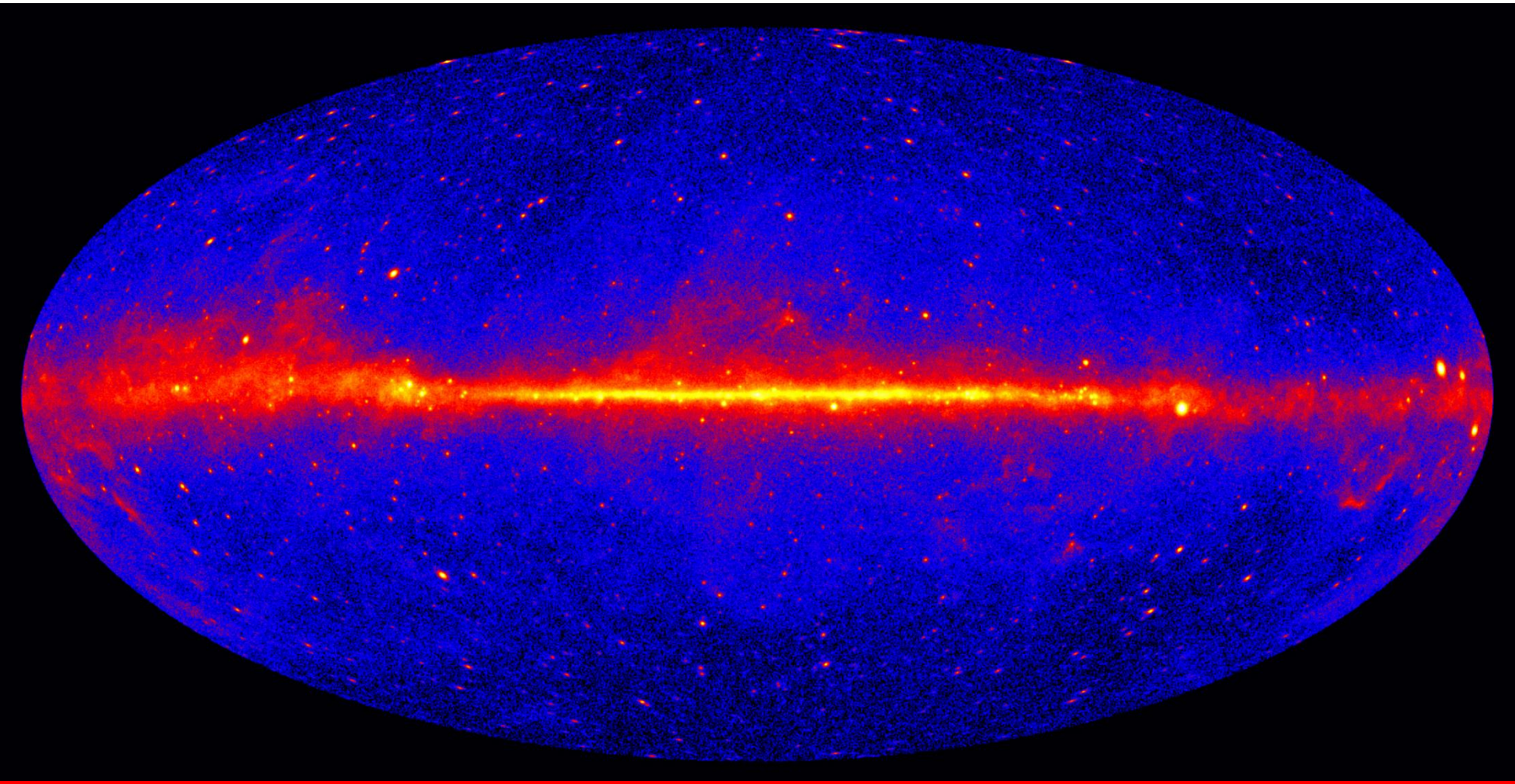
The Cherenkov Telescope Array

Peter Karn

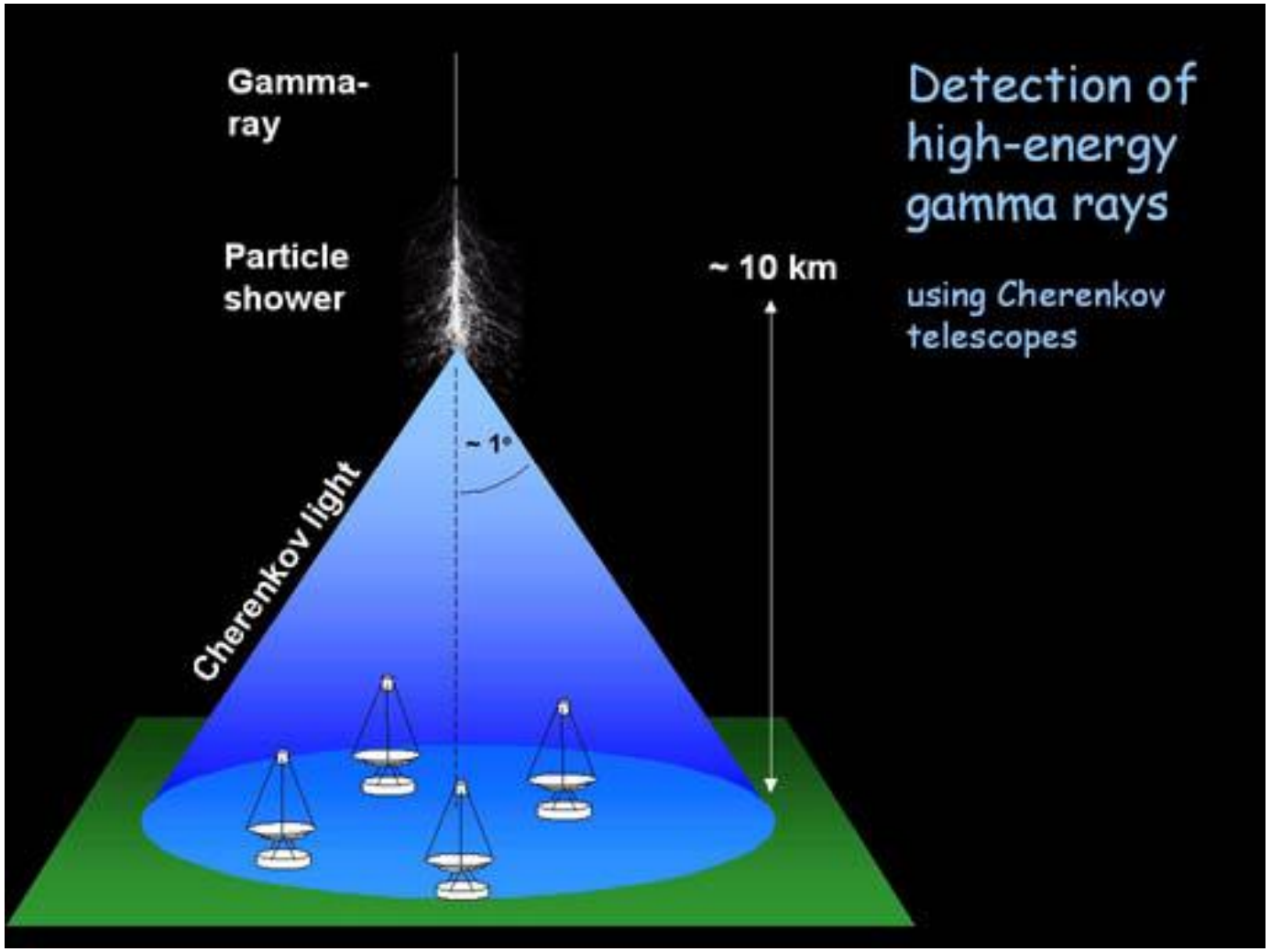
Fermi Gamma Ray Space Telescope

5-year sky map



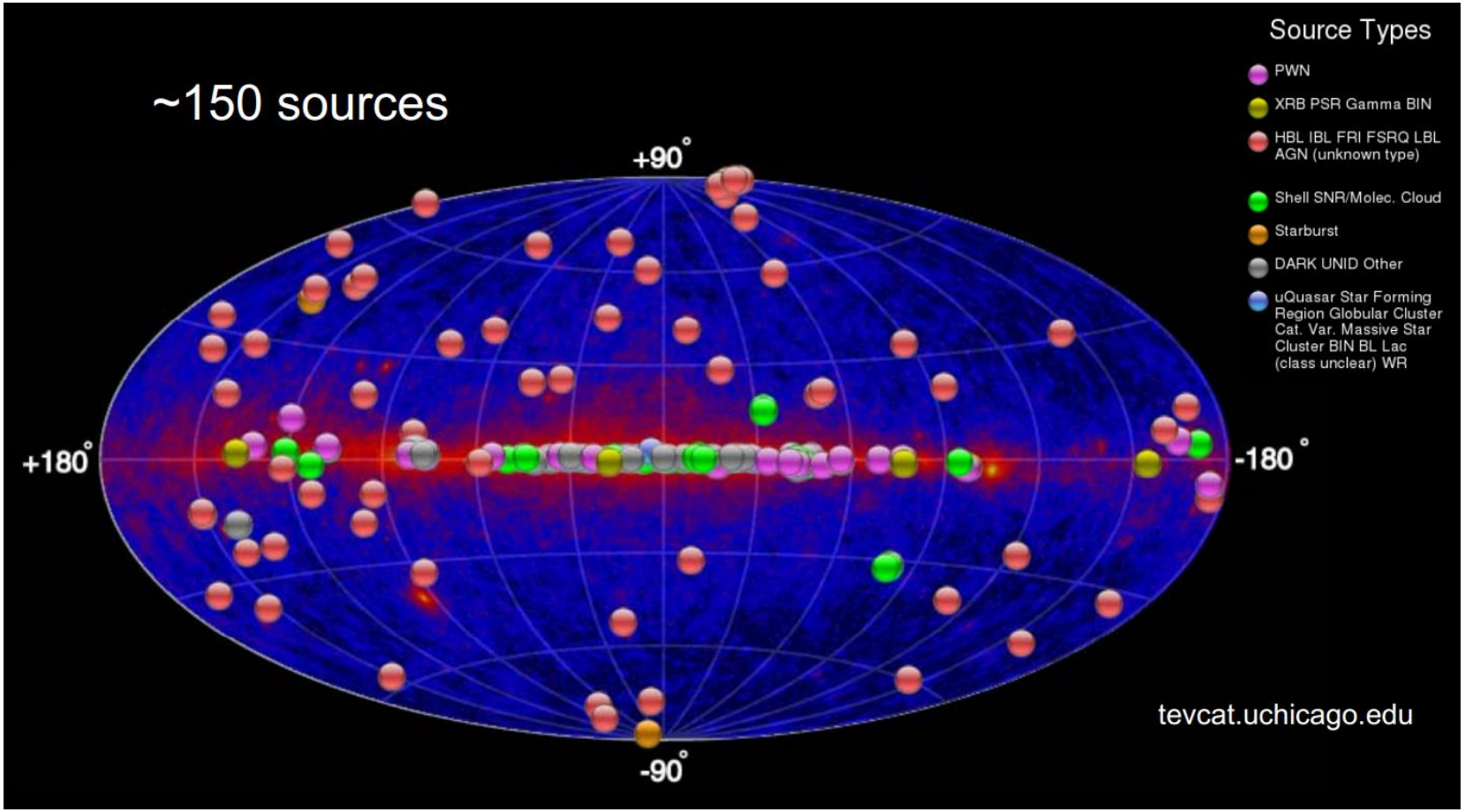
High Altitude Water Cherenkov (HAWC) Observatory

