cherenkov telescope array

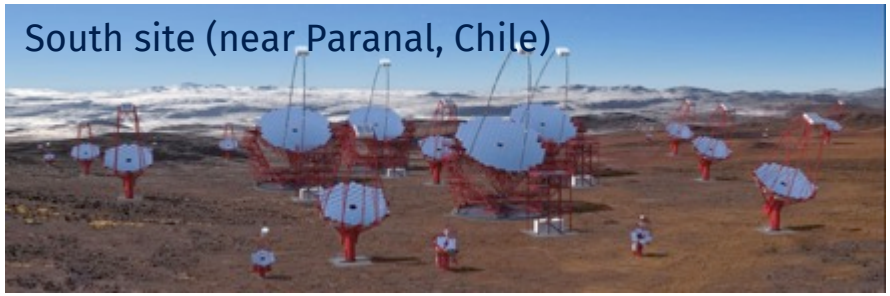
The Cherenkov Telescope Array

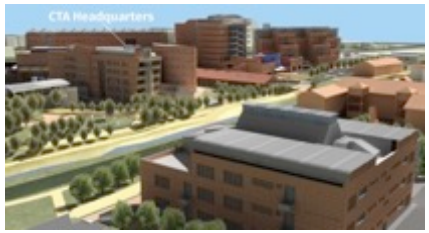
The observatory for ground-based gamma-ray astronomy

Jürgen Knödlseder, for the CTA Consortium

CTA in a nutshell

- First Open Observatory for VHE (>100 GeV) gamma-ray astronomy
- 118 Cherenkov telescopes shared over two sites
  - full sky-coverage
- Expands in performances over existing instruments
  - Sensitivity
  - Angular resolution
  - Energy range





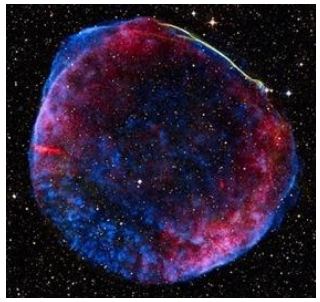
HQ (Bologna, Italy)

SDMC (Zeuthen, Germany)

CTA science

Cosmic Particle Acceleration

How and where are particles accelerated?
How do they propagate?
What is their impact on the environment?

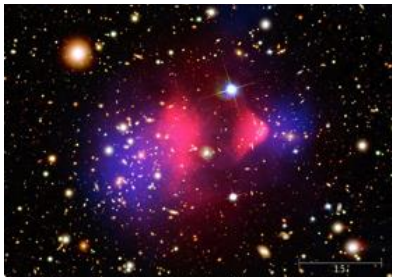


Probing Extreme Environments

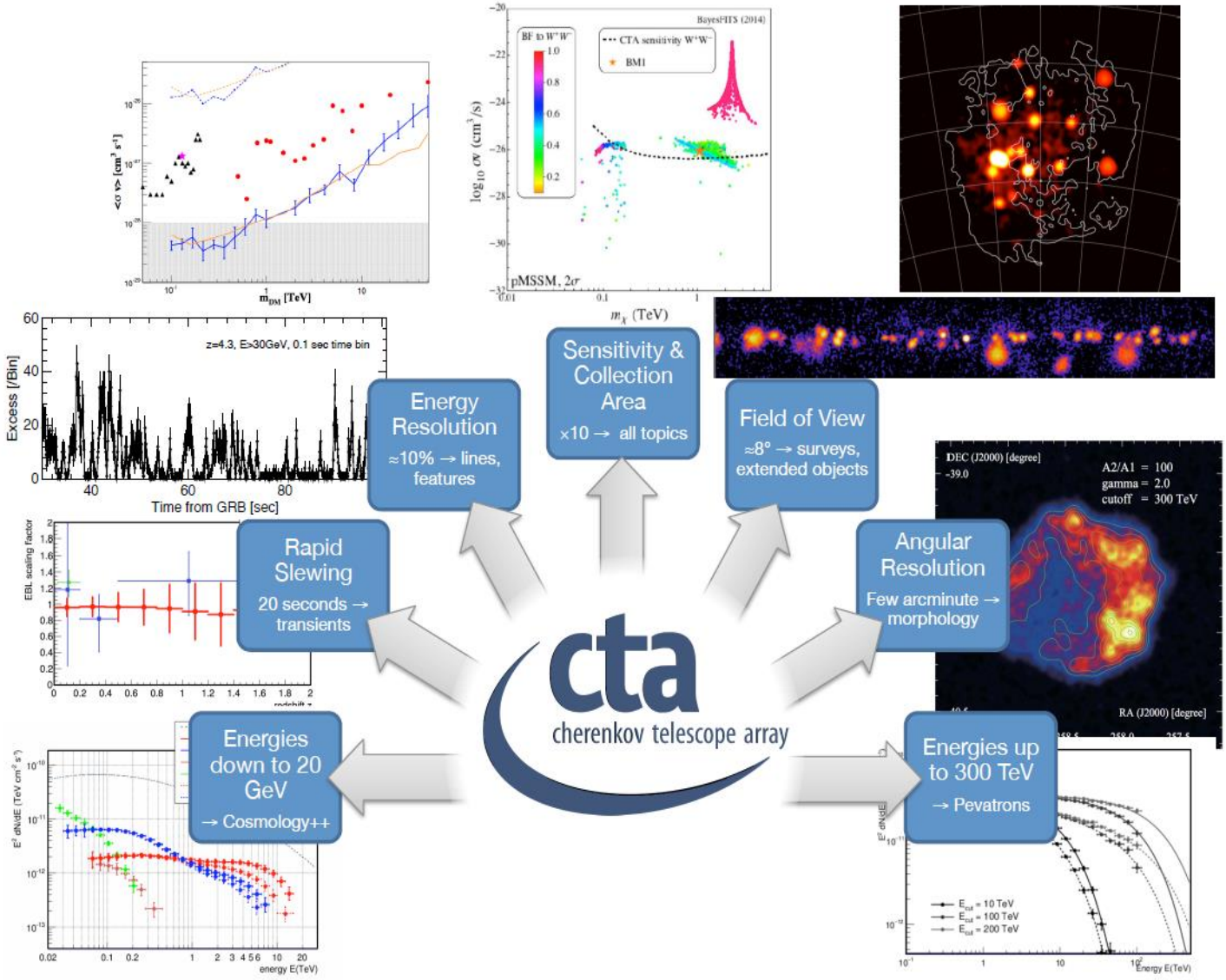
Physics close to neutron stars and black holes
Physics in relativistic jets, winds and explosions
Exploring cosmic voids

Physics frontiers – beyond the Standard Model

What is the nature of Dark Matter? How is it distributed?
Is the speed of light a constant for high-energy photons?
Do axion-like particles exist?



CTA performances



CTA science programs

Key Science Projects (executed by CTA Consortium)

Ensure that important science questions for CTA are addressed in a coherent fashion and with a well-defined strategy

Provide legacy data sets for the entire community (including catalogues)

