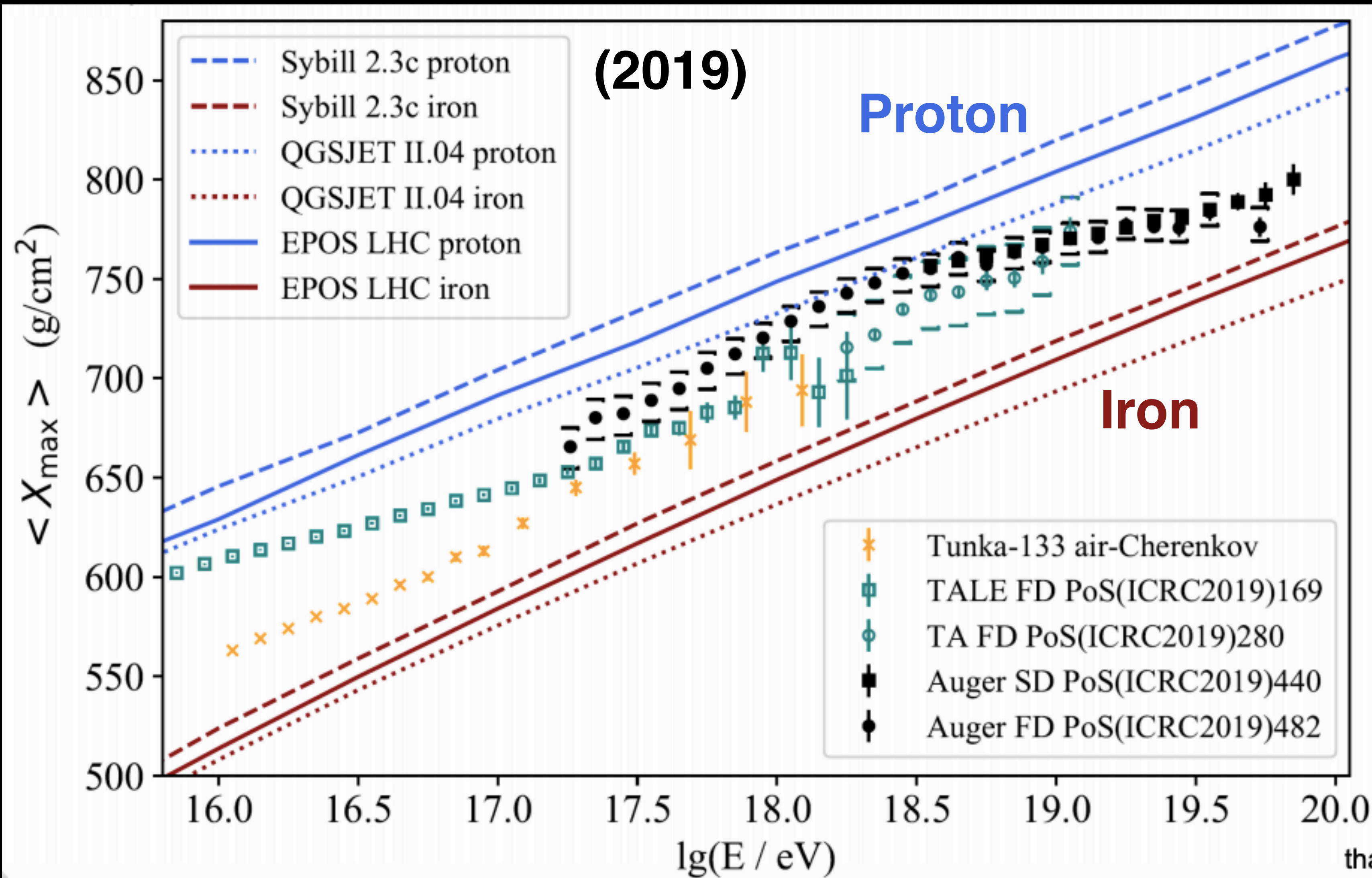
# Recent highlights in UHECRs - Composition



- Auger data favors a change in composition at highest energies (gets closer to iron)



# Recent highlights in UHECRs - Composition



- Auger data favors a change in composition at highest energies (gets closer to iron)
- Much debated at the moment.



