CTA
Cherenkov Telescope Array

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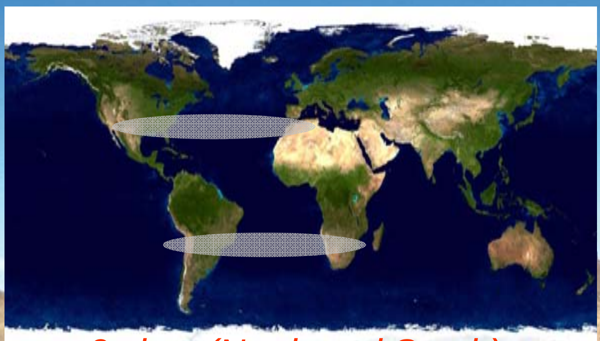
CTA in a nutshell

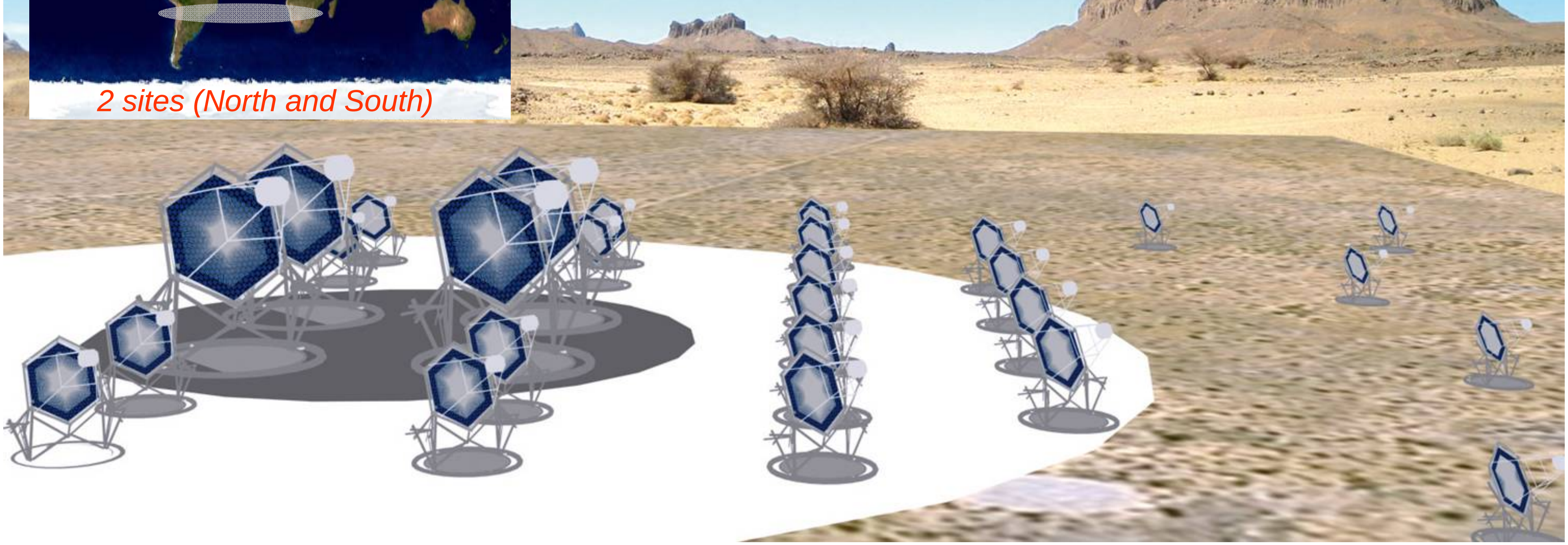
CTA is a new project for ground based gamma-ray astronomy planned to consist of several tens of Imaging Atmospheric Cherenkov Telescopes (IACTs).