Surveys: Galactic Centre, Galactic Plane, Extragalactic, LMC

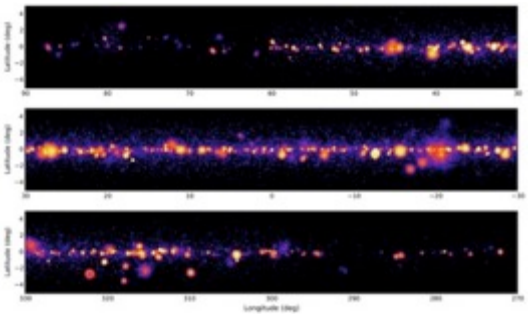
Transients

Cosmic ray PeVatrons

Starforming systems

Active Galactic Nuclei

Galaxy Clusters



arXiv:1709.07997

Proposal-driven User Program

Deep investigation of known sources

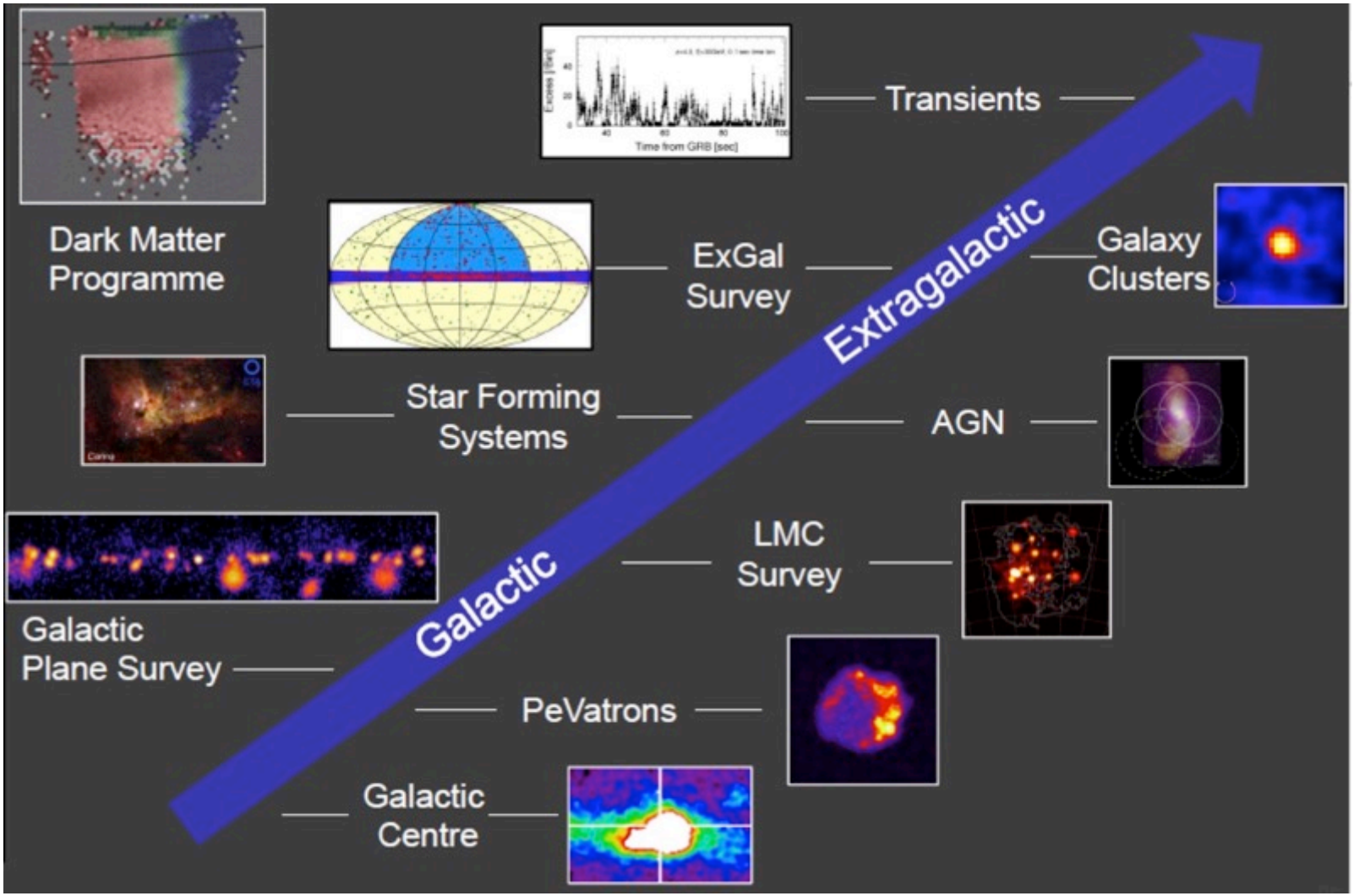
Follow-up of KSP discovered sources

Search for new sources

Multi-wavelength campaigns

Follow-up of ToOs from other wavebands or messengers

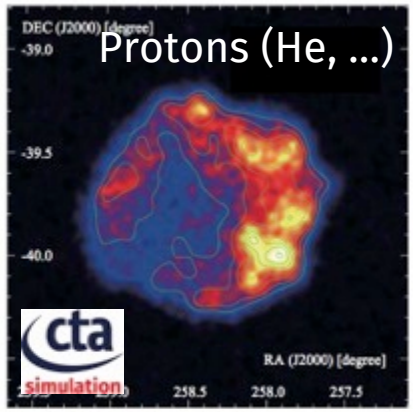
CTA key science

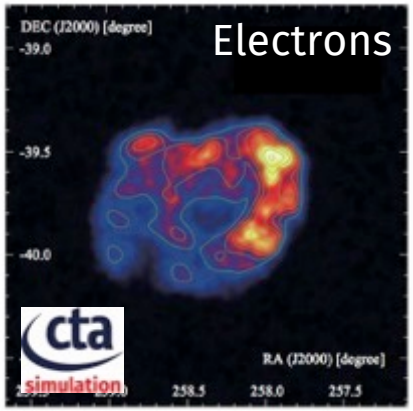


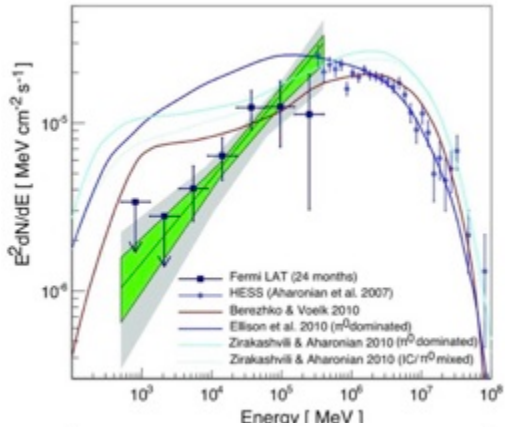
Galactic Cosmic Rays

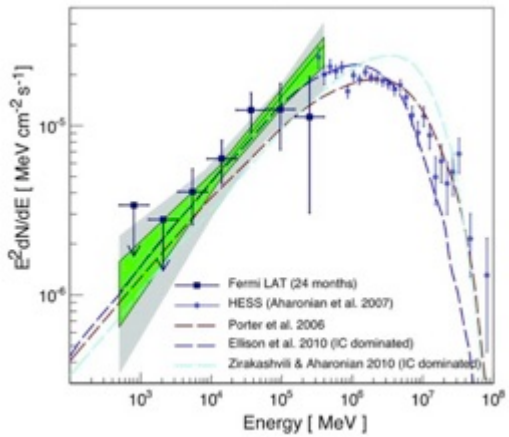
Unveiling the sources of Galactic Cosmic Rays

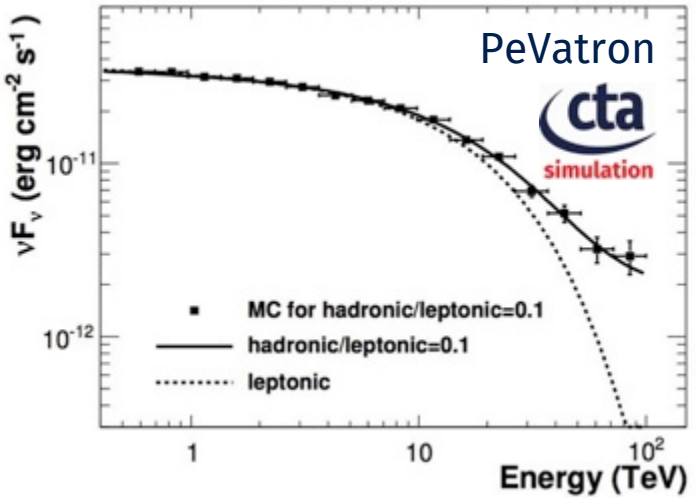
CTA will identify sources of Galactic Cosmic Rays by measuring the spectral and morphological signatures of hadronic particle acceleration











