The CTA Observatory

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In recent years ground-based γ-ray astronomy has experienced a major breakthrough with the impressive astrophysical results obtained mainly by the current generation experiments like CANGAROO, H.E.S.S., MAGIC, MILAGRO and VERITAS. CTA stands for an initiative to build the next generation ground-based γ-ray instrument, will serve as an observatory to a wide astrophysics community. In this poster we discuss the organizational and operational requirements for operating such a large-scale facility as well as the specific needs of VHE γ-ray astronomy. We compare it to other major infrastructures in astrophysics, particle physics and astroparticle physics.

Introduction

The success of ground based γ-ray astronomy experiments in recent years has brought nearly all scientists working in the field in Europe together to design and promote the Cherenkov Telescope Array (CTA). CTA will achieve superior sensitivity by deploying a large number of Cherenkov telescopes of different sizes covering a large area on the ground for high detection rates. CTA foresees improvement of sensitivity of factor 5-10 in the current energy domain (somewhat below 100 GeV to some 10 TeV) and will extend the energy range from 10 GeV to about 100 TeV. The observatory will consist of two arrays: a southern hemisphere array, which allows deep investigation of galactic sources and of the central part of our Galaxy, but also for the observation of extragalactic objects. The northern hemisphere array is dedicated mainly to northern extragalactic objects. Obviously the arrays will not be only restricted to pure astrophysical observations, but will also make contributions to the field of particle physics and cosmology.

CTA will be operated as an open, proposal-driven facility analogous to optical observatories, that shall be available for all scientists from those countries that contribute to the construction and operation of the observatory. It is foreseen to follow the practice of other major, successfully operating observatories (e.g. ESO) and announce calls for proposals on regular intervals which will be peer-reviewed by a changing group of international experts. Based on experience of current experiments and other ground-based observatories, different classes of proposals (targeted, surveys, time-critical, Target of Opportunity and regular programs) are foreseen. User support will be provided via a data centre, in the form of standard processing of data and access to the standard MC simulations and analysis pipelines used in data processing.

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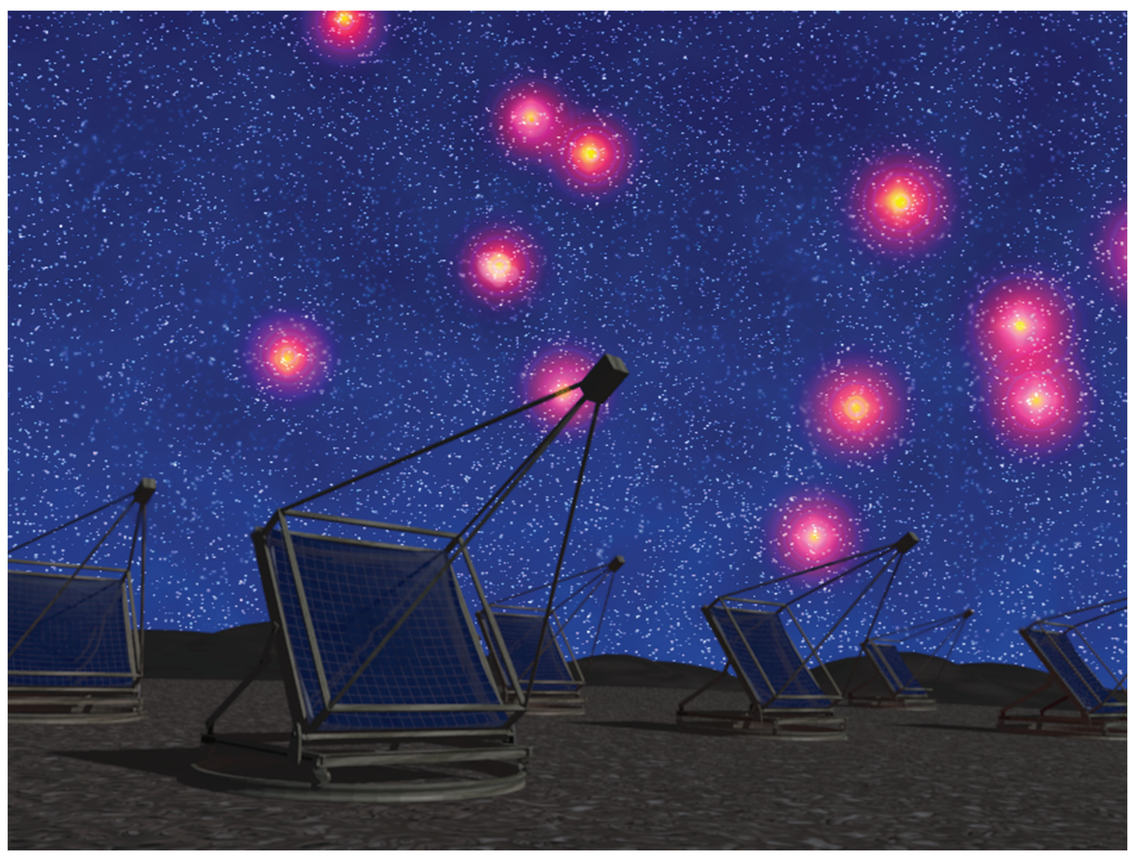