Imaging Air Cherenkov Detectors



VERITAS

Gamma ray astronomy is successful

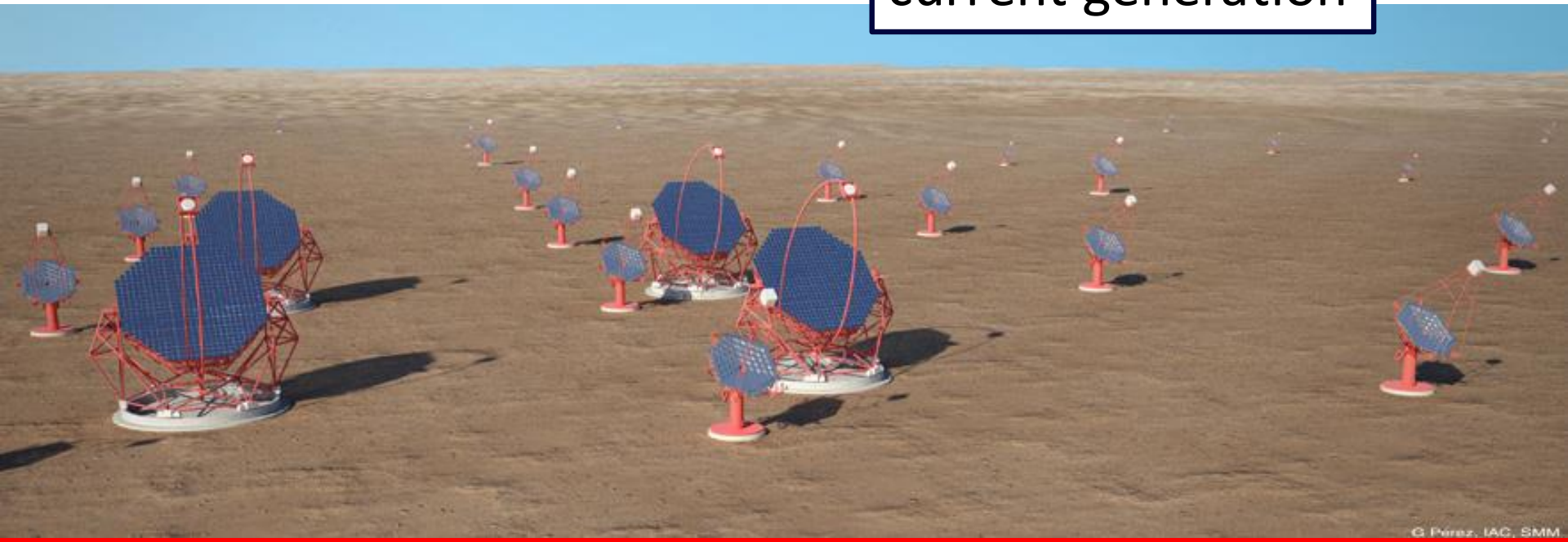


... and there is much more to find

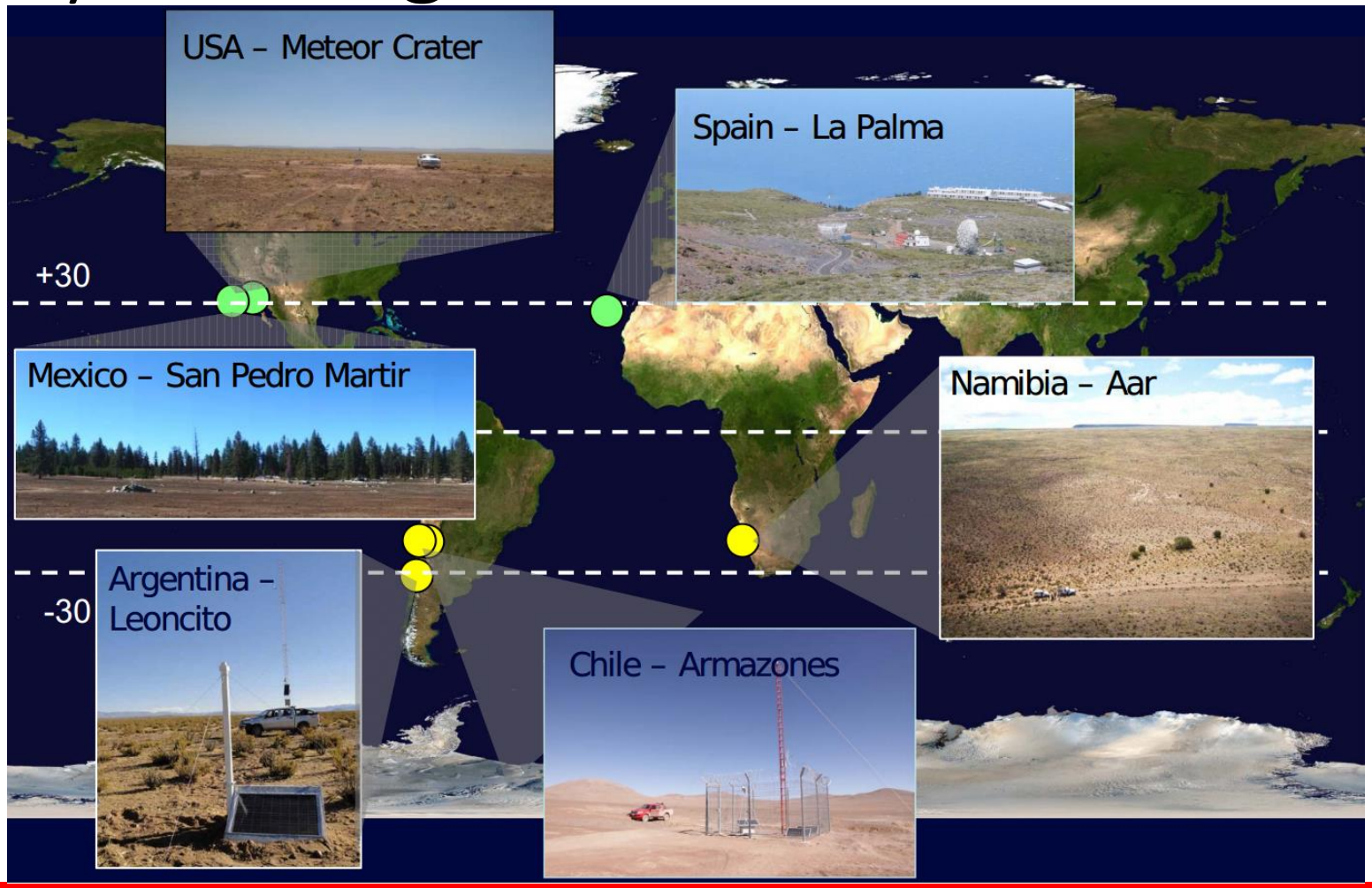
CTA is the next generation

- Wide energy range: 20 GeV – 300 TeV
- Field of view: 8-10 °
