

Cherenkov Telescope Array Observatory CTAO

Scientific area	Astronomy and astroparticle physics
Host country	Germany (Italy: future ERIC)
Infrastructure type	Centralised, multiple sites
Dutch node or similar	-
Legal entity	gGmbH (ERIC status expected in late 2023)
Established	2014
The Netherlands member since	2015 (associate)
Phase	Preparatory (pre-construction)

Duration of agreement

The CTAO gGmbH is temporary, until the new legal entity (ERIC) will take over in the 2nd semester of 2023.

Terms of withdrawal

Members can withdraw with a 3 months prior notice to the end of the business year.

Access to facilities

Not applicable for the time being as users will come later once the CTA Observatory ERIC will be existing and running.

Access to data

Not applicable for the time being as users will come later once the CTA Observatory ERIC will be existing and running.

User definition

The current CTAO gGmbH does not have any users as its purpose is to prepare the design and implementation of the CTAO facility. The construction of the CTA Observatory will formally start once the CTA Observatory ERIC will be in place and it should last 5-6 years. The finalized statutes of the CTA Observatory ERIC talk about users as European and international researchers. Data will be available to the users once the CTA Observatory ERIC is in place and running.

Description

CTA is a ground-based gamma-ray observatory constructed at two locations: one for observing the Northern hemisphere from La Palma (CTA-N), and one to observe the Southern hemisphere from La Paranal, Chile (CTA-S). Both consist of many individual telescopes which detect Cherenkov light from airshowers generated when gamma-ray photons enter the atmosphere. From these airshowers the direction and the energy of the photons are reconstructed. CTA covers a broad part of the spectrum (20 GeV to >100 TeV), with a sensitivity ten times better than current facilities like H.E.S.S., MAGIC and Veritas, and below 100 GeV outperforming the Fermi gamma-ray satellite by many orders of magnitude for transient sources.

The gamma-rays that CTA will detect are created by the most extreme phenomena in the Universe such as supernovae, merging neutron stars and black holes, as well as through collisions of certain types of the still enigmatic dark matter particles.

The CTA Observatory (CTAO) was founded to manage the construction and operation of the instrument; the current interim legal entity, the CTAO gGmbH with shareholders (members) from 11 countries plus ESO, is charged with preparing the design and the implementation of the Observatory and will give way to the CTAO European Research Infrastructure consortium (ERIC) with governments as shareholders. The Netherlands is currently an associate member country of the gGmbH. The Netherlands has the ambition to join the ERIC but is not one of its founding members.

The CTA Consortium includes 1,500 members from more than 150 institutes in 25 countries. The scientists and engineers of the CTA Consortium devised the CTA concept more than a decade ago and have been the driving force behind its design. The Consortium has developed and detailed CTA's key science goals and will be

responsible for the science analysis and publication of scientific results of the Key Science Projects, ensuring that CTA produces legacy data sets and data products for use by the entire community. Consortium member institutes will make in-kind contributions to CTA construction and will support array commissioning and science verification and science operations. The consortium is a separate entity from the CTA Observatory. In the future there may be a new statute for the consortium, with the membership more closely aligning with CTAO ERIC membership.

Financial details

Mean Dutch membership over 5 year period (k€): 40 (*)
Mean Dutch share of contribution over 5 year period (%): 1.5 % (*)

*Associate membership gGmbH

Year	NL membership (k€)	NL contribution (% of total)	Total membership (k€)	Total expenditure (k€)	Turn-over (k€)
2016	40	1.78	2,250	n/a	n/a
2017	40	1.59	2,510	n/a	n/a
2018	40	1.63	2,450	n/a	n/a
2019	40	1.27	3,141	n/a	n/a
2020	40	1.26	3,187	n/a	n/a

Employee statistics

	Female	Male	Other	Total
Total	16	21	0	37
Of which Dutch	0	0		0

Table 1. Employee statistics for 2019 in Full Time Equivalents (FTE)

Use of the infrastructure

User, application, sample request and data request information

n/a

Comments by the RI:

Not applicable for the time being as users will come later once the CTA Observatory ERIC will be existing and running. The current CTAO gGmbH does not have users as it does not produce any data products but focuses its work on preparing the construction of the CTA Observatory ERIC.