**Many questions remain in UHECR science**

**What are the sources? What is the composition? What happens at the highest energies?**

**#6**



# A bit about me

- Undergrad in electromechanical engineering (UTN, Argentina)
- PhD in Physics from UW-Madison (2009-2013)
- Postdoc at Barnard College, Columbia U (2014-2017)
- Assistant professor at UAlabama (2017-now)
- Married, two daughters (9 and 14).

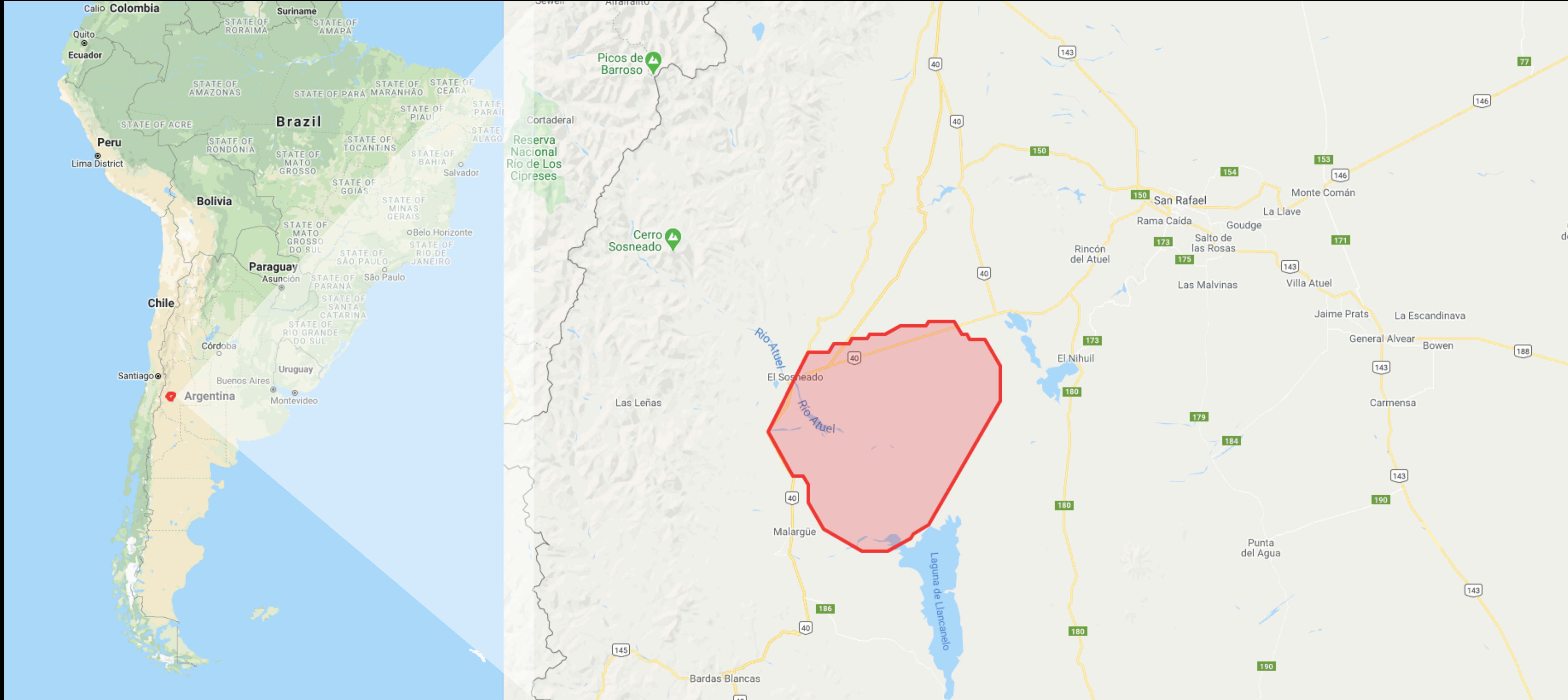


# A bit about my path



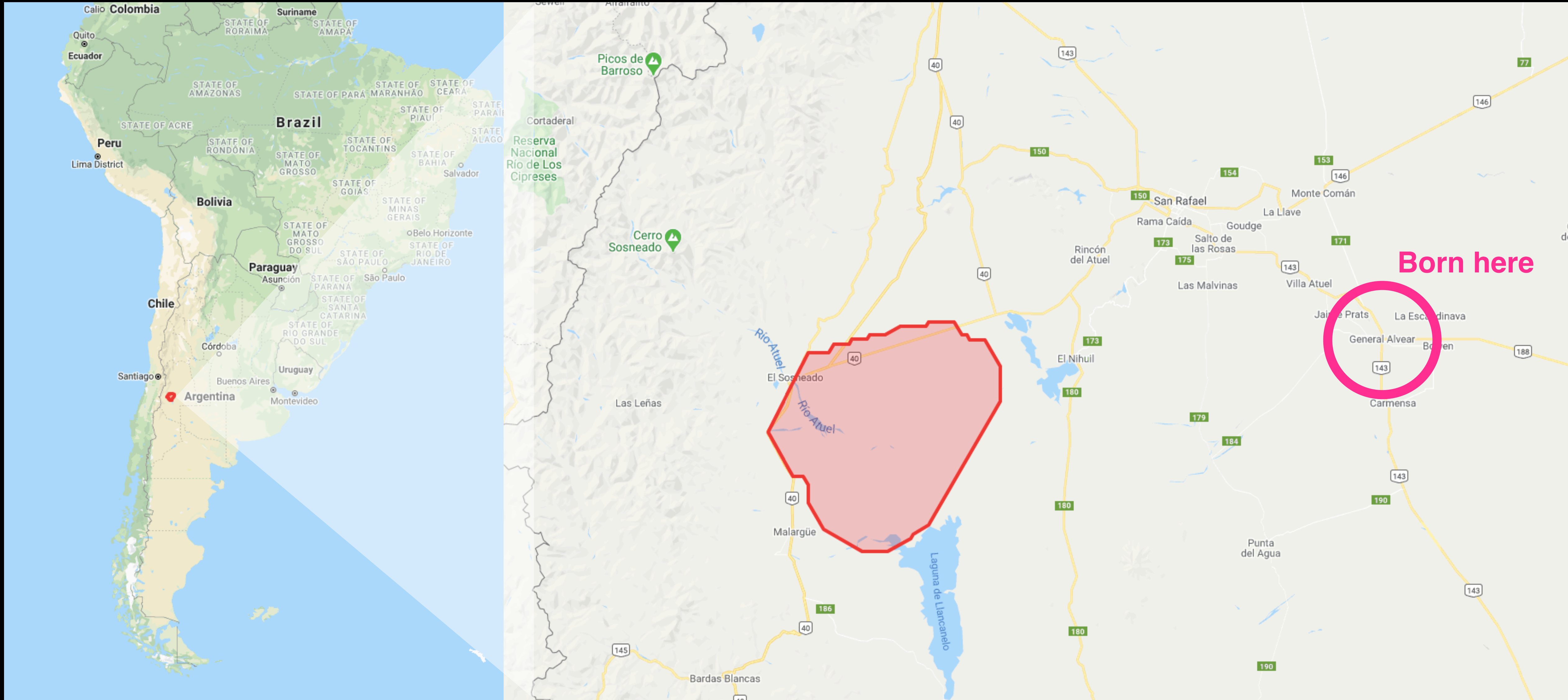


# A bit about my path





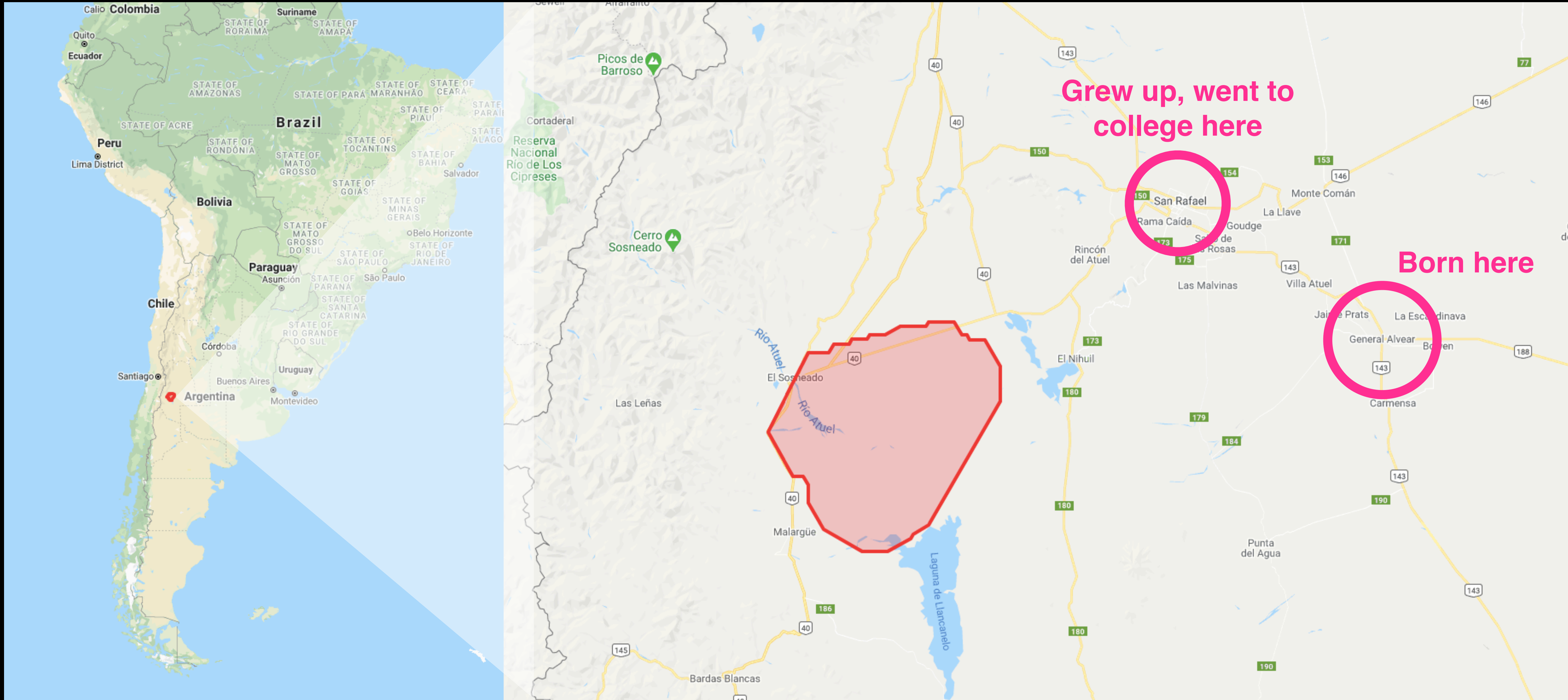
# A bit about my path



Born here

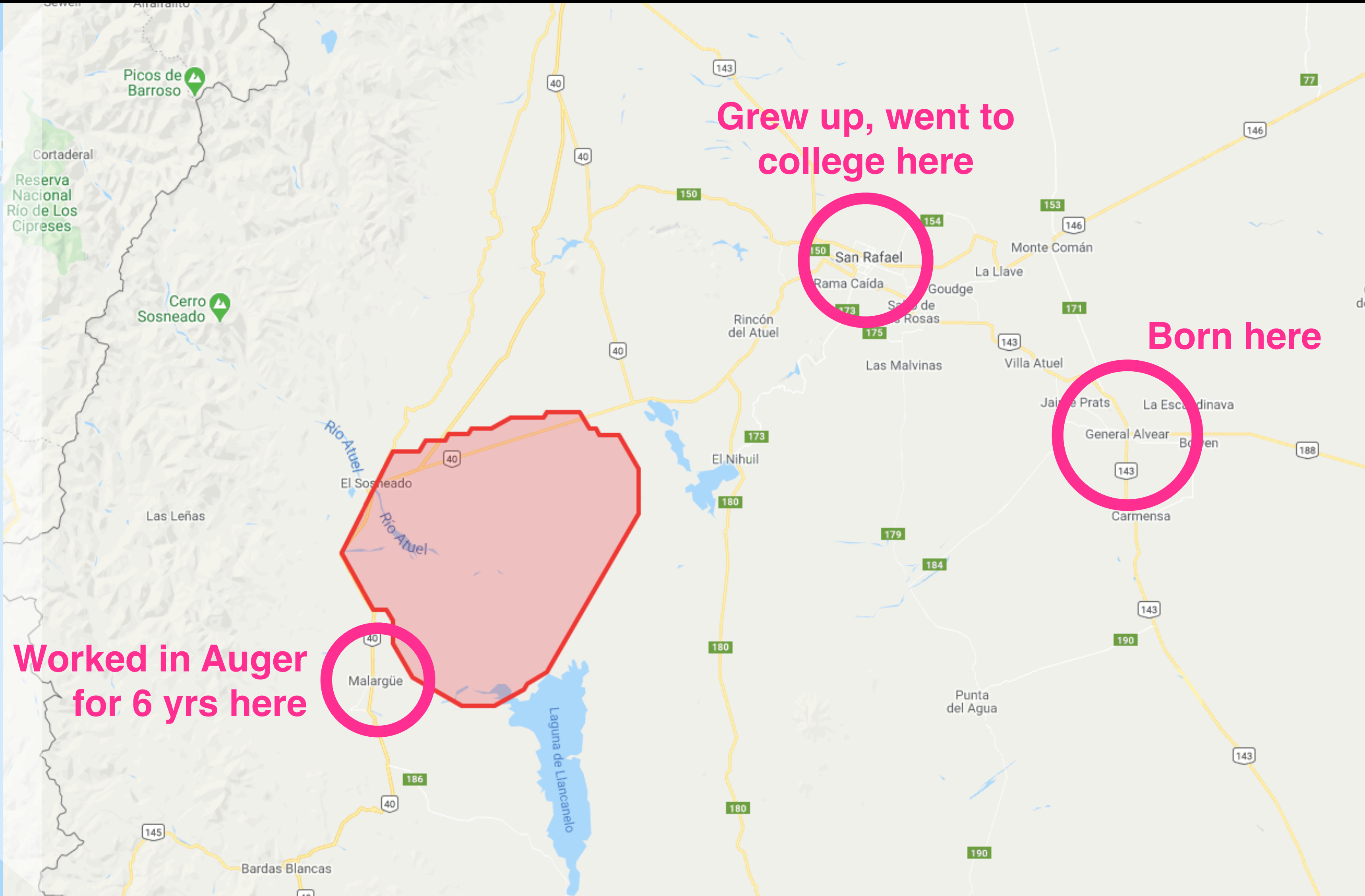


# A bit about my path





# A bit about my path













# My years in Auger



# My years in Auger

First “baby”: LIDAR telescopes





# My years in Auger

First “baby”: LIDAR telescopes



Installation of the 100th SD station





# My years in Auger

First “baby”: LIDAR telescopes



Installation of the 100th SD station

Another SD station





# My years in Auger

First “baby”: LIDAR telescopes





# My years in Auger



- Worked as an engineering undergrad for 3 years in Auger, then as an observatory engineer for 3 more years.
- Helped build 3/4 LIDAR telescope stations. Set up the testing system for surface detector electronics. Assembled, tested and calibrated 18/24 FD cameras. Provided operation and monitoring software.
- Applied to physics grad school at 28, with a 2 yo daughter.