- Energy resolution: 10-15%
- Angular resolution: < 0.1°
- Rapid slew time: 20 s

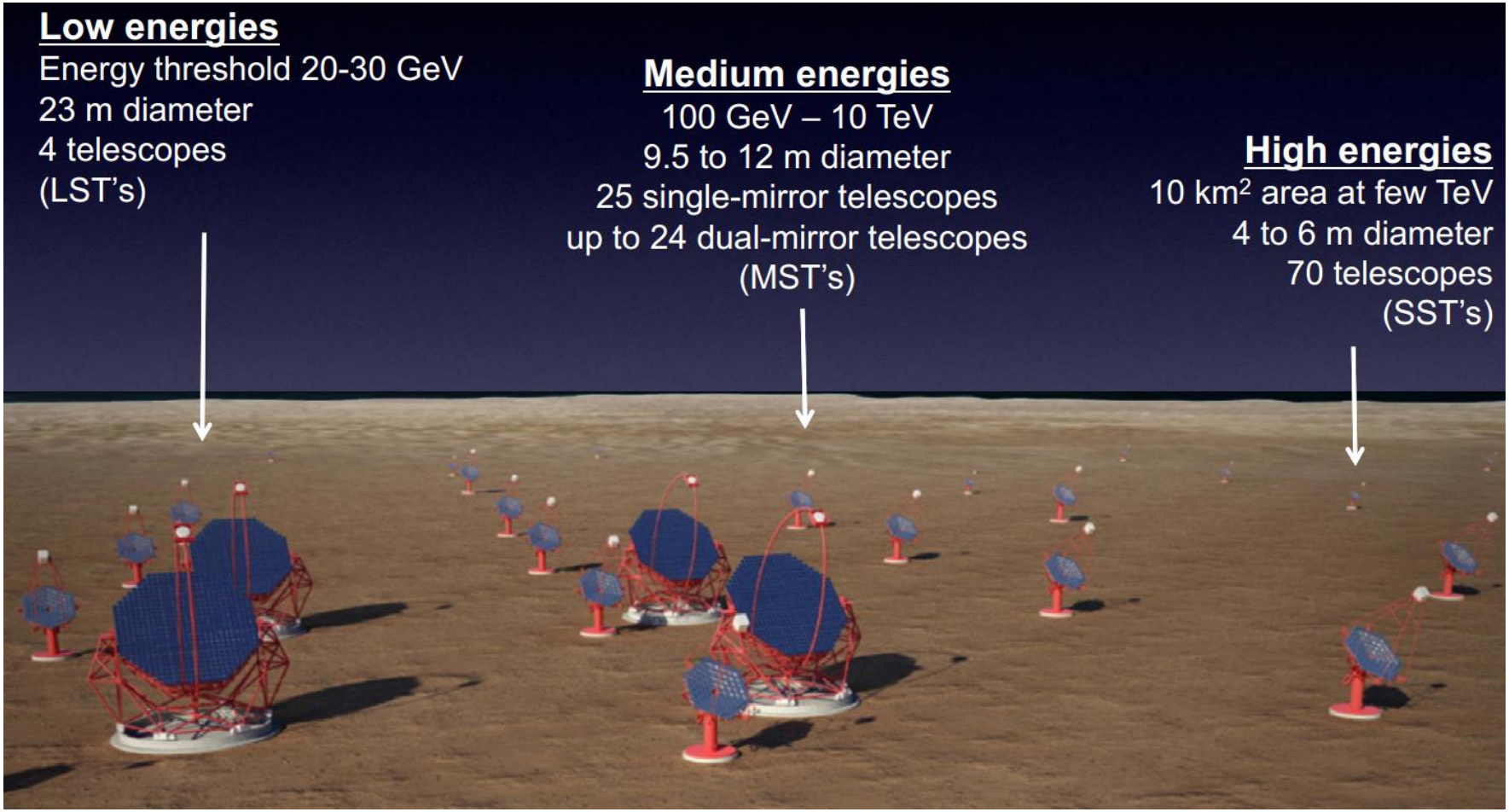
10x sensitivity and collection area of current generation



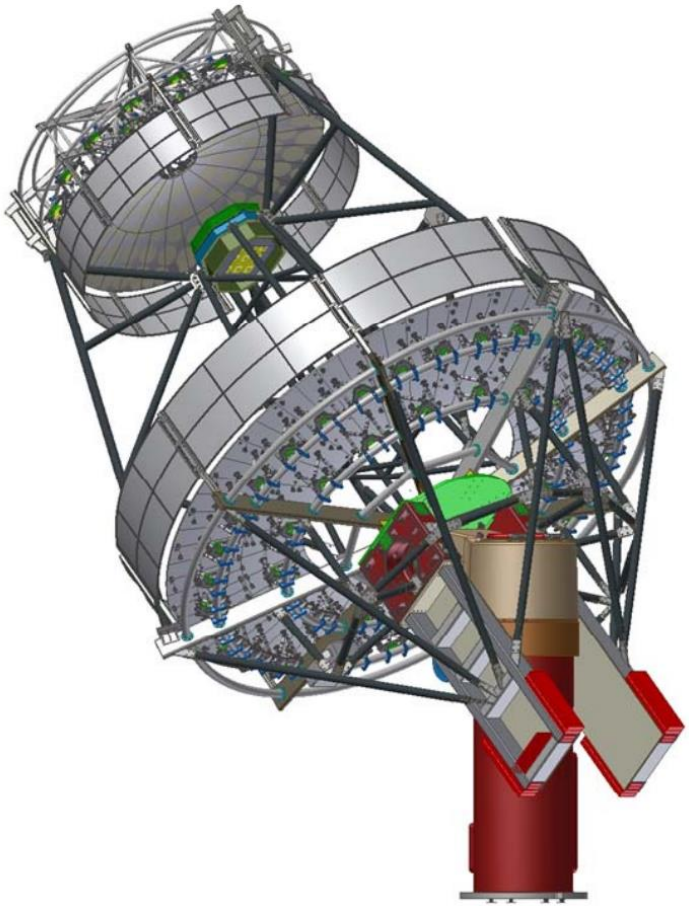
Sites in North and South for full sky coverage