Deliveries to the RI

Contributions provided by organisations or companies in the participating countries

n/a

Comments by the RI:

The current CTAO gGmbH has the purpose to prepare the design and implementation of the CTAO facility. The construction of the CTA Observatory will formally start once the CTA Observatory ERIC will be in place and it should last 5-6 years. Deliveries mainly in-kind contributions are still to come and should represent about 74% of the total contributions to the construction cost.

Total sum spent on other deliveries such as equipment, services and consumables

Year	NL (k€)	Other countries (k€)	NL (% of total)
2016	n/a	237.000	n/a
2017	n/a	960.000	n/a
2018	n/a	1.219.600	n/a
2019	n/a	2.152.000	n/a

Table 2: Total sum spent on other deliveries such as equipment, services and consumables

Comments by the RI:

Rounded amounts in Euro of the current CTAO gGmbH annual expenses for services, equipments and other costs.

Income from user fees

n/a

Comments by the RI:

No users at the moment.

Additional questions to the RI (2020)

What is the Dutch contribution to the RI?

The Dutch participation in the current CTAO gGmbH consists in an annual contribution (EUR 40k) since 2015 to the overall Budget as Associate Member. This translates in membership within the Council and straw voting rights.

Currently, are there any RI's that provide similar kinds of research infrastructure and services as yours in the world?

Ground-based gamma-ray astronomy – imaging the Universe at very-high energies (VHE) above tens of GeV and covering several decades of the electromagnetic spectrum – is a young branch of astronomy that has developed very rapidly since the detection of the first cosmic VHE source in 1989. The Cherenkov Telescope Array Observatory (CTAO) is envisaged as a general-purpose observatory for this VHE waveband and it will be the first truly open VHE observatory, providing accessible data products and support services to a wide community. It is motivated by the success of existing imaging atmospheric Cherenkov telescopes (IACTs) such as H.E.S.S., MAGIC and Veritas.

What are the overlaps and what are the main differences? To which extent do you cooperate or compete?

The preceding gamma-ray instrumentation pioneered the research of the Universe at the highest-energy electromagnetic radiation including ground-based telescopes – H.E.S.S., MAGIC, VERITAS – and space instrumentation – INTEGRAL, Swift, FERMI, AGILE – each of which have produced new and outstanding scientific discoveries. The CTA Observatory is much larger than current instruments (a factor of ~20 more telescopes), resulting in vastly improved performance but also specific challenges in design, construction and operation.

What are the RI's major educational and outreach activities?

During 2016-2019, CTAO educational and outreach activities were mainly:

- Producing promotional material: public CTA website, brochures in different languages, film series released via YouTube & social media, a press kit.
- Ensuring and consolidating the presence of the CTA project on social media (Facebook, Twitter, Instagram, YouTube, LinkedIn and Flickr).
- Creation of "CTA for Educators" and its Spanish counterpart "CTA para Educadores" (web pages with educational initiatives and material to bring the gamma-ray astronomy to education levels from primary to the University) and of the annual event "Women of CTA" already at its 4th edition, where three female CTA members present their work and chat with the public.

- Participating in high-level international conferences and exhibitions around the world (EAS, SPIE, COSPAR, IAU, MPI Open House, Open Day at the ORM...).
- Co-organization of activities with partners, or participation in their activities, including a series of talks in high schools in La Palma, workshops and in-person/virtual visit at the ORM with visits to the LST-1, formal education programmes with teachers, on-line talks given by women directed towards secondary school students, and Chilean workshops and activities for the Astronomy Day.

In 2019, CTAO launched the "Astrodiversity" project, whose goal is to create or support initiatives within the inclusion and diversity framework to foster equity in science globally like "AMANAR: Under the same sky" that promotes and supports the scientific education of children living in the Saharawi refugee camps in Tindouf (Algeria).

CTAO also organised in 2019 the "Astrochat Night" live, an opportunity to chat with a panel of experts to resolve some of your curiosities about the Universe and learn about the latest advancements in science technology.

Last, in 2019 a more active participation from the CTA Outreach Committee started being fostered through the presentation of CTA communication efforts at the CTAC General Meetings.