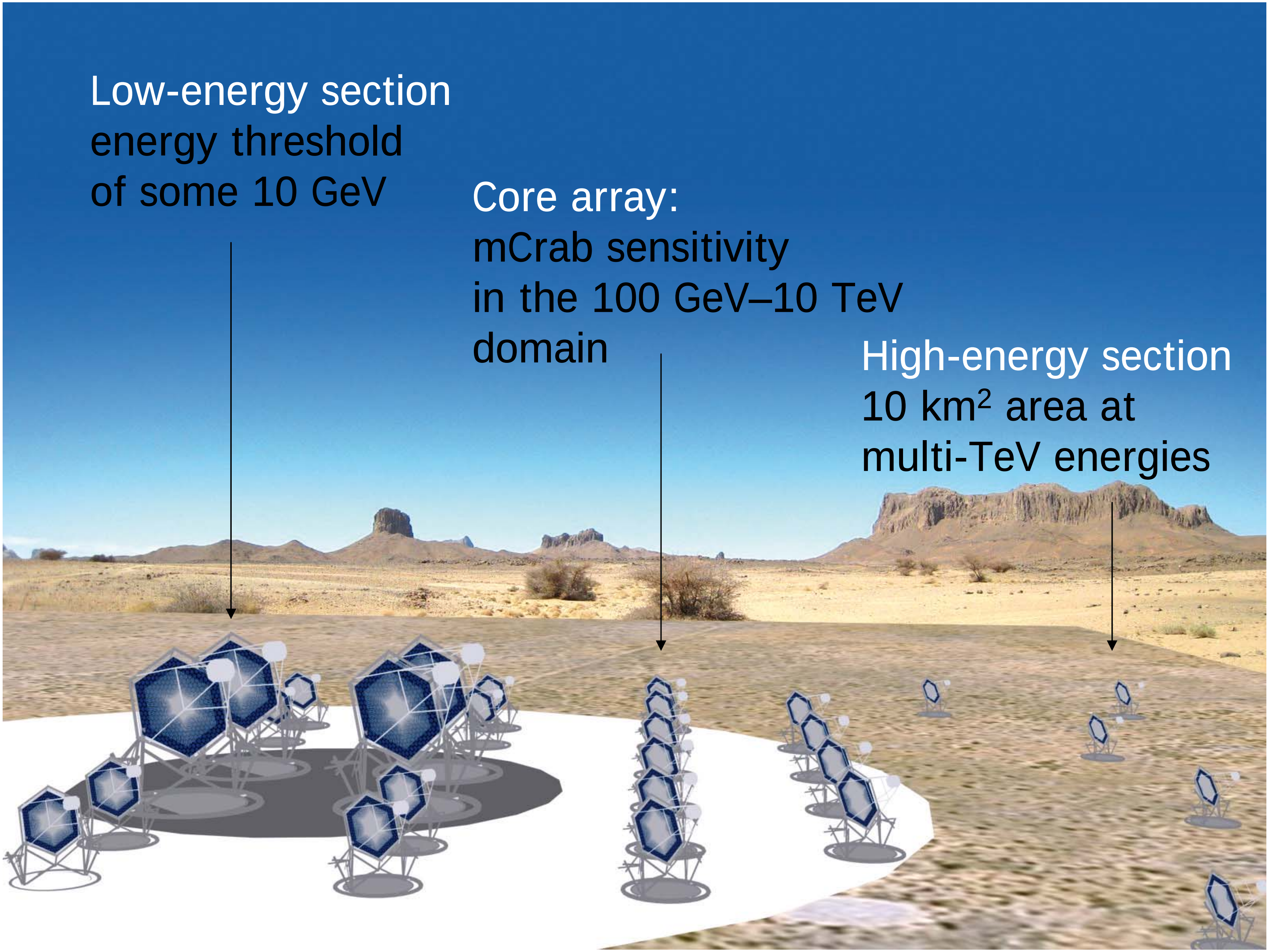
CTA is an Astroparticle research infrastructure aimed to work as an observatory providing services making gamma-ray astronomy accessible to the entire community.

The CTA international consortium is currently committed in a Design Study phase.