#7



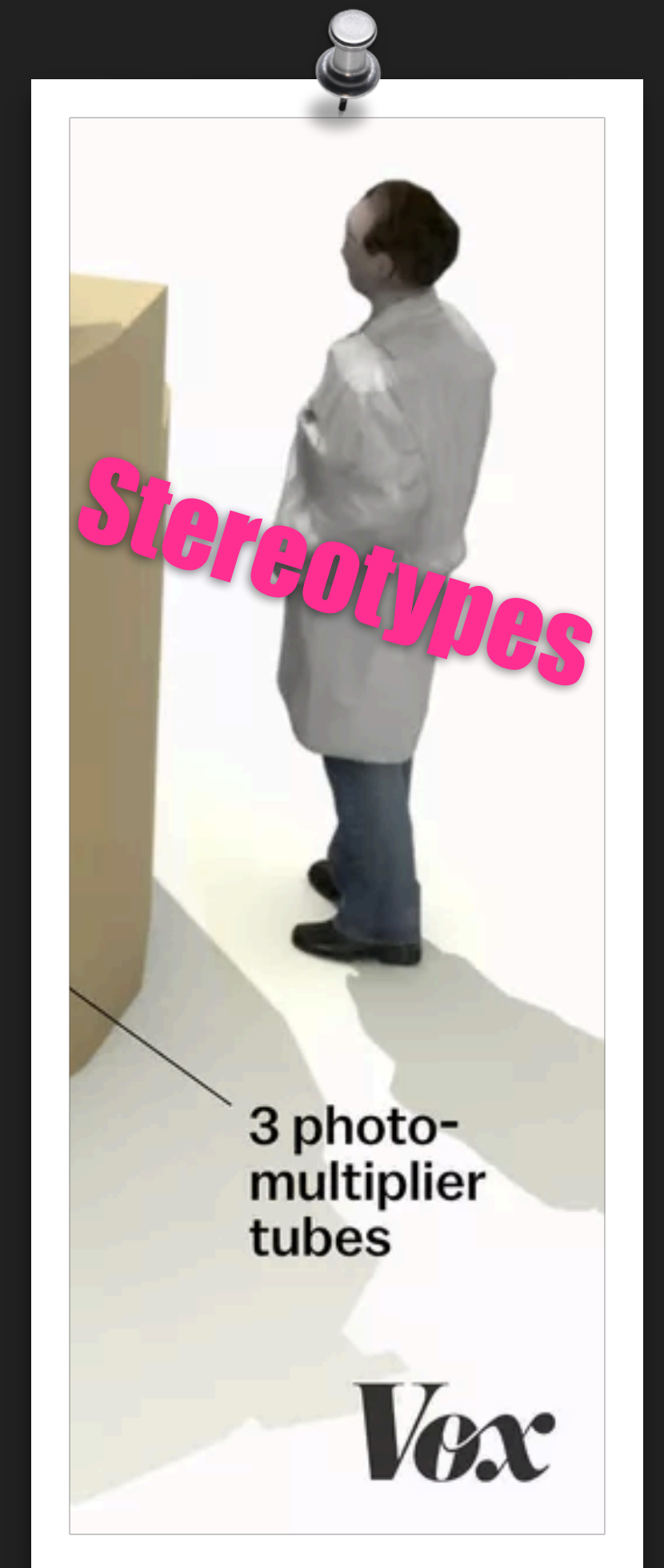
**Science is a transformational  
adventure, both personally and  
intellectually.**

**#7**



Science is a transformational adventure, both personally and intellectually.

There are many paths to science, and many ways to be a scientist.



