Synergies with CTA and VHE Astrophysics

XMM-Newton: The Next Decade
Workshop Madrid 5/2016

Werner Hofmann
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Cherenkov Telescopes for TeV gamma ray astronomy

Cherenkov “light pool” on the ground

250 m
H.E.S.S. Galactic Plane Survey

77 TeV gamma ray sources, most extended at arc-min. scale
Northern & Southern sites
Up to ~100 telescopes per site
– provide multiple views of cascades
– provide large gamma-ray detection area

3 different telescope sizes (4 m, 14 m, 23 m)
to cover $2 \times 10^{10}$ eV to $3 \times 10^{14}$ eV range;
effective area grows with energy, compensating the decreasing flux
Angular resolution of few arc min.
The Cherenkov Telescope Array

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Up to ~100 telescopes per site
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3 different telescope sizes (4 m, 14 m, 23 m)
to cover 2 x 10^{10} eV to 3 x 10^{14} eV range;
effective area grows with energy, compensating the decreasing flux
Angular resolution of few arc min., ~8 degr. fov
CTA Consortium

32 Countries
over 200 Institutes
over 1200 Members
CTA Observatory gGmbH

Founded in summer 2014

Shareholders
- Czech Republic (Academy of Sciences)
- France (CNRS, CEA)
- Germany (DESY, MPG)
- Italy (INAF)
- Japan (ICRC)
- Spain (IAC)
- Switzerland (Univ. Zurich)
- UK (STFC)

Provides legal and organisational framework
Runs central CTA Project Office

Associates
- Netherlands
- South Africa
- Sweden
More on status

Design
Critical Design Review in June 2015

Sites
Site negotiations with IAC/La Palma, ESO/Chile well advanced, aim to finalize agreements in 2016
Evaluation of offers to host CTA Headquarters and CTA Science Data Management Centre ongoing, CTAO Council aims for decision in Summer 2016

Framework
MoU in preparation to allow start of implementation in 2017, followed by International Convention
Medium Size Telescope Prototype at DESY Zeuthen
Small Size Telescope Prototypes

at Cracow

on Sicily

at Meudon

First dual-mirror Cherenkov telescopes
Large Size Telescope Prototype

Ground breaking at La Palma
Oct. 2015
Dual-Mirror Medium Size Telescope

9.7 m primary
5.4 m secondary
5.6 m focal length, f/0.58

8° field of view
11328 x 0.07° SiPMT pixels
CTA Science Goals
CTA Key Science Projects
and Synergies
Theme 1: Cosmic Particle Acceleration
- How and where are particles accelerated?
- How do they propagate?
- What is their impact on the environment?

Theme 2: Probing Extreme Environments
- Processes close to neutron stars and black holes?
- Processes in relativistic jets, winds and explosions?
- Exploring cosmic voids

Theme 3: Physics Frontiers – beyond the SM
- What is the nature of Dark Matter? How is it distributed?
- Is the speed of light a constant for high energy photons?
- Do axion-like particles exist?
CTA science programme

Key Science Projects
- Ensure that important science questions for CTA are addressed in a coherent fashion and with a well-defined strategy,
- Conceived to provide legacy data sets for the entire community

Example: galactic and extragalactic surveys

- Deep investigation of known sources
- Follow-up of KSP discovered sources
- Multiwavelength campaigns
- Follow-up of ToOs from other wavebands / messengers
- Search for new sources
- ...

Proposal-Driven User Programme
Challenge

Particle accelerator
“Beam”
(unknown, to be explored)

“Target(s)”
(usually poorly known)

X-rays
(electron beam)

Gamma rays

Neutrinos
(proton beam)

Absorption in photon fields

Use all available multiwavelength/multimessenger information to diagnose beam and target
Gamma rays & X-rays from electron and proton populations

Including cooling

X-rays from secondary electrons

arXiv:1006.5210
CTA Centric MWL view

- Radio
- IR, Optical, UV
- X-ray
- Neutrino
- Grav. waves

- Target selection & ToOs
- Object properties
- Wide-band SED

- CTA observations
- Modeling

- Particle population, acceleration process
- Object properties
- Feedback of particles on environment
## Role of X-ray data for CTA Key Science Projects

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