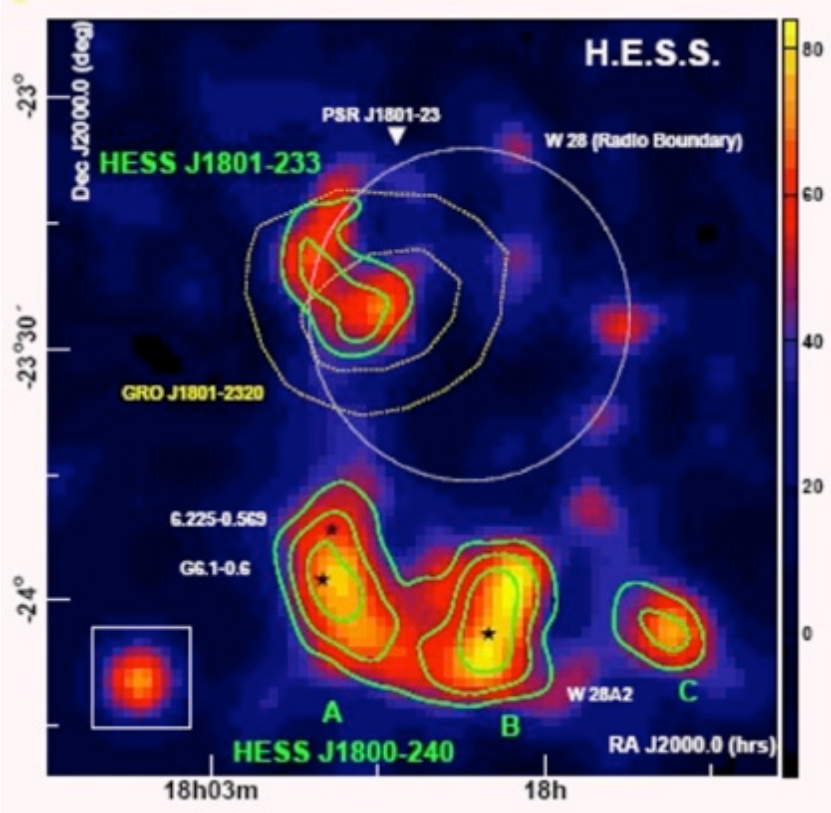
nergy

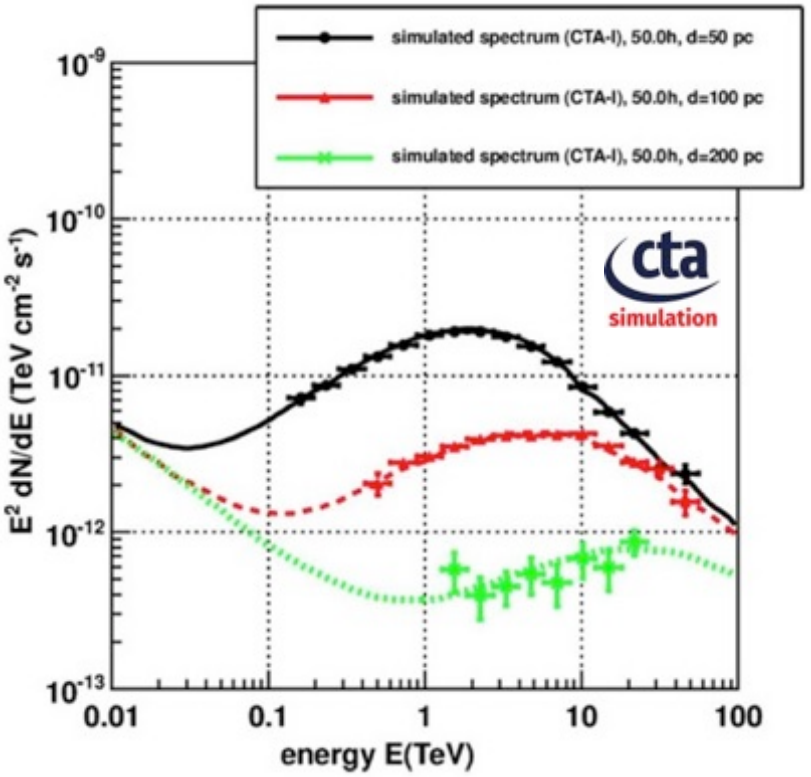
Catalogues

Galactic Cosmic Rays

Understanding particle escape from acceleration sites

CTA will observe the leaking of cosmic rays from the source into the interstellar medium, providing clues on cosmic-ray-propagation physics



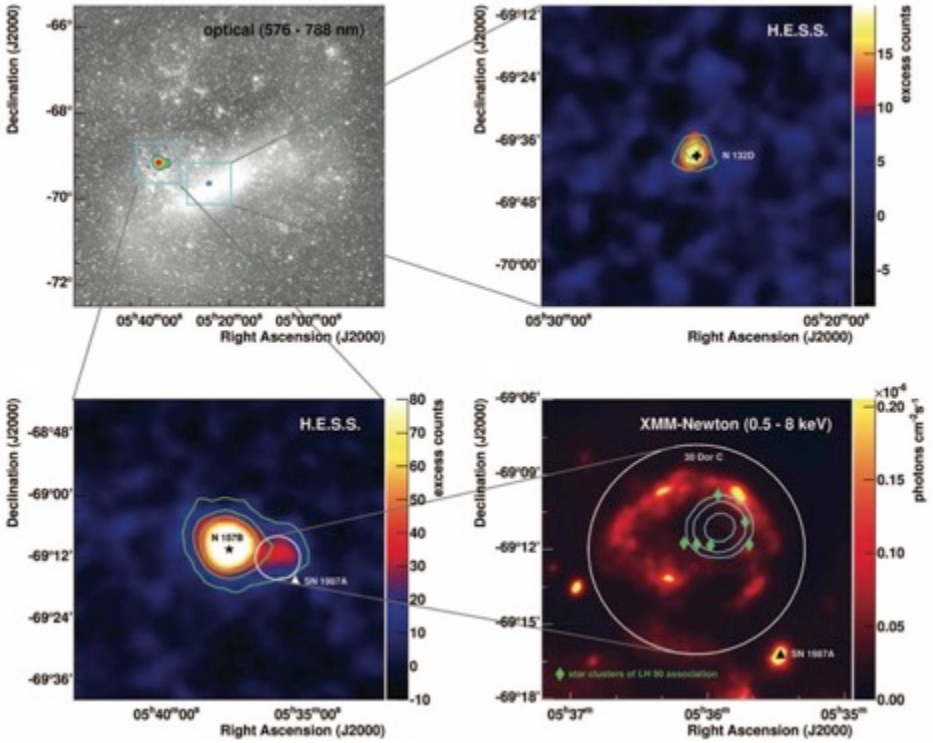


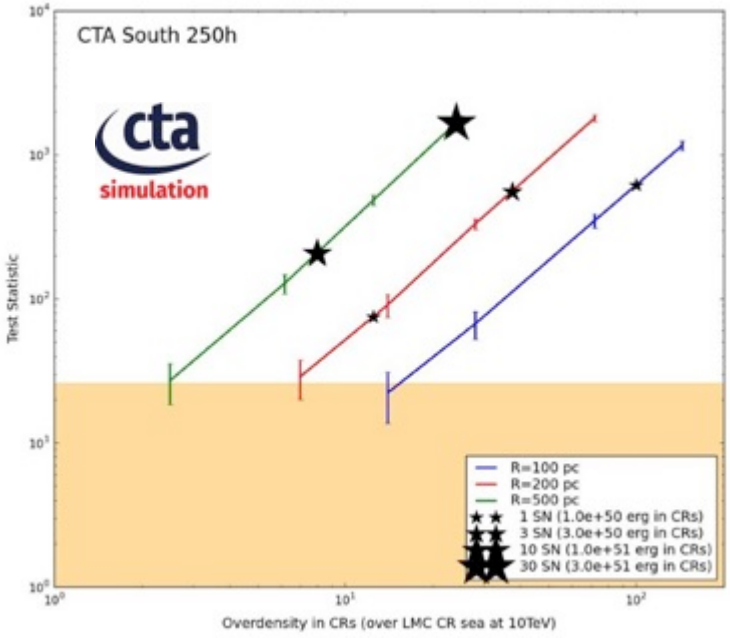
Cosmic Rays beyond our Galaxy

Understanding cosmic-ray physics in diverse environments

CTA will probe cosmic-ray physics in a large variety of environments, covering dwarf galaxies, normal galaxies and starburst galaxies