2 sites (North and South)




Low-energy section
energy threshold
of some 10 GeV
Core array:
mCrab sensitivity
in the 100 GeV–10 TeV
domain
High-energy section
10 km^2 area at
multi-TeV energies

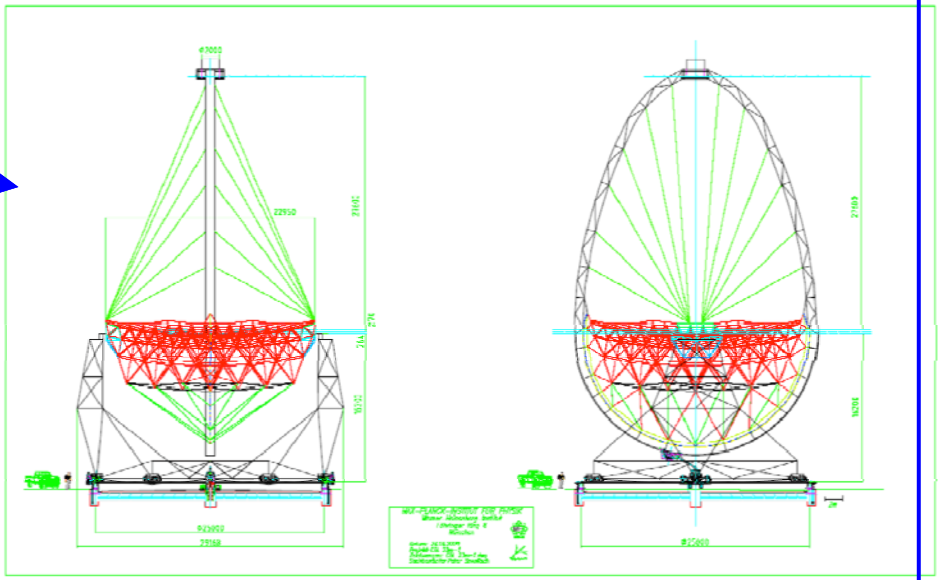
Large Size Telescope

Le "design" du Telescope de 23 m

- Collaboration LAPP/MPI-Munich pour la conception et réalisation de grands télescopes et leur asservissement

L'amortissement actif de vibrations

- Etudes d'asservissement actif de structures.
- Conception d'un « multipode » (comme l'arceau de Magic) mais pourvu d'un système d'amortissement actif de vibration localisé sur les câbles constituant le haubanage de la structure.
- Possibilité de repositionner "statiquement" la caméra a travers un système d'amortissement localisé sur les haubans

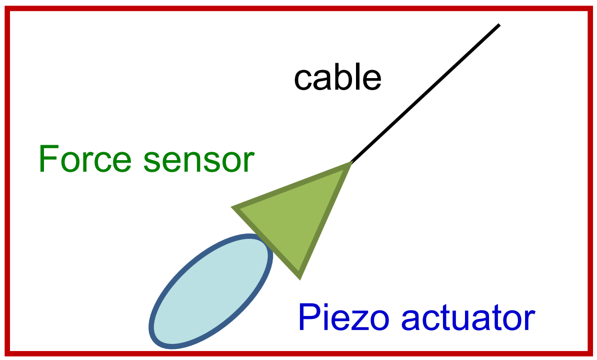


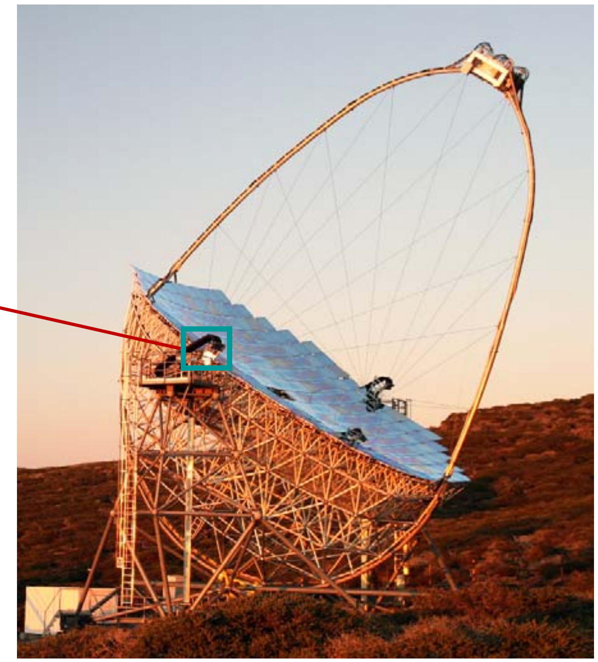
1) Calculs et simulation
2) Optimisation Design et Conception
3) Driving and control system

