cta cherenkov telescope array **FACTS**

The Next Generation in Very High-Energy Astronomy

Credit: Gabriel Pérez Díaz, IAC

Quick facts about CTA:

CTA will be the largest ground-based gamma-ray observatory in the world with 118 telescopes located in the northern and southern hemispheres.

CTA will have unprecedented accuracy and will be 10 times more sensitive than existing instruments.

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

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

CTA will have a broad energy coverage from billions to trillions the energy of visible light.

The Observatory is expected to generate approximately 100 petabytes (PB) of data in the first five years of operation (1 PB = 1 million GB).

CTA 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 1,400 members from 31 countries are engaged in the scientific and technical development of CTA. The CTAO gGmbH, which is governed by a growing list of shareholders, will prepare the design and implementation of the Observatory.

CTA 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 approximately 10 times better sensitivity than current instruments, providing novel insights into the most extreme events in the Universe.

The project to build CTA 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 is expected to begin in 2020.

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

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The science

The gamma rays observed by CTA are 10 trillion times more energetic than visible light and contain information about some of the most extreme phenomena in the Universe.

Cosmic targets

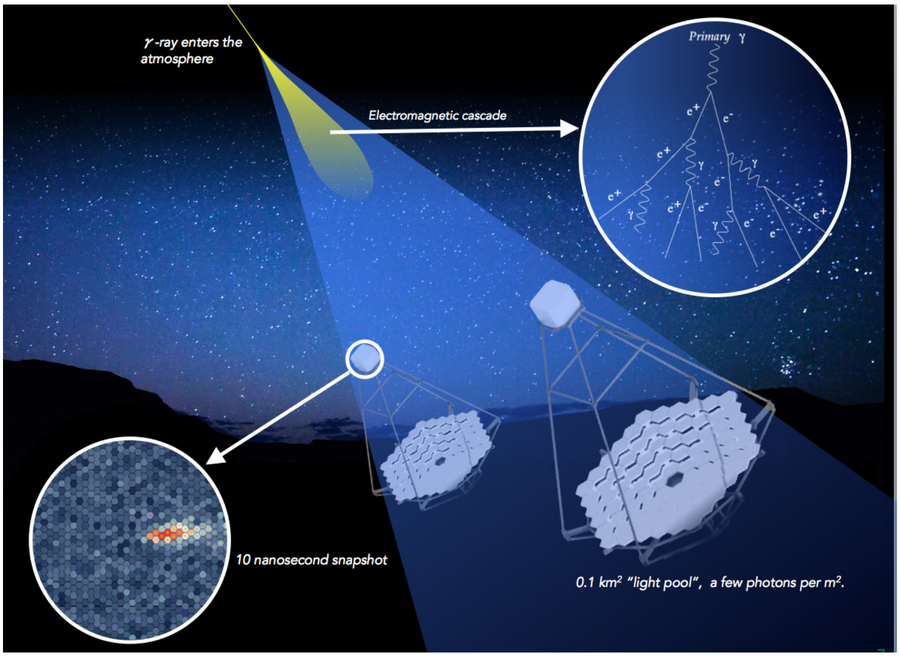
In our own galaxy, the Milky Way, CTA will detect cosmic sources that include the remnants of supernova explosions, the rapidly spinning ultra-dense stars known as pulsars and stars in binary systems and large clusters. Beyond the Milky Way, CTA will detect star-forming galaxies and galaxies with supermassive 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 150. CTA will build on the advances pioneered by its predecessors in order to expand this catalogue tenfold, detecting more than 1,000 new objects.

CTA 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.

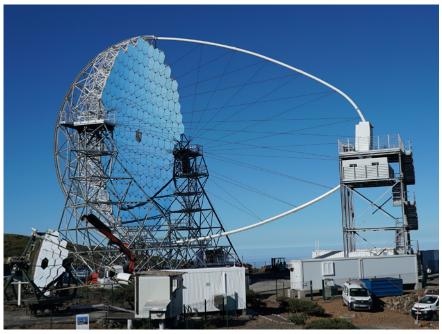
Detecting Cherenkov light



The gamma rays that CTA 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. CTA's 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, CTA will maximize its coverage with more than 100 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 CTA 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 more than 1,400 members from 200 institutes in 31 countries.

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