Large Magellanic Cloud

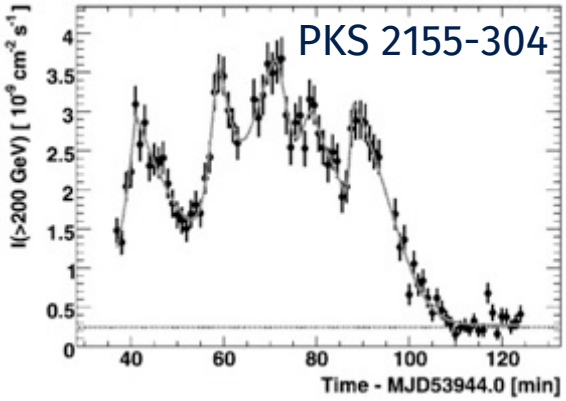


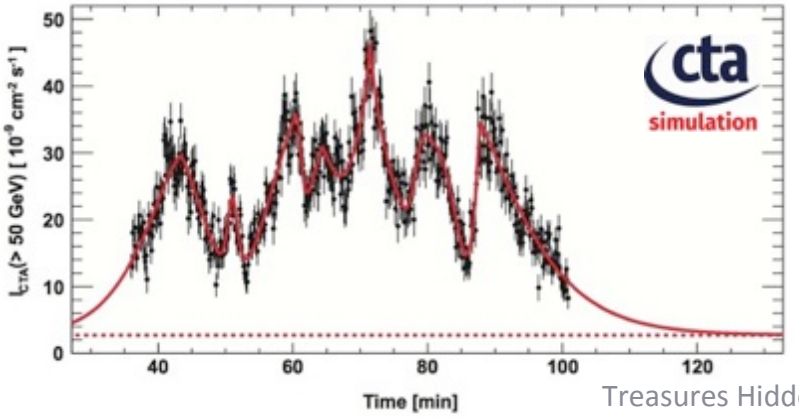


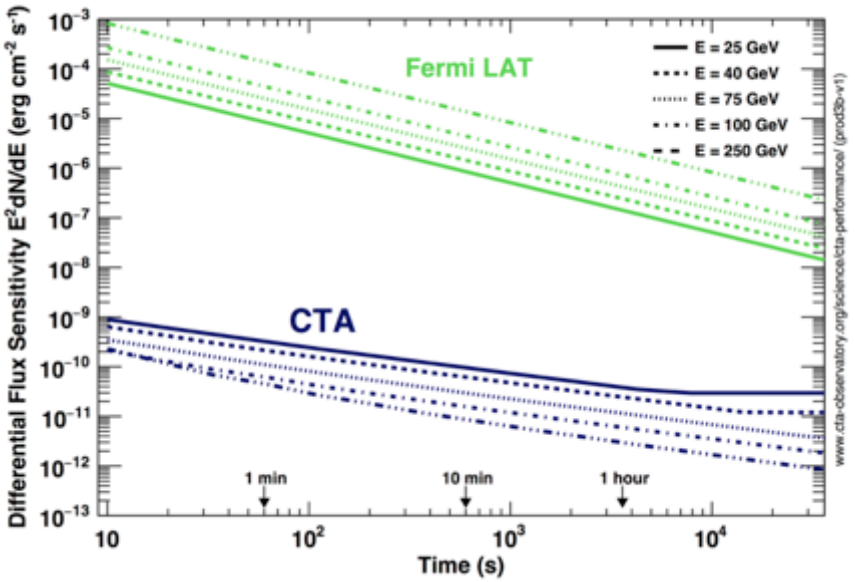
Black hole particle accelerators

Studying blazar variability at sub-minute time scale

CTA will be able to measure variability time scales down to several seconds, corresponding to emission zone dimensions of 1 A.U. for plausible Doppler factors, probing particle acceleration physics and jet formation models



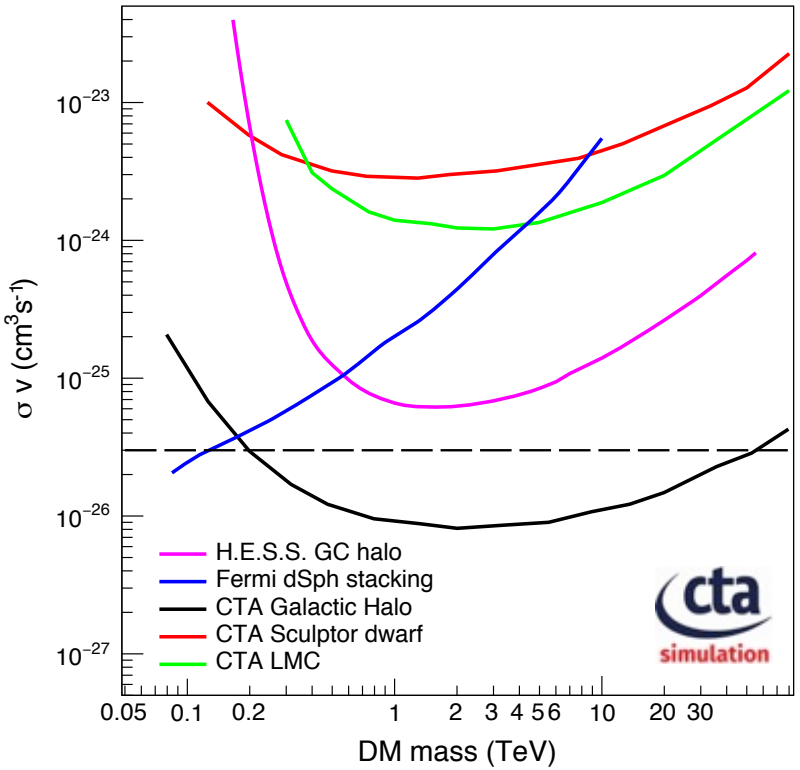




The quest for Dark Matter

Searching for WIMP Dark Matter

CTA has a unique discovery window for WIMP dark matter in the few 100 GeV to few 10 TeV energy domain, reaching the weak-scale cross sections inferred from the relic dark matter density

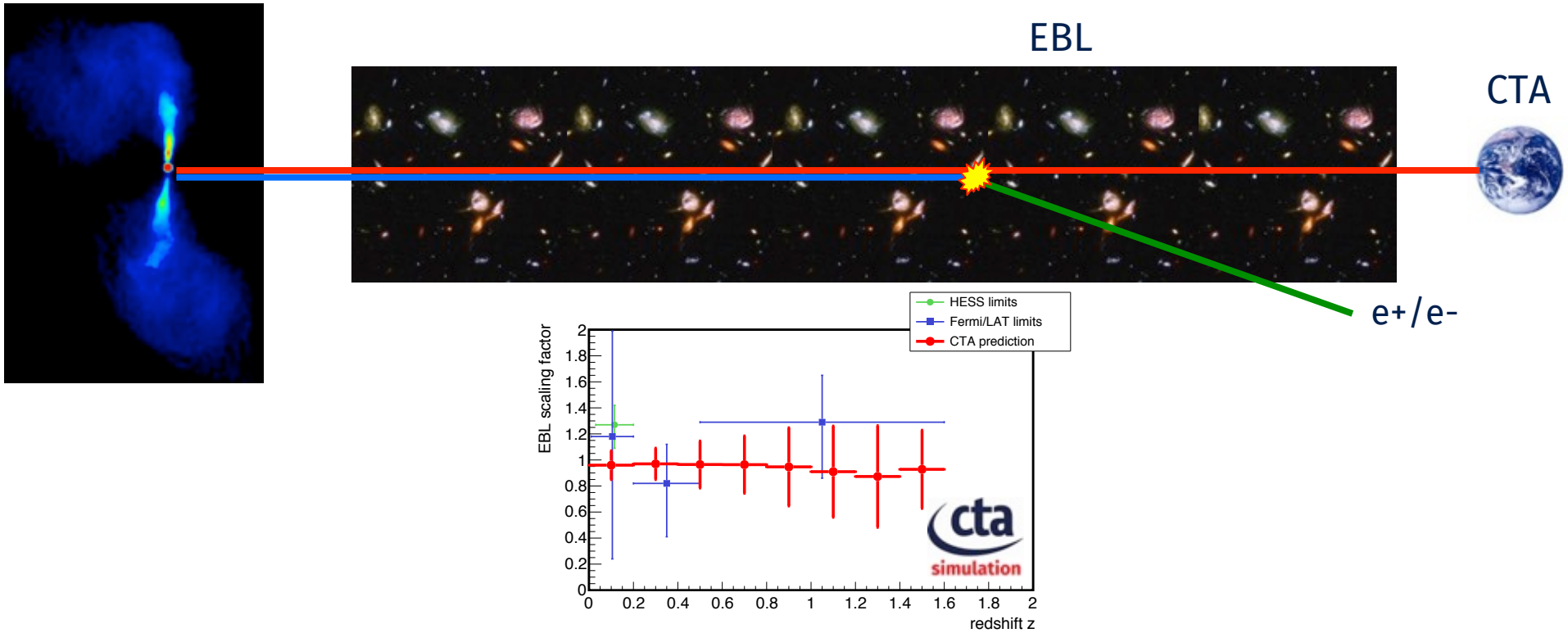


Probing the Universe

Probing the star-formation history over cosmic times

CTA will measure the attenuation of gamma rays by pair production on infrared photons and thus determine the level of the extragalactic infrared background light