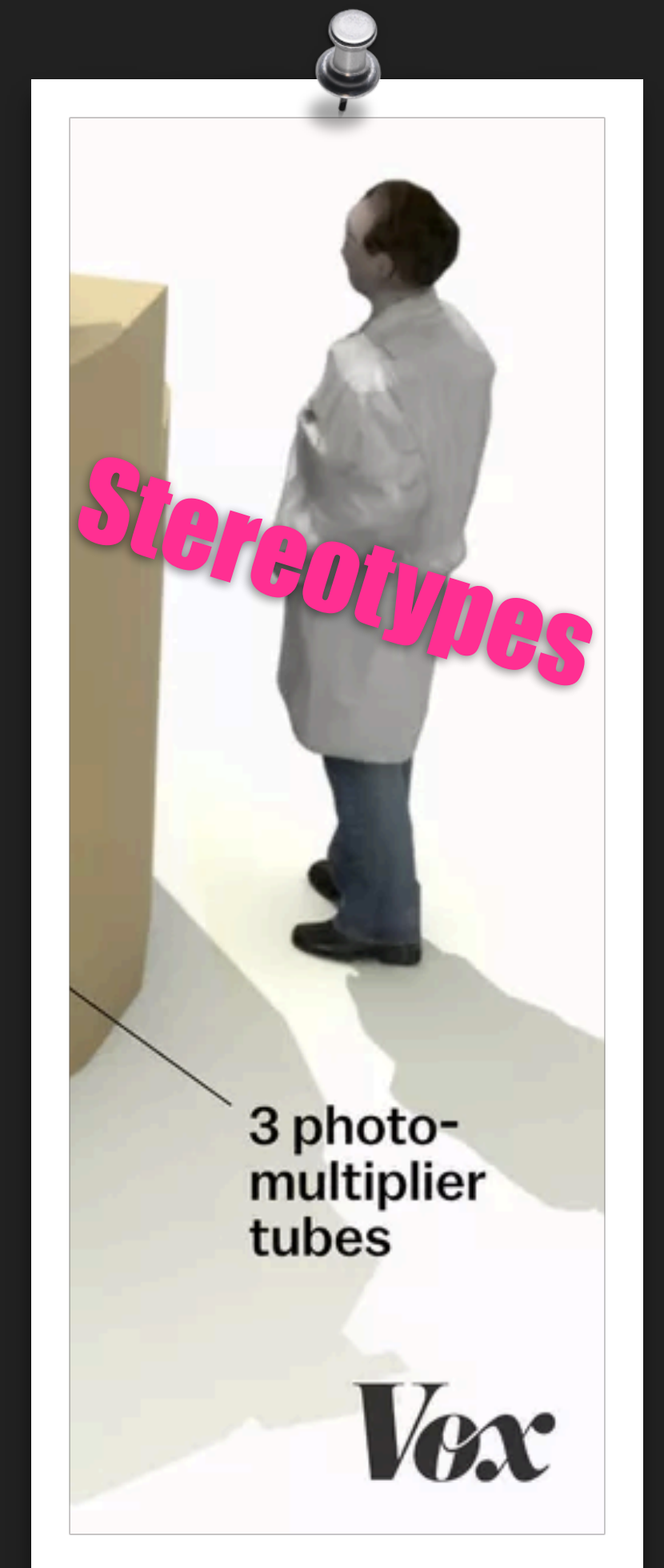
#7



Science is a transformational  
adventure, both personally and  
intellectually.

There are many paths to science,  
and many ways to be a scientist.

Thank you



#7



# A few more resources

- [TED-Ed video on cosmic rays](#)
- [Detect cosmic rays and charged particles with your phone!](#)
- [The history of the field by Prof James Cronin \(Nobel prize 1980, pioneer of the Auger observatory\)](#)
- [Cloud chamber at high altitude](#)
- Feel free to reach out to me for questions! [jmsantander@ua.edu](mailto:jmsantander@ua.edu)