Three telescope sizes maximize science potential



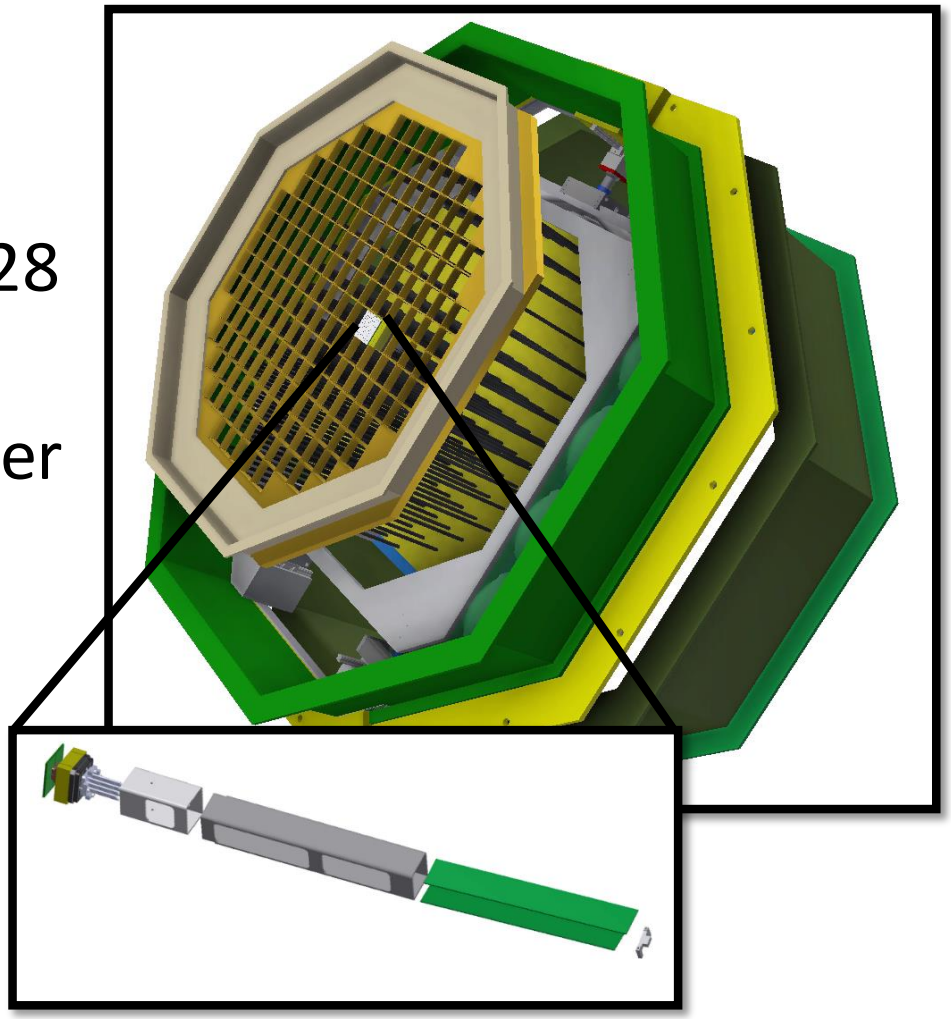
CTA-US is working on the Schwarzschild-Couder Telescope



- Two mirror design
- Improved optics -> smaller SiPM camera
- 11,328 pixels
- 8° field of view
- Prototype in AZ this year
- Extension to CTA array

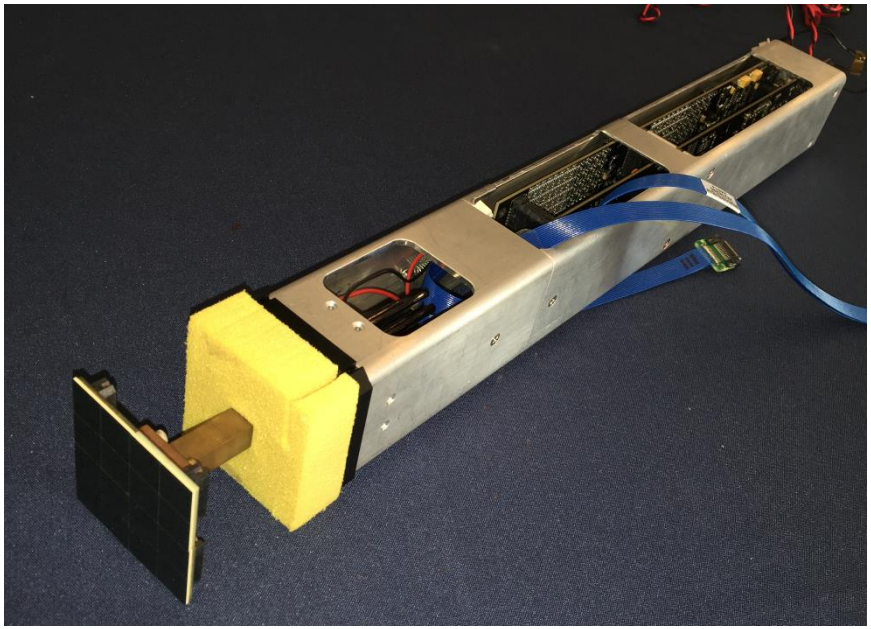
Camera Basics

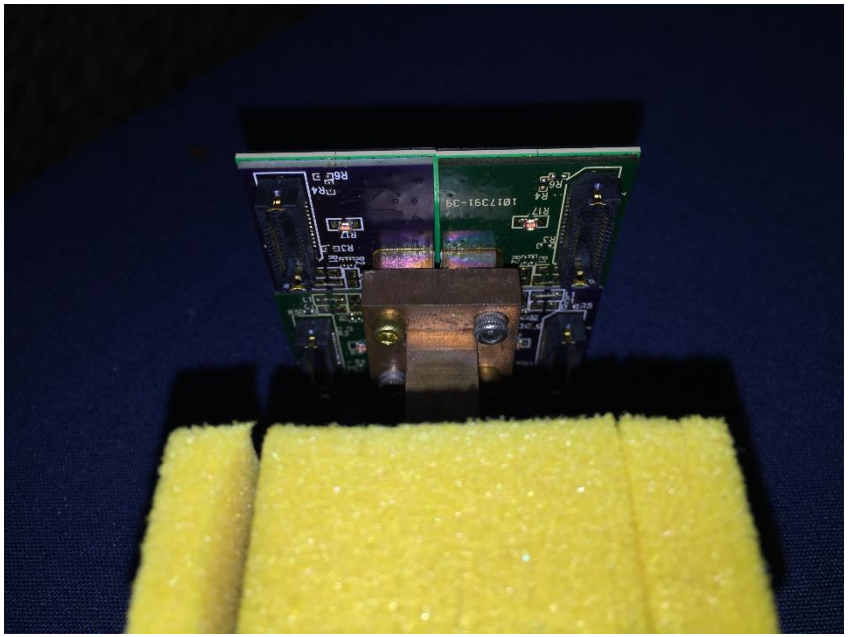
- 177 SiPM focal plane modules
- 64 pixels per module:11,328 channels in total
- Readout, digitization, trigger assembly via TARGET custom ASIC