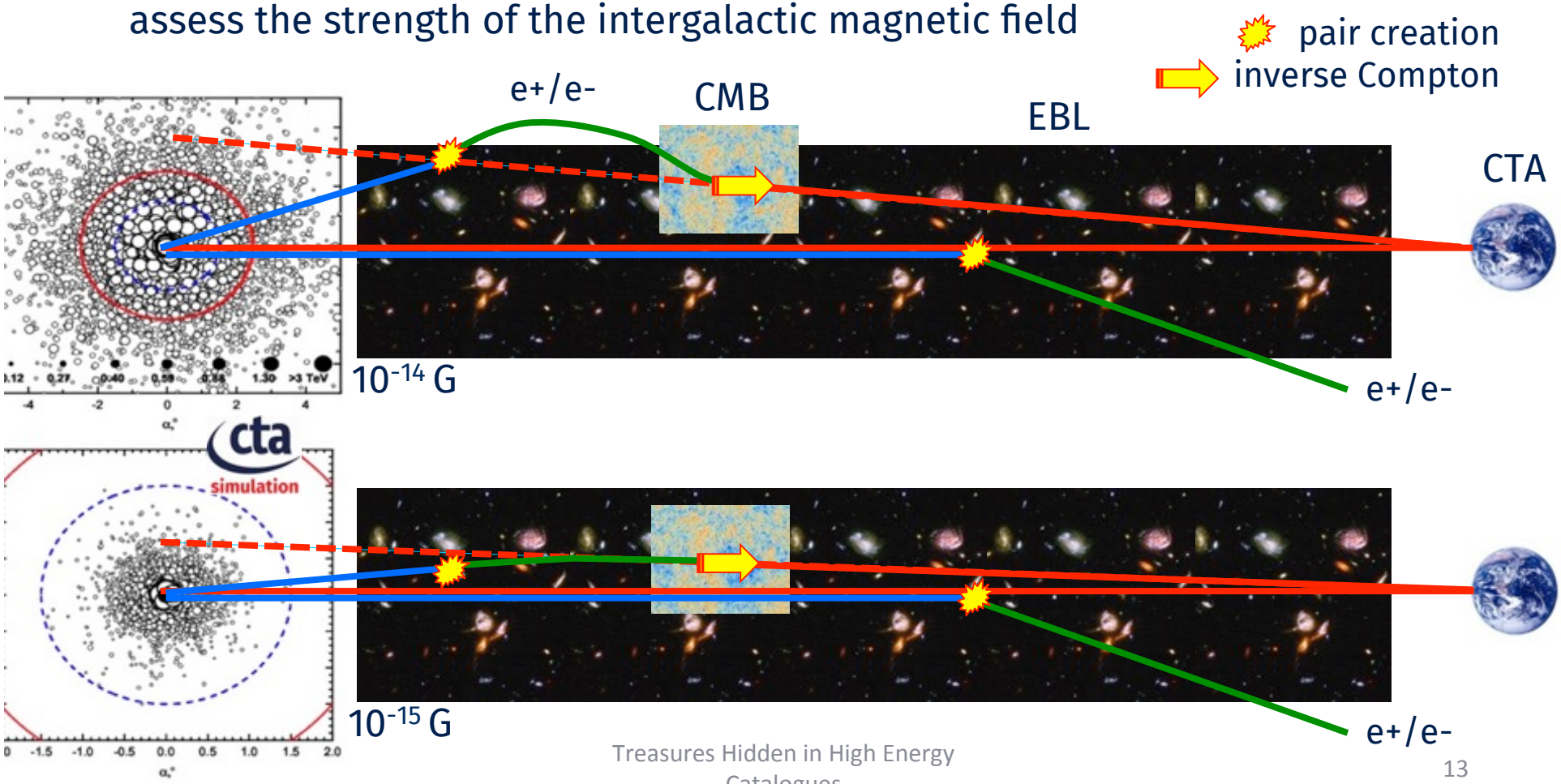
pair creation



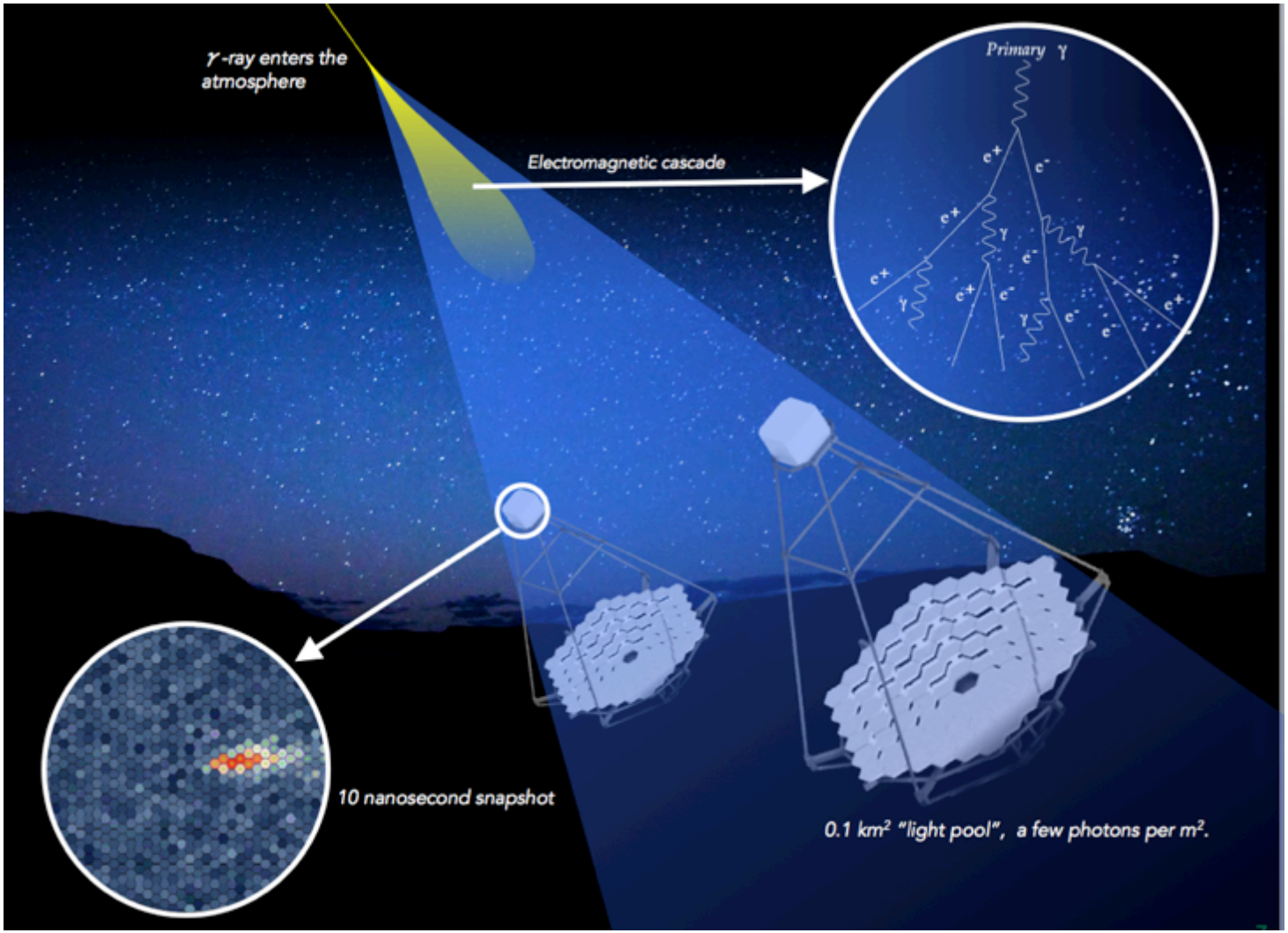
Probing the Universe

Probing the intergalactic magnetic field

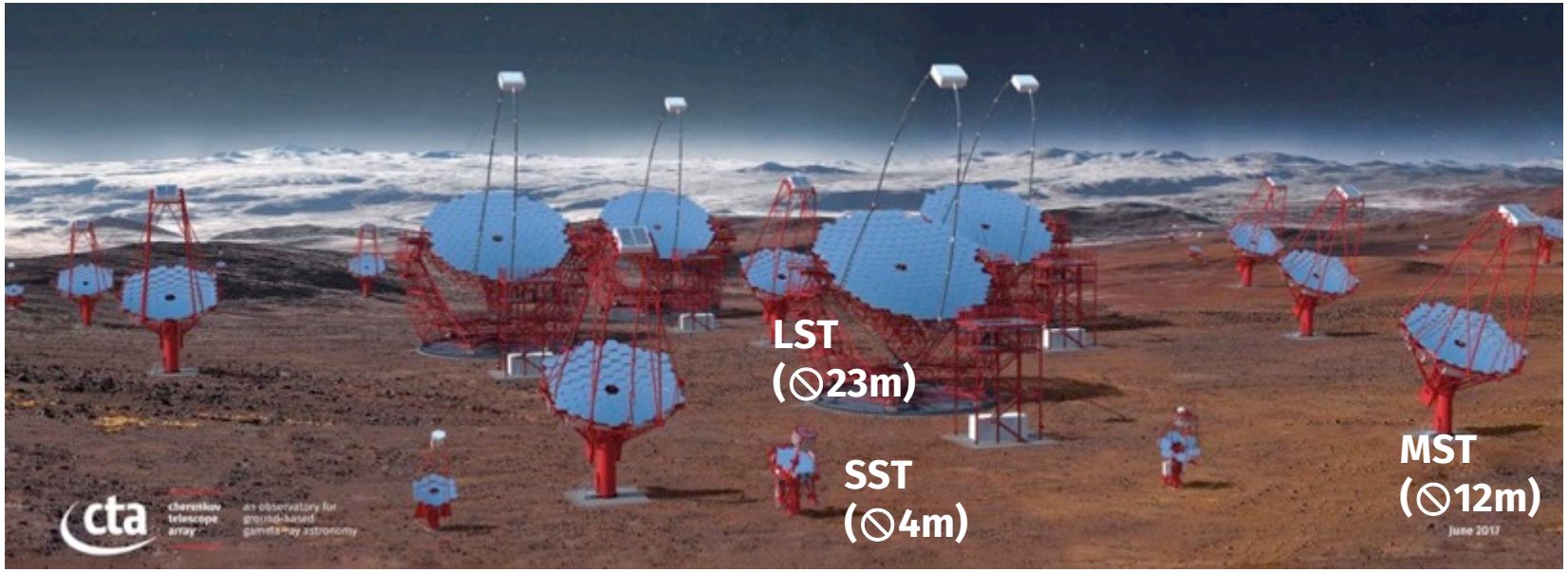
CTA will search for pair halos around AGN or for echoes in their flares to assess the strength of the intergalactic magnetic field