One of the several design variants proposed for the medium-size CTA telescopes (Credit ASPERA/G.Toma/A.Saftoiu)

Specific Needs of VHE γ-ray Astronomy

Like the major optical and radio observatories the CTA arrays will be situated in remote locations, which means that the operation of the array should be as robotic as possible. On the other hand, the detection technique of Cherenkov telescopes require operation of high voltages, which makes the robotic operations challenging. It is also foreseen that the observations of a single source are distributed over several nights and on same night several sources from different proposals will be observed. Therefore the onsite operations i.e. the observations and maintainance will be handled by the onsite staff rather than visiting astronomers.

Another challenge will be the data rate from the foreseen ~100 telescopes. The remote location will most likely not allow the real-time transfer of the raw data, but the data will rather be pre-processed onsite.

The layout of the CTA observatory will consist of operations centre/centres, data centre, managment and user community.

Comparison with Other Major Facilities

The community of scientists actively involved in Cherenkov Astronomy in Europe involve currently about 360 scientists (120 in the HESS collaboration and 180 in the MAGIC collaboration, about 20 in VERITAS, and about 40 scientists not associated with these current instruments). Planning and designing CTA involves about another 100 scientists not currently involved in either of the currently running experiments. CTA is hence expected to serve a community larger than those to any national astronomical facility in Europe and comparable to the size of the community using the ESO observatory in the 1980s. In **Table 1** we compare foreseen CTA Observatory to some of the major facilities in astrophysics, astroparticle physics and particle physics.

Table 1. Major facilities in astrophysics, astroparticle physics and particle physics

Astrophysics	
Anglo-Australian Observatory	
Members	Australia and United Kingdom (from 1st of July 2010 only Australia)
Financial Contribution	Goverments of Australia and UK (from 1st of July 2010 only Australia)
Access	Australian and British scientific public
Extra Funds	
ALMA	
Members	ESO, NRAO and NOAJ
Financial Contribution	main: ESO, NSF + NRC, NSC, NINS
Access	Scientific public in all member countries + VO
Extra Funds	by agencies/countries
ESO	
Members	13 countries
Financial Contribution	Identical Fraction of GNP
Access	Scientific public in all member countries (no quota) + VO
Extra Funds	by agencies/countries, buys special data
ORM	
Members	12 Telescopes
Financial Contribution	Separately to each telescope/telescope group
Access	Scientific public in all member countries (no quota) + VO
Extra Funds	by agencies/countries, buys special data
JCMT	
Members	JCMT is part of JAC together with UKIRT, which is establishment of the UK, Canada and the Netherlands
Financial Contribution	Funding agencies in UK (55%), Canada (25%) and The Netherlands (20%)
Access	All scientific public in all countries (quotas).
Extra Funds	
VLA	
Members	National Facility of USA
Financial Contribution	Part of NRAO, which is supported by NSF and associated universities, Inc.
Access	Scientific public in all countries
Extra Funds	by a"92not-for-profit"92 science management corporation
Particle physics	
ANTARES	
Members	25 groups
Access	Whole Collaboration
Extra funds	by some extrenal organiztions, Regional and European funds
AUGER	
Members	99 groups from 18 countries
Financial Contribution	Internationl organizations and agencies and organizations from participating countries with uneven fractions.
Access	Whole Collaboration
Extra Funds	
CERN	
Members	20 member states
Financial Contributions	Identical Fraction of GNP
Access	Scientific public in all member countries and "'94Observer"'94 countries
Extra funds	by agencies/countries
ICECUBE	
Members	36 groups
Financial Contribution	Primary Funding Source: National Science Foundation
Access	Whole collaboration
Extra Funds	by agencies/countries
Astroparticle physics	
HESS	
Members	24 groups
Financial Contribution	Very uneven fraction (dynamic range 1:50)
Access	Whole Collaboration
Extra Funds	by agencies/coutries, no scientific returns
MAGIC	
Members	22 groups
Financial Contribution	Identical fraction of GNP and R&D
Access	Whole Collaboration
Extra Funds	by agencies/countries, no scientific returns
VERITAS	
Members	23 groups
Access	Whole collaboration
Extra Funds	by agencies/countries
CTA	
Members	**Over 50 institutes in 13 countries**
Access	**Scientific public in all member countries + Visiting Observers**
Extra funds	**by agencies/countries**

More Information

More information on the CTA project at
www.cta-observatory.org