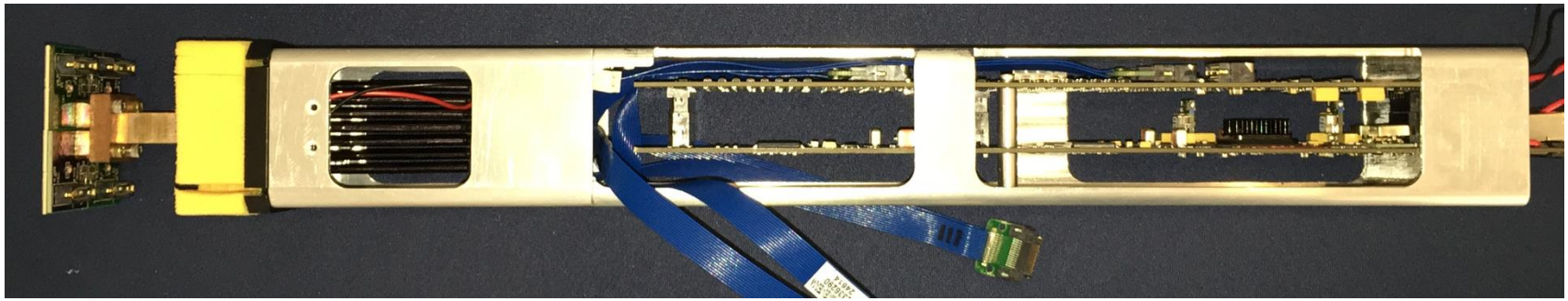


Assembled lattice and bulkhead

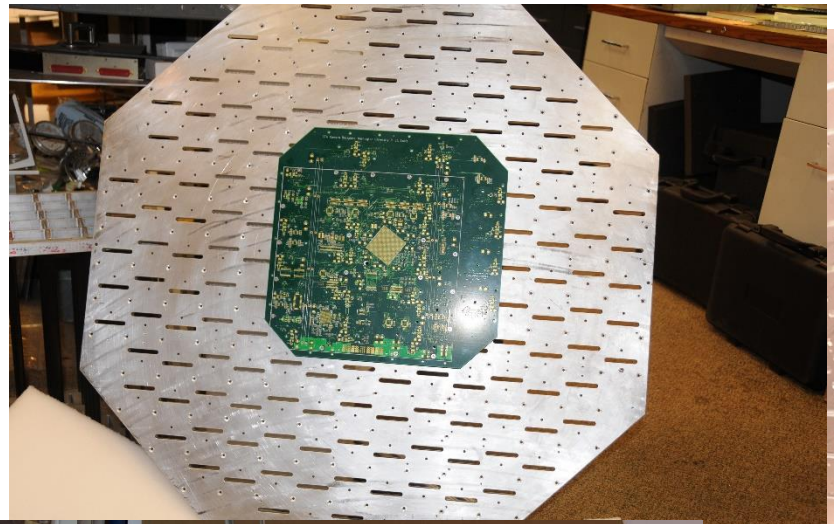
Camera Module

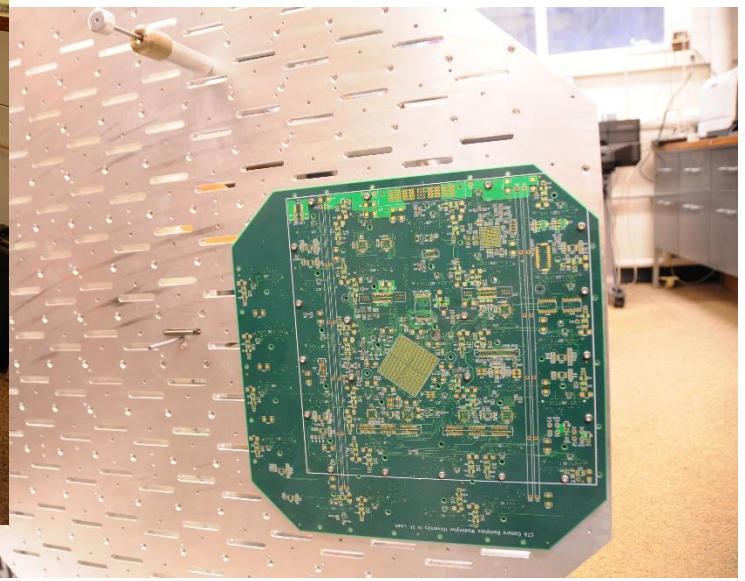


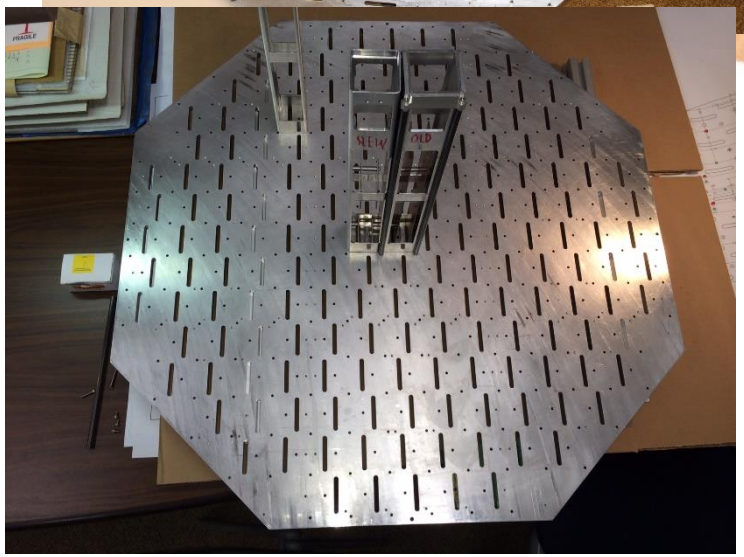




Backplane fitting onto mechanics







Camera backplate with backplane test-fit, module inserter/ejector.

Science themes guide observing strategy

1) Cosmic Particle Acceleration
   - How and where are particles accelerated?
   - How do they propagate?
   - What is their impact on their environment?

2) Probing Extreme Environments
   - Processes close to neutron stars, black holes
   - Processes in relativistic jets, winds, explosions

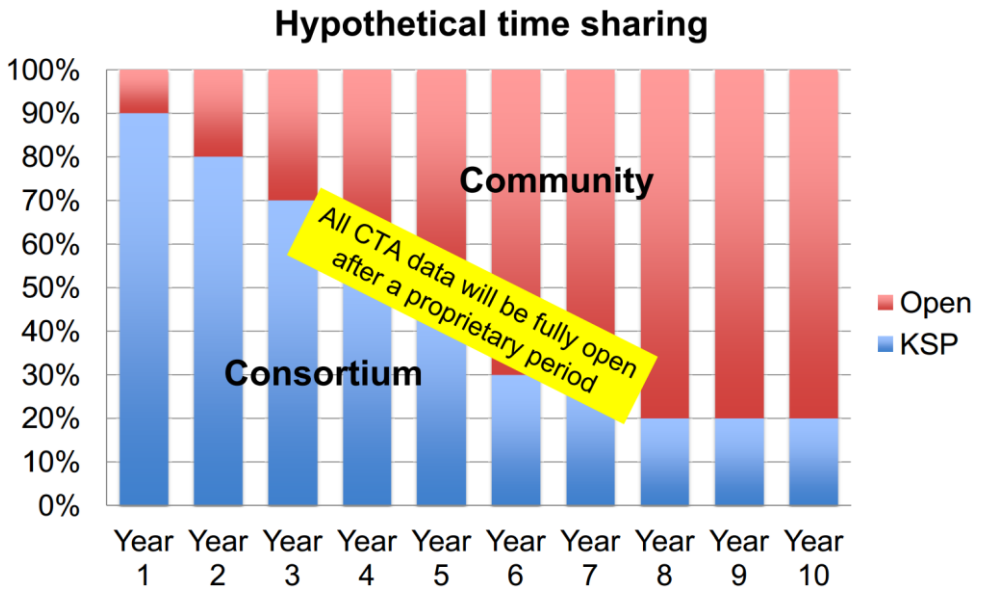
3) Physics Frontiers – beyond the SM
   - What is the nature of dark matter?
   - Is the speed of light a constant?
   - Do axion-like particles exist?