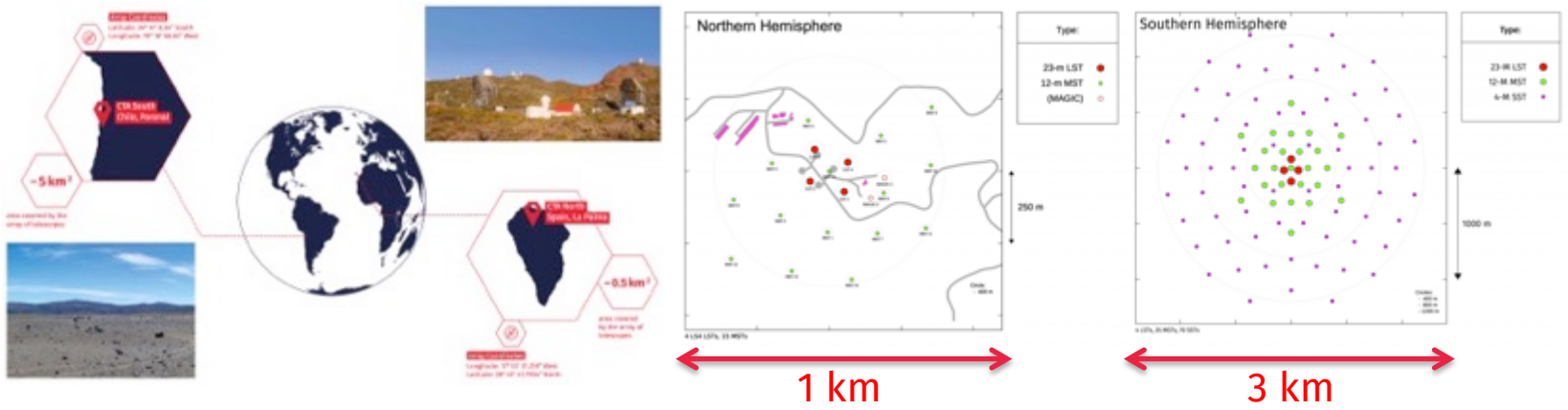


How CTA works

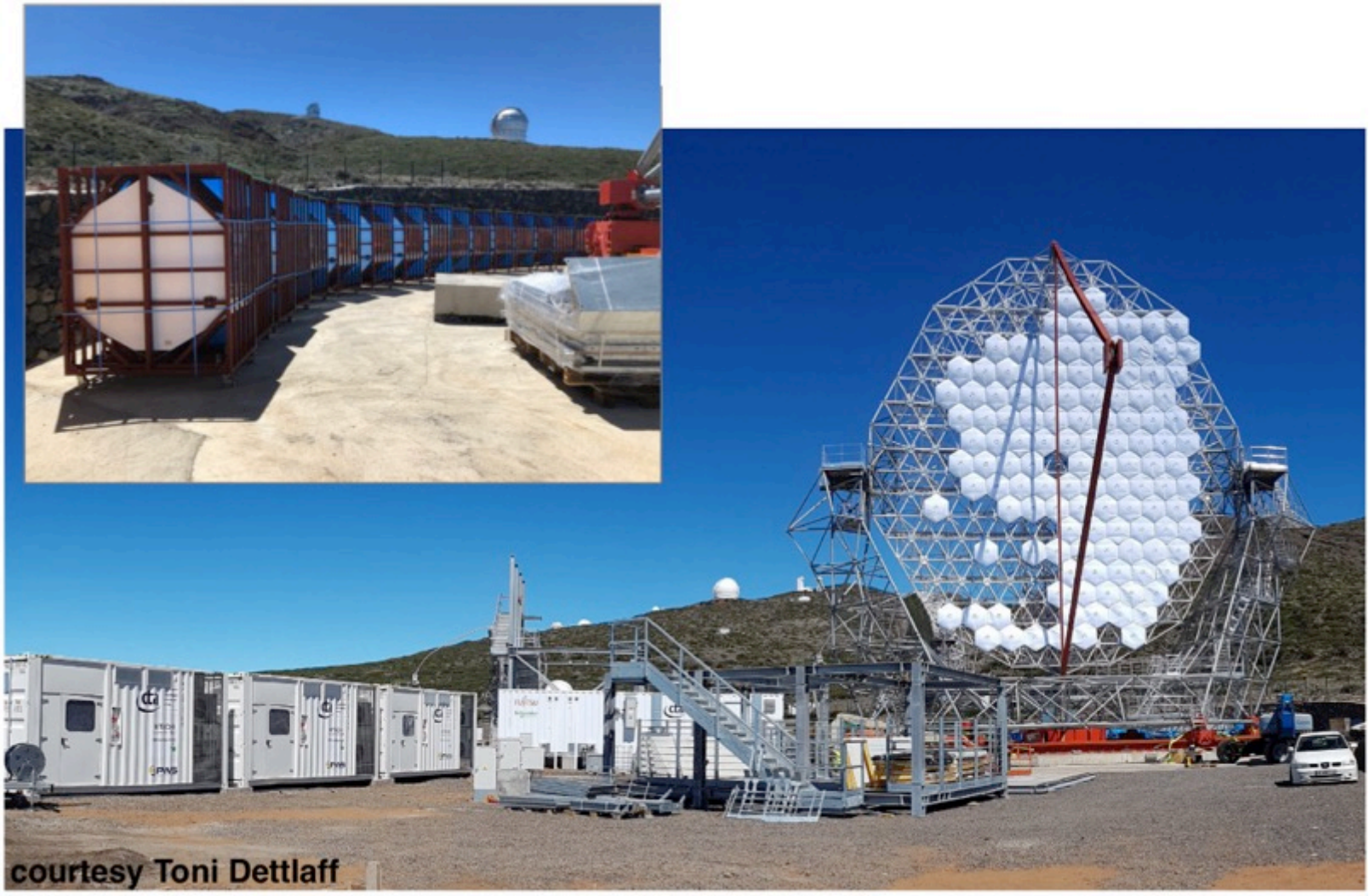


Array sites

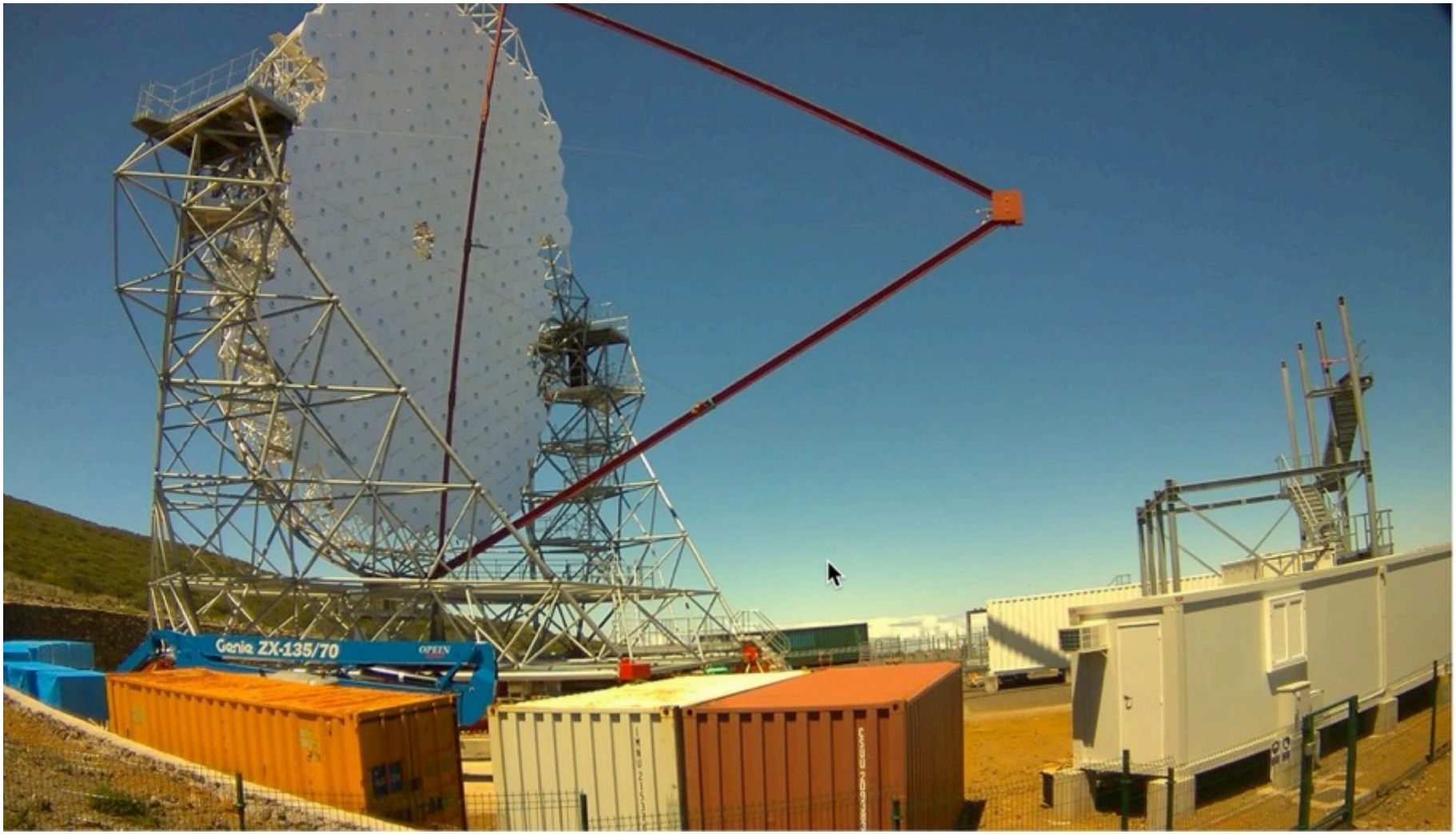

LST
(⦸23m)
SST
(⦸4m)
MST
(⦸12m)
cta
cherenkov
telescope
array
an observatory for
ground-based
gamma-ray astronomy
June 2017


~5 km²
~0.5 km²
Northern Hemisphere
Type:
23-m LST
12-m MST
(MAGIC)
250 m
Southern Hemisphere
Type:
23-M LST
12-M MST
4-M SST
1000 m
1 km
3 km

