cta cherenkov telescope array **FACTS**

The Next Generation in Very High-Energy Astronomy

Credit: Gabriel Pérez Díaz, IAC

Quick facts about the CTA Observatory (CTAO):

CTAO will be the largest ground-based gamma-ray observatory in the world with dozens of telescopes located in the northern and southern hemispheres.

CTAO will have unprecedented accuracy and will be up to 5-10 times more sensitive than existing instruments.

CTAO will look at the sky at higher resolution than ever measured before.

The naturally occurring cosmic particle accelerators CTAO will probe can reach energies much higher than man-made accelerators.

CTAO will have a broad energy coverage from billions to trillions the energy of visible light (20 GeV to 300 TeV).

The Observatory is expected to generate approximately 35 petabytes (PB) of data in the first five years of operation (1 PB = 1 million GB).

CTAO will be the first ground-based gamma-ray observatory open to the world-wide astronomical and particle physics communities as a resource for data from unique, high-energy astronomical observations.

Building the world's most advanced ground-based gamma-ray detector

CTA is a global initiative to build the world's largest and most sensitive high-energy gamma-ray observatory. More than 1,500 members from 25 countries contribute to the definition of the instrument design and the scientific programme of CTAO. The CTAO gGmbH, which is governed by a growing list of shareholders, will prepare the design and implementation of the Observatory.

CTAO will serve as an open observatory to the world-wide physics and astrophysics communities. The CTA Observatory will detect high-energy radiation with unprecedented accuracy and up to 10 times better sensitivity than current instruments, providing novel insights into the most extreme events in the Universe.

The project to build CTAO is well advanced: working prototypes exist for all the proposed telescope designs and significant site characterization and design work has been undertaken. The southern hemisphere site is located close to the existing European Southern Observatory site at Paranal, Chile. The northern array site is at the Roque de los Muchachos astronomical observatory on the island of La Palma, Spain. Construction will begin once the final legal entity of CTAO, an ERIC, is established.

CTAO's unprecedented accuracy and improved sensitivity will provide deep insights into the turbulent, high-energy Universe.

This publication has received funding from the European Union's Horizon 2020 research and innovation programs under Grant Agreement No 676134.

Saupfercheckweg 1
69117 Heidelberg
Germany

+49-6221-516471
cta-observatory.org

facebook.com/ctaobservatory
@CTA_Observatory

The science

The gamma rays observed by CTAO are trillion times more energetic than visible light and contain information about some of the most extreme phenomena in the Universe.

Cosmic targets

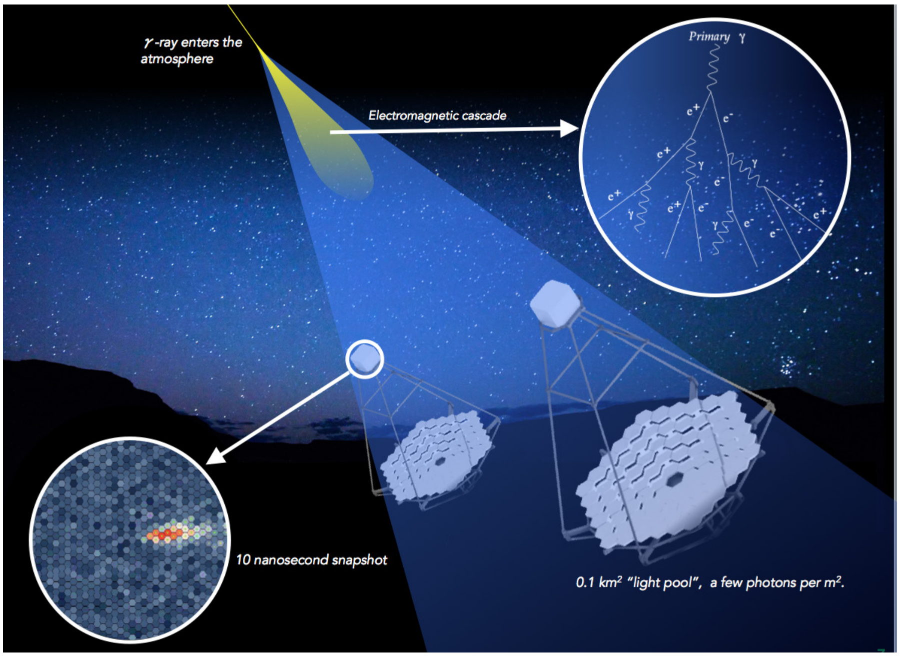
In our own galaxy, the Milky Way, CTA will detect cosmic sources that include the remnants of supernova explosions, the rapidly spinning ultra-dense stars known as pulsars and stars in binary systems and large clusters. Beyond the Milky Way, CTA will detect star-forming galaxies and galaxies with supermassive black holes at their centres (active galactic nuclei) and, possibly, whole clusters of galaxies. CTA may even find a signature of dark matter, evidence for deviations from Einstein's theory of special relativity and definitive answers to the contents of cosmic voids, the empty space that exists between galaxy filaments in the Universe.

Advancing the science

Current generation ground-based gamma-ray detectors (H.E.S.S., MAGIC and VERITAS) have been collecting results since 2003, increasing the number of known gamma-ray-emitting objects from 10 to more than 200. CTAO will build on the advances pioneered by its predecessors in order to expand this catalogue, detecting more than 1,000 new objects.

CTAO will transform our understanding of the high-energy Universe by addressing three major study themes: understanding the origin and role of relativistic cosmic particles, probing extreme environments and exploring the frontiers of physics.

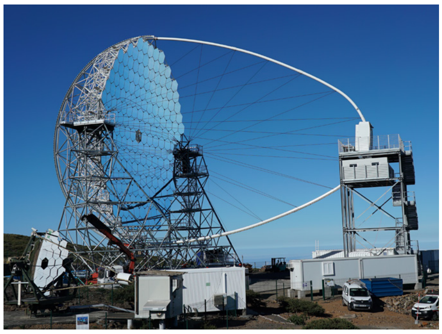
Detecting Cherenkov light



The gamma rays that CTAO will detect do not make it all the way to the Earth's surface. When they reach the Earth's atmosphere they interact with it, producing cascades of subatomic particles. Nothing can travel faster than the speed of light in a vacuum but, in air, a very energetic particle can travel faster than light, which is slowed by the index of the refraction of the air. Thus, very-high energy particles in the atmosphere can create a cone of blue "Cherenkov light" similar to the sonic boom created by an aircraft exceeding the speed of sound. Although the light is spread over a large area, the cascade only lasts a few billionths of a second. CTAO telescopes' large mirrors and high-speed cameras will detect the flash of light and image the cascade generated by the gamma rays for further study of their cosmic sources.

The telescopes

Since high-energy gamma rays are extremely rare, CTAO will maximize its coverage with dozen of telescopes split between one site in the northern hemisphere and a larger site in the southern hemisphere. At least three classes of telescopes are required to cover the full CTAO energy range (20 GeV to 300 TeV): Large-Sized Telescope (LST), Medium-Sized Telescope (MST) and Small-Sized Telescope (SST). Each telescope design includes a large segmented mirror (23m, 12m and 4m diameter, respectively) to reflect the Cherenkov light to a high-speed camera that can digitize and record the image of the shower.



Above, the LST prototype on La Palma. Credit: Iván Jiménez, IAC

The CTA Consortium includes about 1,500 members from more than 150 institutes in 25 countries.

Rev0721