Active control on cables

Control implementation :

- Collocated sensor & actuator along the cable





Control strategy :

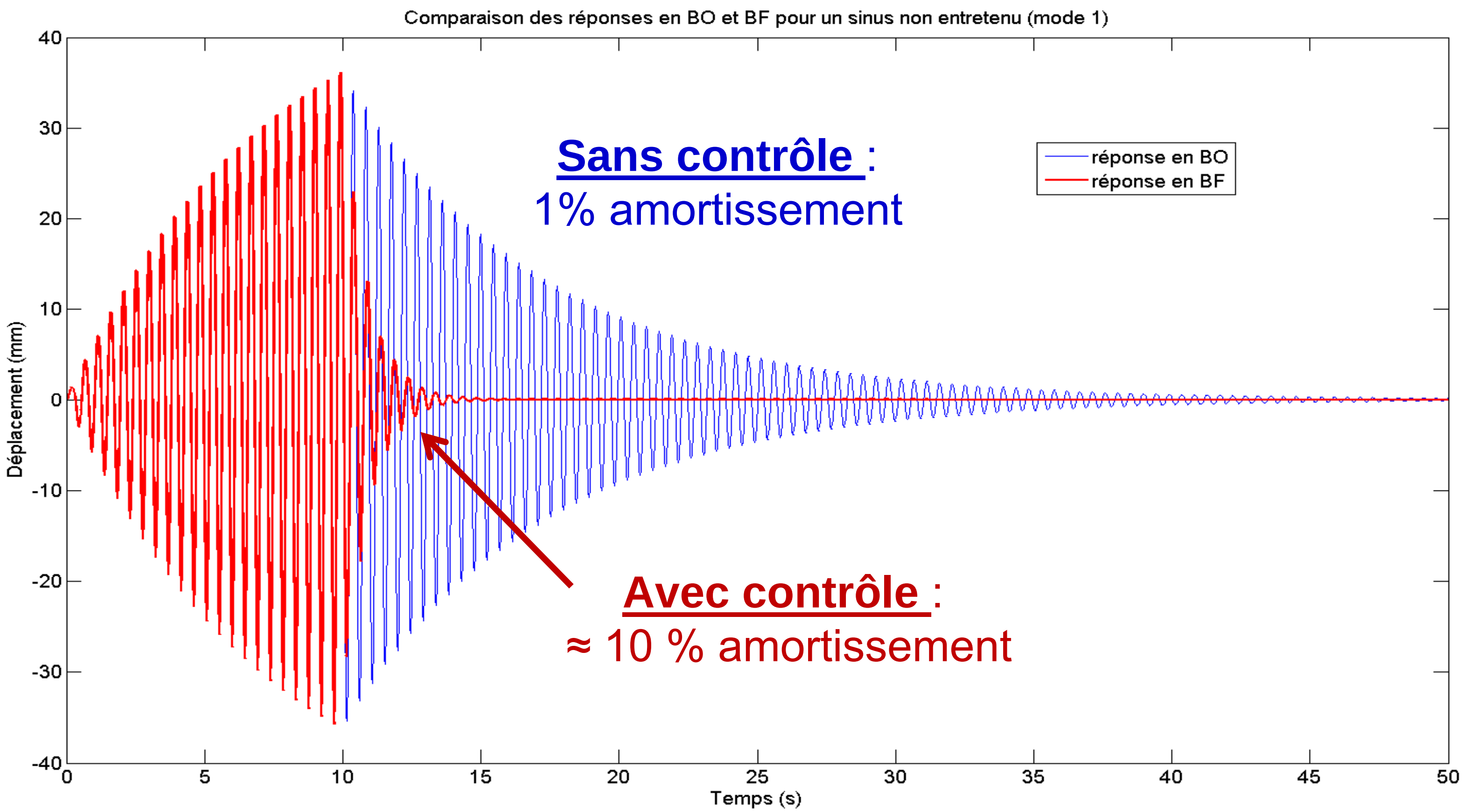
- Cancel the effort variation (due to camera displacements) in the active cable
- ***Maximize the modal strain energy fraction to maximize performances***