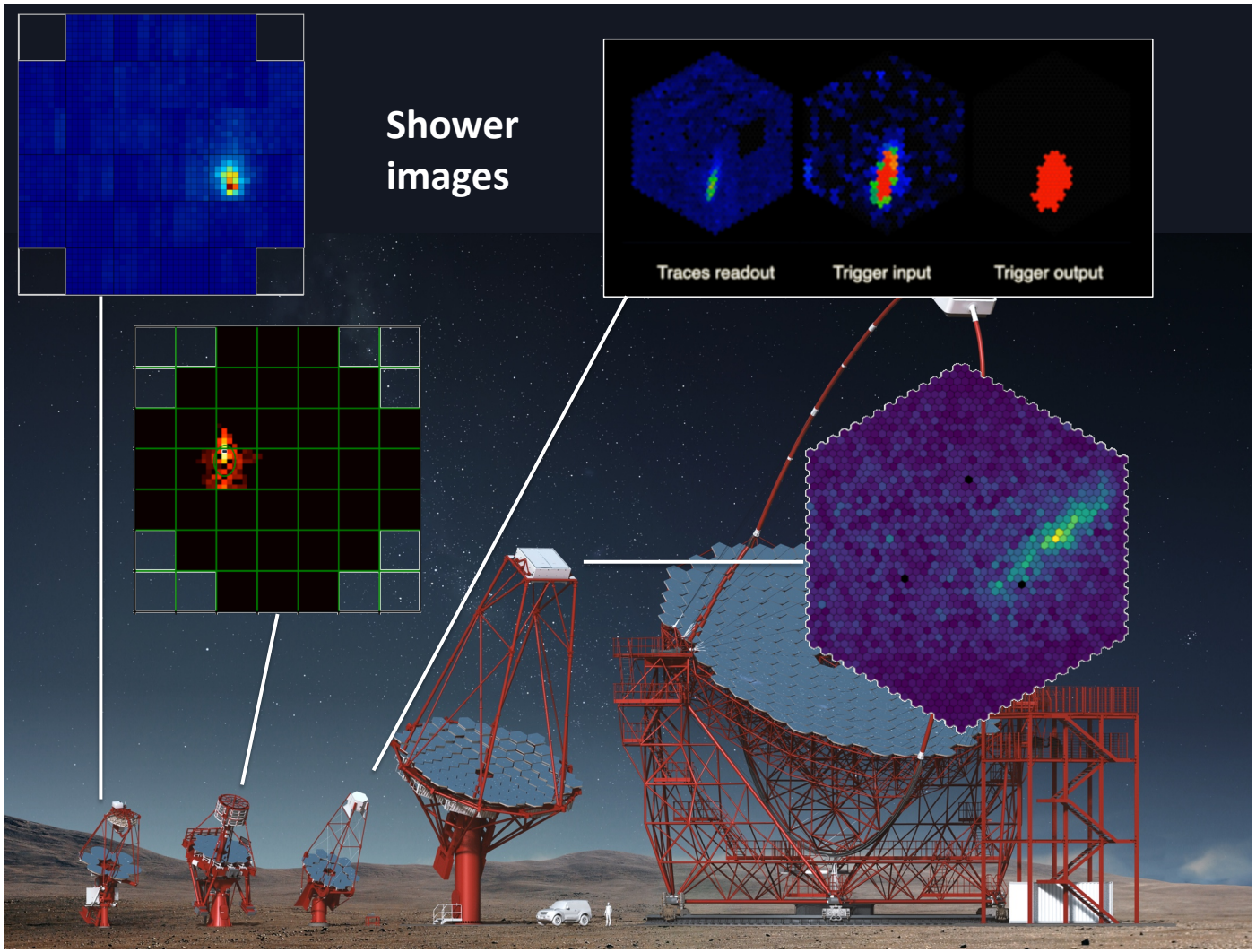
LST-1 prototype construction started



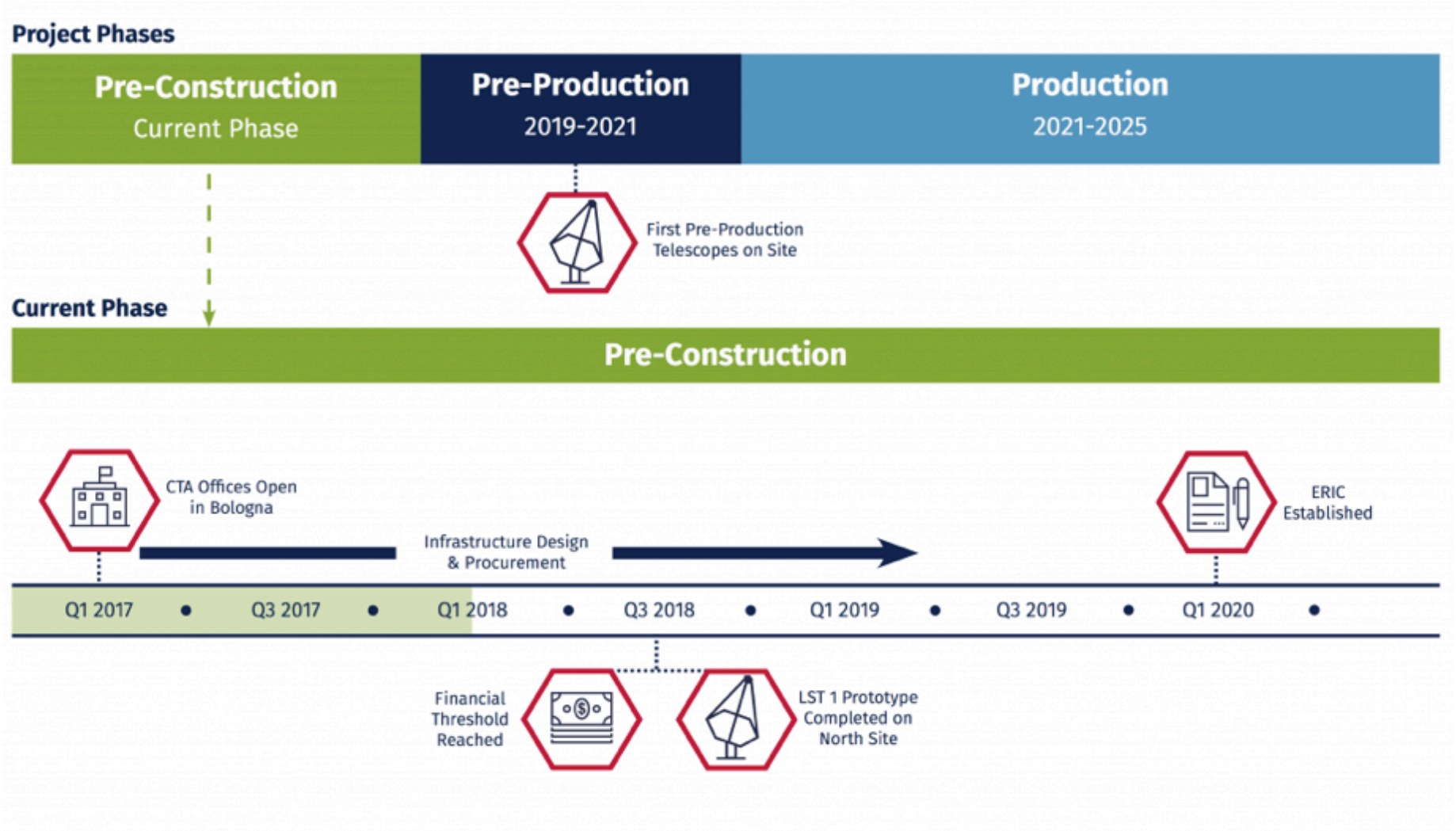
LST-1 prototype construction started



Prototypes for all other telescopes exist



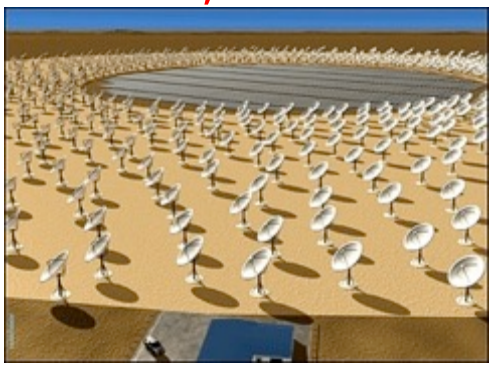
Project status



Project timeline

Synergies

SKA, LOFAR

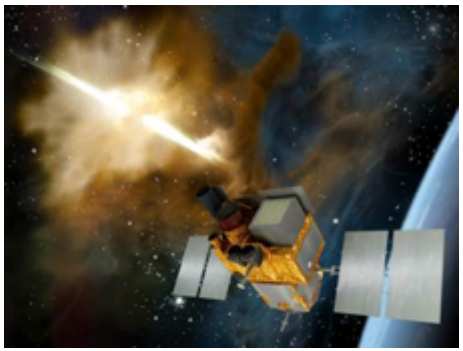


Broad band coverage
Alerts

Virgo/LIGO

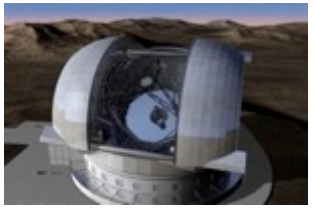
GW alerts

SVOM



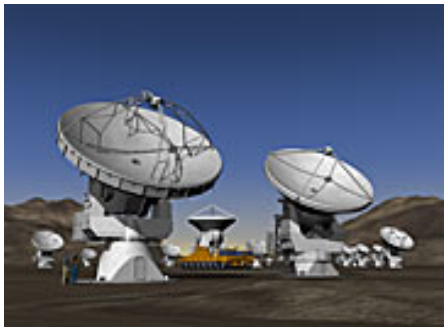
Alerts

...



...

ALMA