Key Science Projects

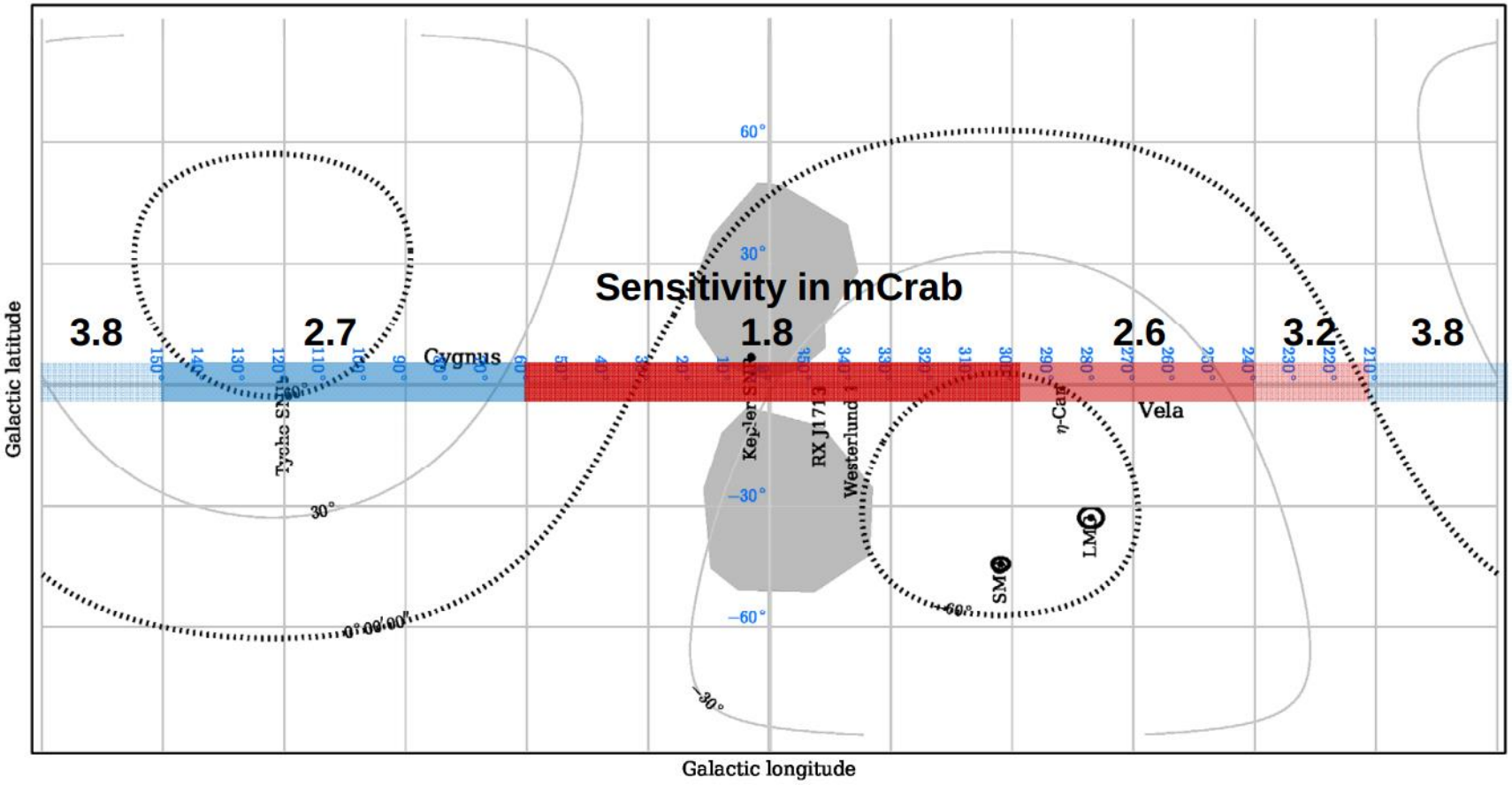
e.g. Galactic and Extragalactic Surveys, Active Galaxies, etc.

CTA is a tool for the community

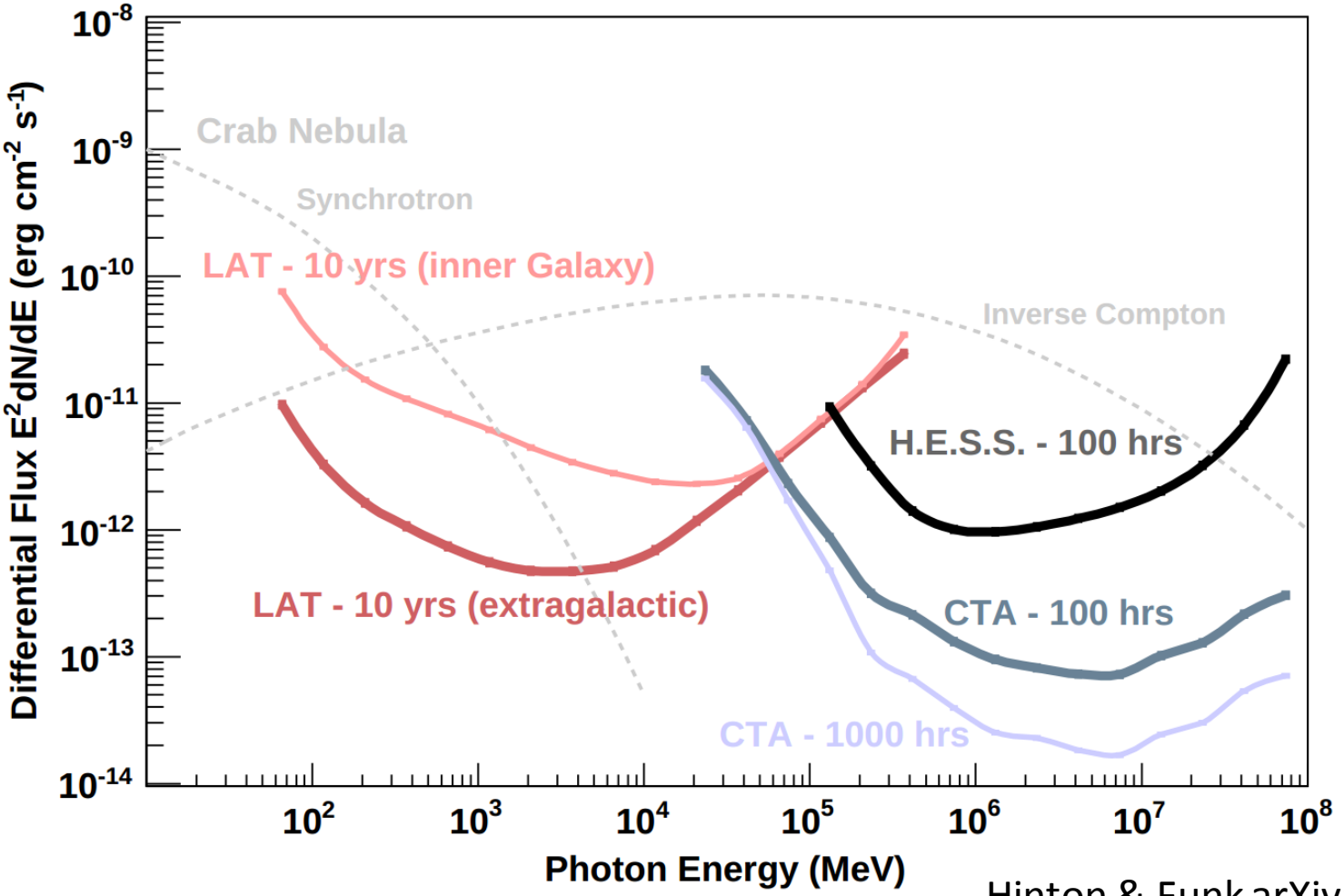
- All CTA data will be made public
- Legacy datasets
- Observing time shared between consortium (for Key Science Projects) and public