→ **Implement the controller on most efficient cables OR change cables locations**

Amortissement actif

Cas 3 : excitation de type effort sinusoïdal

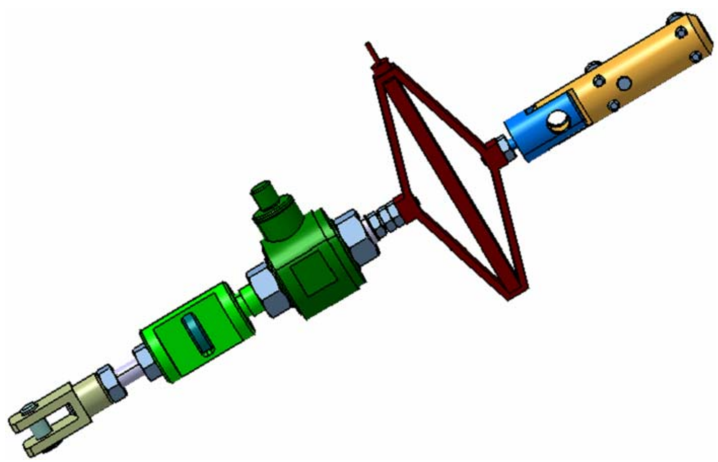
- à t = 10s l'effort d'excitation est supprimé
- en BF , le contrôle est activé à t = 10s

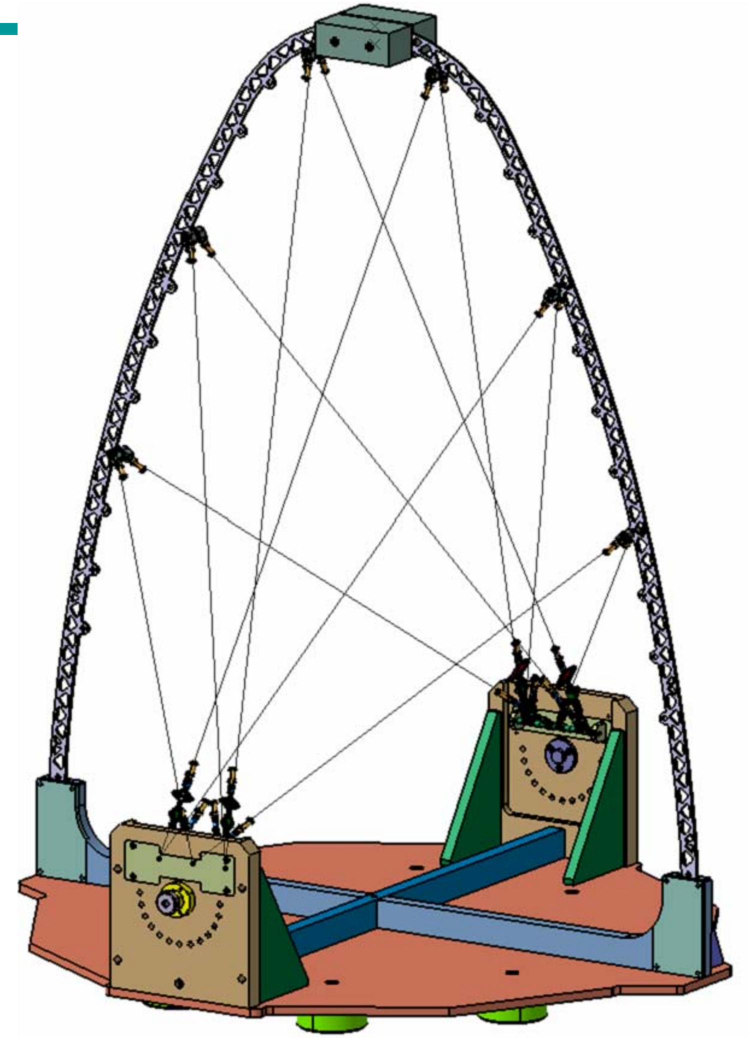


Details on prototype design

Current design :

- Zenithal configuration
- Arch made in Stainless Steel
- Camera represented by a mass
- Tendons (active & passive)
- Many possibilities of tendons locations

