cherenkov telescope array

SCIENCE

Venturing Beyond the High-Energy Frontier

Credit: NASA/ESA/SSC/CXC/STScI

CTAO will explore the most extreme phenomena in the Universe

CTA is an initiative to build the world's largest and most sensitive very high-energy gamma-ray observatory. With dozens of telescopes located in the northern and southern hemispheres, the CTA Observatory will detect high-energy radiation with unprecedented accuracy and will be up to 10 times more sensitive than current instruments.

The current generation of very high-energy gamma-ray detectors (H.E.S.S., MAGIC and VERITAS) have been collecting results since 2003, increasing the number of known gamma-ray-emitting celestial 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's unique capabilities will help us to address some of the most perplexing questions in astrophysics. CTA will seek to understand the impact of high-energy particles in the evolution of cosmic systems and to gain novel insight into the most extreme and unusual phenomena in the Universe. CTA will search for annihilating dark matter particles and deviations from Einstein's theory of special relativity and even conduct a census of particle acceleration in the Universe.

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.

CTAO's unique capabilities will include:

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

An energy resolution of 10 percent will improve CTAO's ability to look for spectral features and lines associated with the annihilation of dark matter particles.

Energies as low as 20 GeV will allow CTAO to probe transient and time-variable gamma-ray phenomena in the very distant Universe with unprecedented precision.

Energies up to 300 TeV will push CTAO beyond the edge of the known electromagnetic spectrum with unprecedented accuracy, providing a completely new view of the sky and allowing us to search for extreme particle accelerators.

A field of view of eight degrees will allow CTAO to survey the sky much faster and measure very extended regions of gamma-ray emission.

An angular resolution approaching one arcminute will allow CTAO to resolve many cosmic sources to understand how ultra-relativistic particles are distributed in and around these systems.

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

Study topics

Ground-based gamma-ray astronomy is a young field with enormous scientific potential. The current generation instruments have already demonstrated the huge physics potential of astrophysical measurements at teraelectronvolt (TeV) energies.

With its superior performance, the prospects for CTAO combine guaranteed science – the in-depth understanding of known objects and mechanisms – with anticipated detection of new classes of gamma-ray emitters and new phenomena, and a very significant potential for fundamentally new discoveries.

CTA will seek to address questions in and beyond astrophysics falling under three major themes:

Theme 1: Understanding the Origin and Role of Relativistic Cosmic Particles

Theme 2: Probing Extreme Environments

Theme 3: Exploring Frontiers in Physics

Key targets

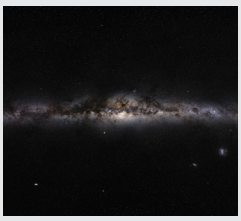
CTAO will be able to detect hundreds of celestial objects in our Galaxy. These galactic sources will include the remnants of supernova explosions, the rapidly spinning ultra-dense stars known as pulsars and more normal stars in binary systems or in large clusters.

Beyond the Milky Way, CTAO will detect star-forming galaxies and galaxies with supermassive black holes at their centres (active galactic nuclei) and, possibly, whole clusters of galaxies. The gamma rays detected with CTAO may also provide 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.

More specifically, CTAO will observe the key targets listed to the right in order to address its three major themes. Learn more about what CTAO will seek to discover and its expected performance at www.cta-observatory.org.

Credit: NASA/ESA/SSC/CXC/STScI

Galactic Centre



Credit: ESO/S. Brunier

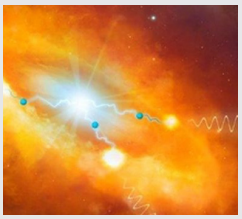
Galactic Plane

Credit: X-ray: NASA/CXC/MIT/E.-H Peng. Optical: NASA/STScI

Galaxy Clusters

Credit: Bucksnort Observatory

Large Magellanic Cloud

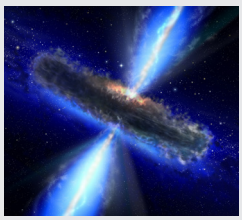


Credit: Dr Mark A. Garlick/ H.E.S.S. Collaboration

Cosmic Ray PeVatrons

Credit: NASA, ESA, and The Hubble Heritage Team (STScI/AURA)

Star Forming Systems



Credit: ESA/NASA

Active Galactic Nuclei

Credit: NAOJ

Transient Phenomena

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