Galactic survey: wide and deep

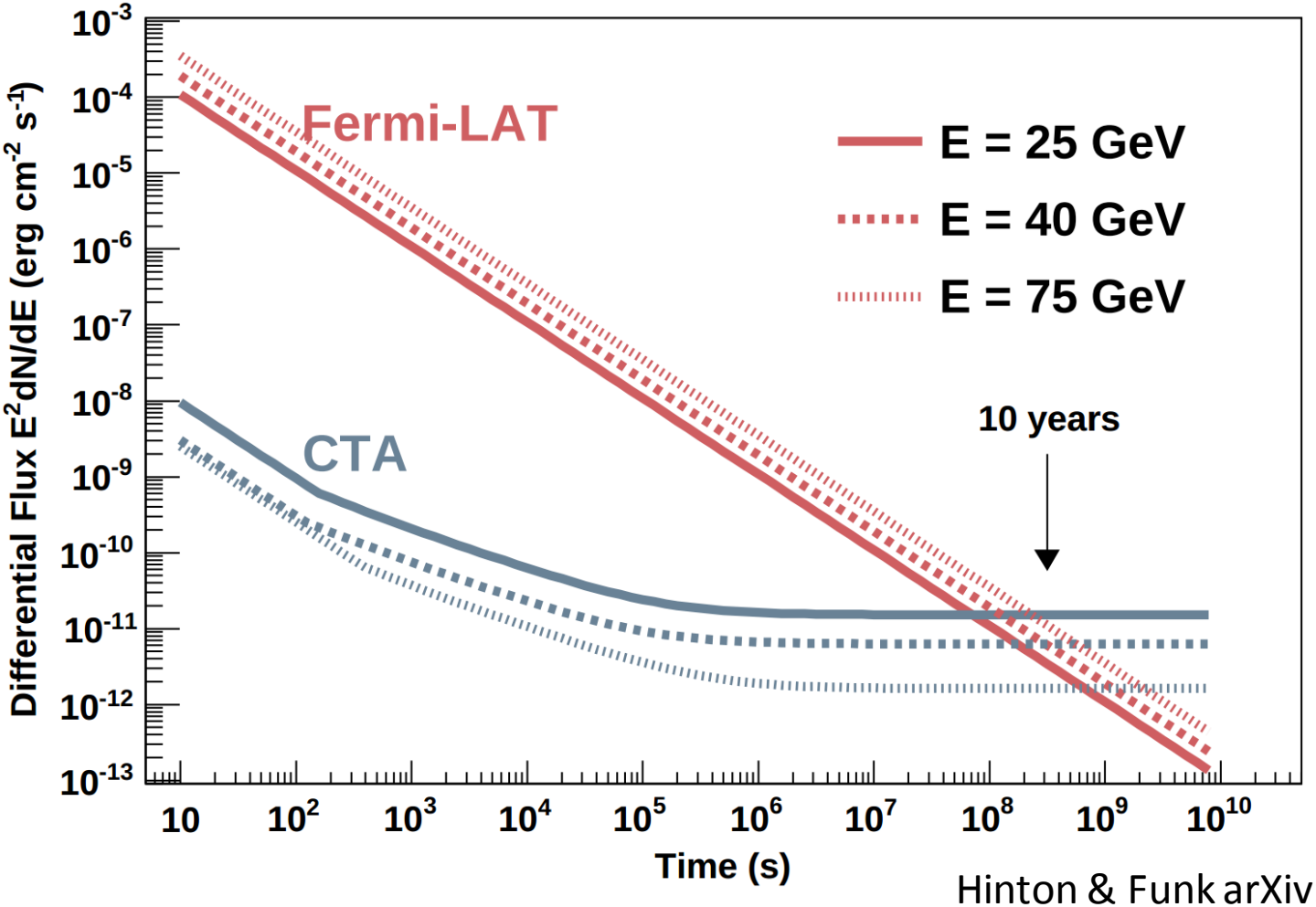


10x gain in sensitivity



Hinton & Funk arXiv:1205.0832

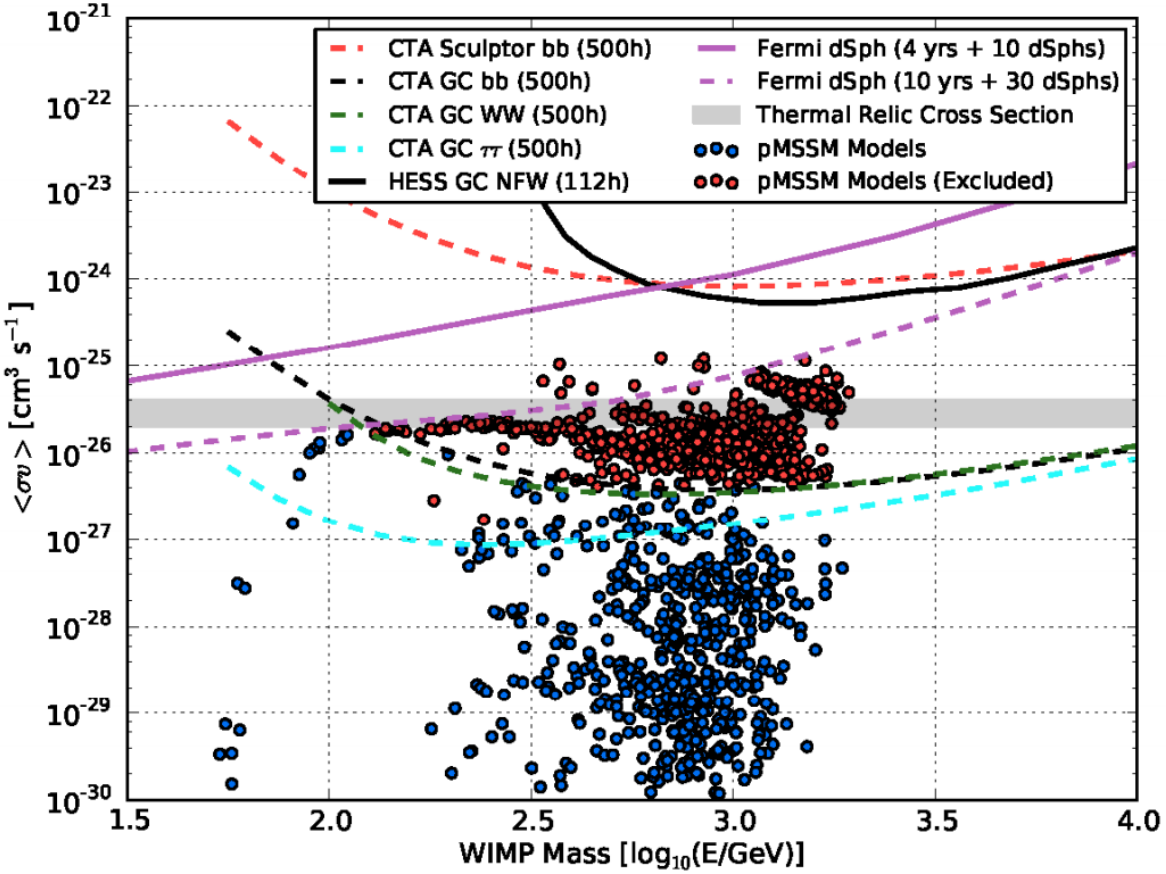
Catching flares and bursts



Hinton & Funk arXiv:1205.0832

Cutting deep into dark matter parameter space

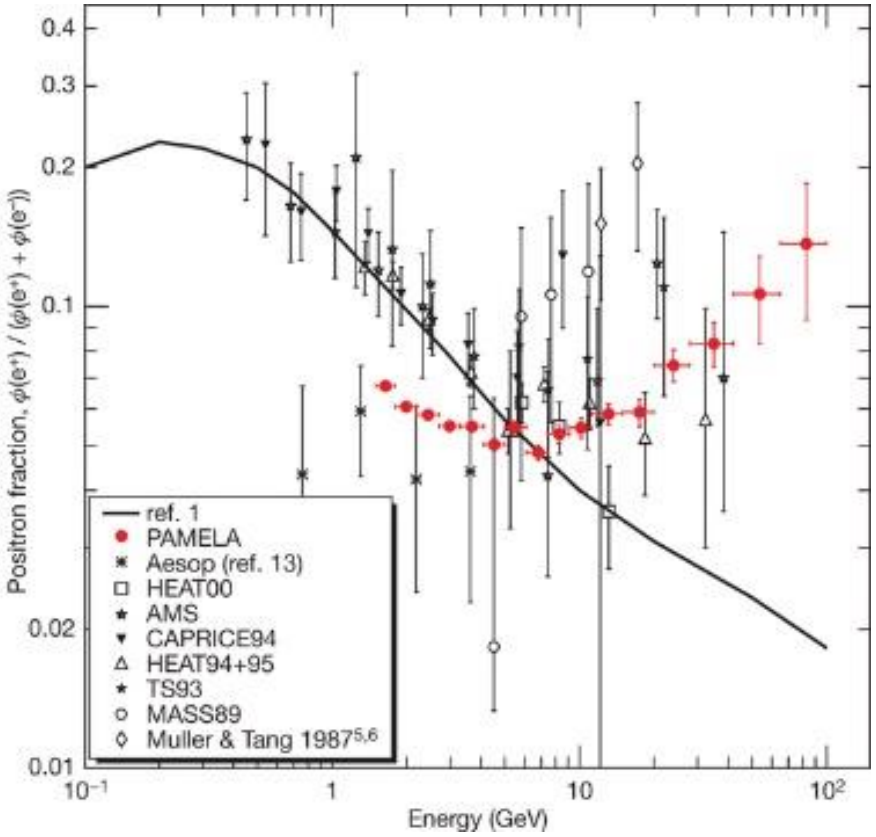
M. Wood et al. arXiv:1305.0302



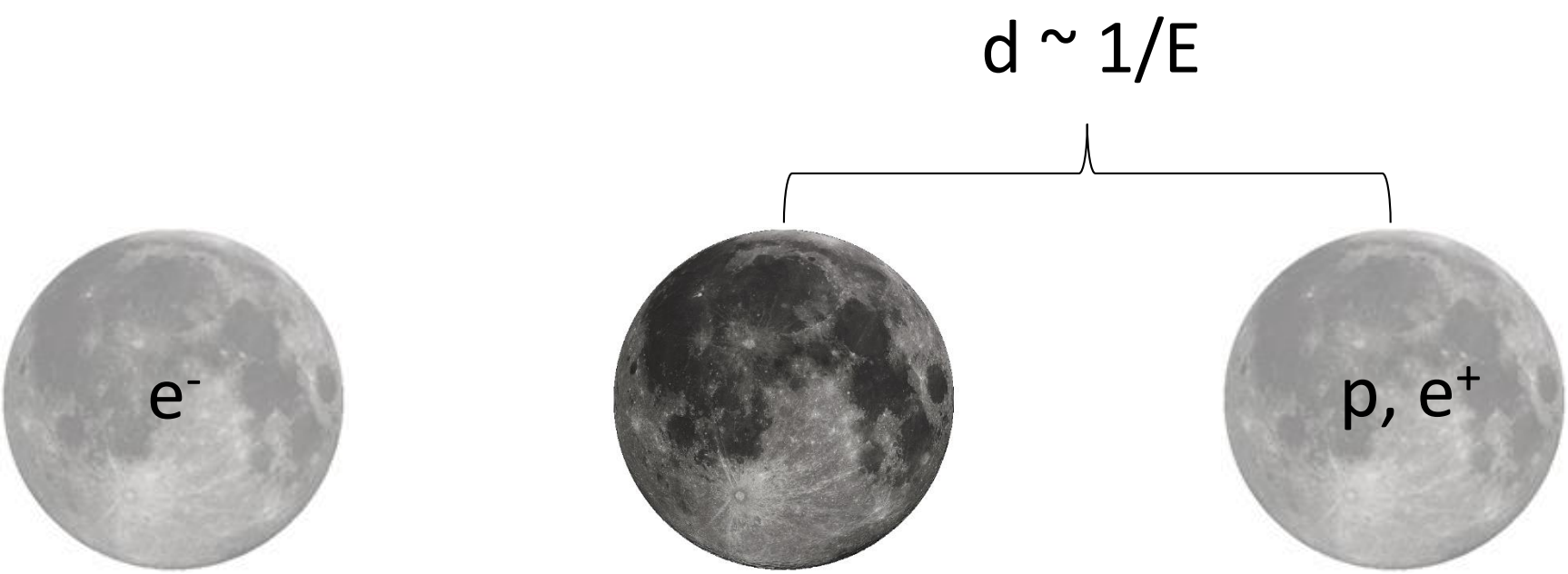
And maybe measure the positron fraction too…

Positron fraction measurement

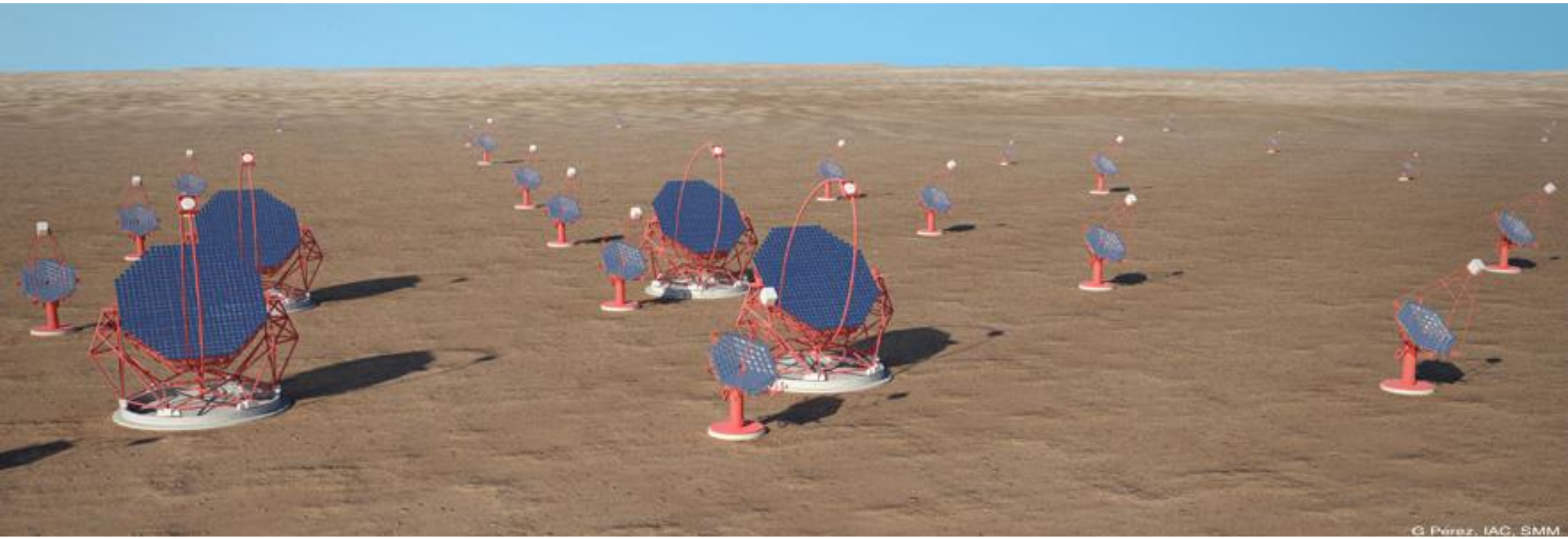
- Since Pamela, we have known fraction rises
- Explanations: local source or DM annihilation?
- Extend to high energies and measure exact shape of spectra for the answer
- CTA could go beyond energy range of AMS



Earth-Moon Spectrometer



The Cherenkov Telescope Array is coming in 2020



Over 1200 scientists in 29 countries are using their experience to create the next generation gamma-ray observatory, an instrument of great discovery potential and utility for the astrophysics community.

Backup

Telescope Stats

	LST "large"	MST "medium"	SCT "medium 2-M"	SST "small"
Number	**4 (S)** **4 (N)**	**25 (S)** **15 (N)**	**≤ 24 (S)**	**70 (S)**
Energy range	20 GeV to 1 TeV	200 GeV to 10 TeV	200 GeV to 10 TeV	> few TeV
Effective mirror area	> 330 m^2	> 90 m^2	> 40 m^2	> 5 m^2
Field of view	> 4.4°	> 7°	> 7°	> 8°
Pixel size ~PSF θ_{80}	< 0.11°	< 0.18°	< 0.075°	< 0.25°
Positioning time	50 s, 20 s goal	90 s, 60 s goal	90 s, 60 s goal	90 s, 60 s goal
Target capital cost	7.4 M€	1.6 M€	< 2.0 M€	420 k€