ISM ionisation
BH jet imaging

Fermi

Low-energy coverage
Alerts

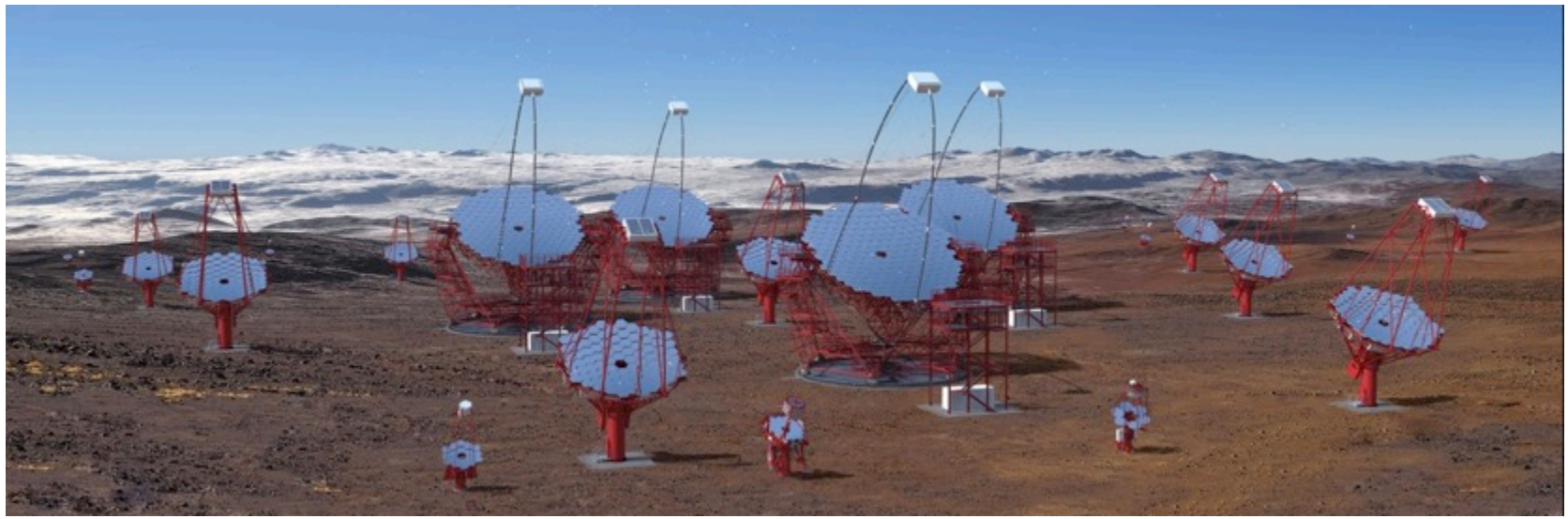
HAWC

Sky survey
Alerts

Athena

Cosmic rays / SNR
Jet-disk connection

Take home message



- CTA will be a major infrastructure for high-energy astronomy for the next decades
- CTA science focuses on cosmic rays, particle acceleration physics and dark matter searches
- A broad range of synergies exists with other scientific domains, and CTA will reach well beyond the traditional high-energy community