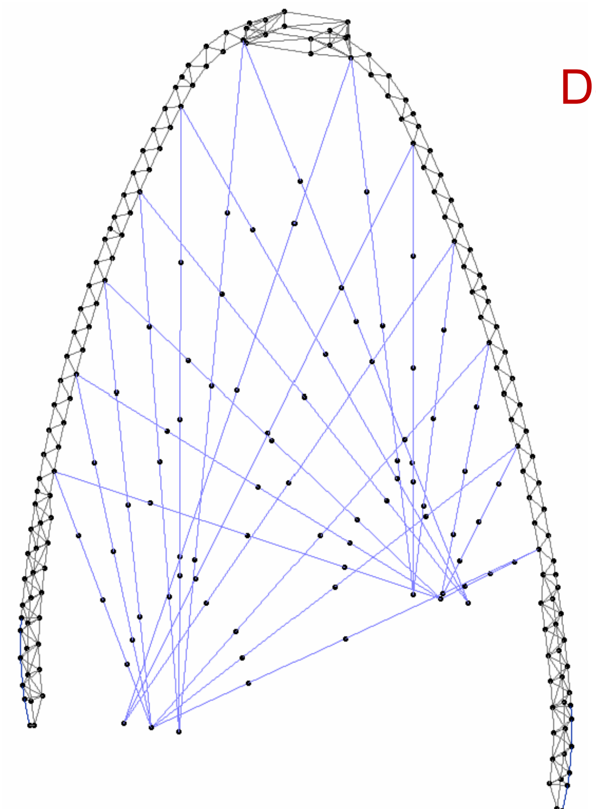




Detailed design complete, production already started

LST arch design study

Ø Weight and stiffness of the arch : critical parameters for active control



Design study of the arch is starting at LAPP

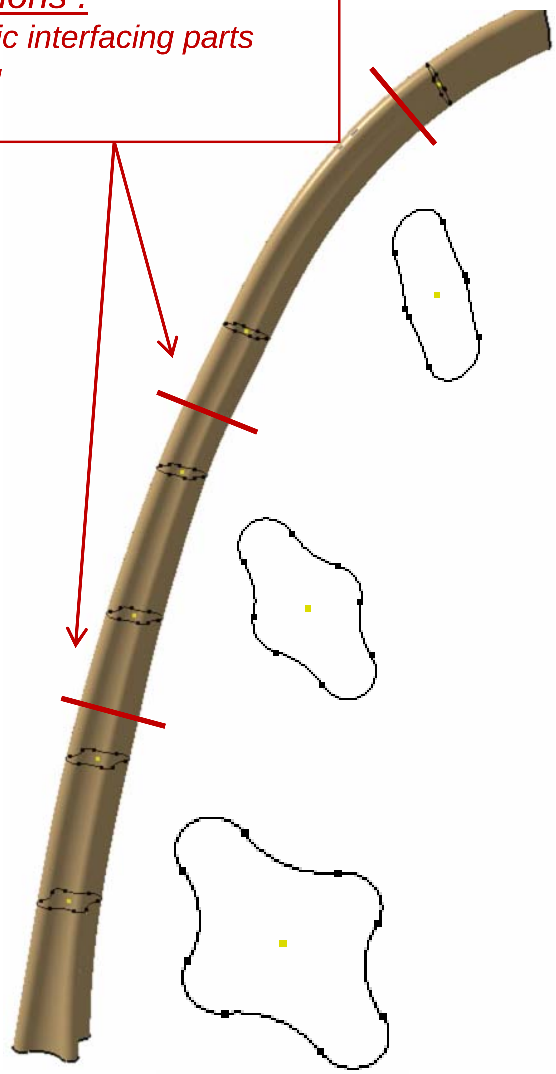
Starting from current baseline :

- Aluminum truss structure
- *Composite truss structure*
- *Composite structure : other possibilities ("monolithic" section)*

Determine the optimal configuration of the arch *(active control included)*

LST arch design & camera interfaces

Junctions :
Metallic interfacing parts
Gluing
…



Ø Alternative concept :
- "Monolithic" composite structure
- Arch divided into 3 or 4 pieces (transport)
- Minimize on site assembly operations

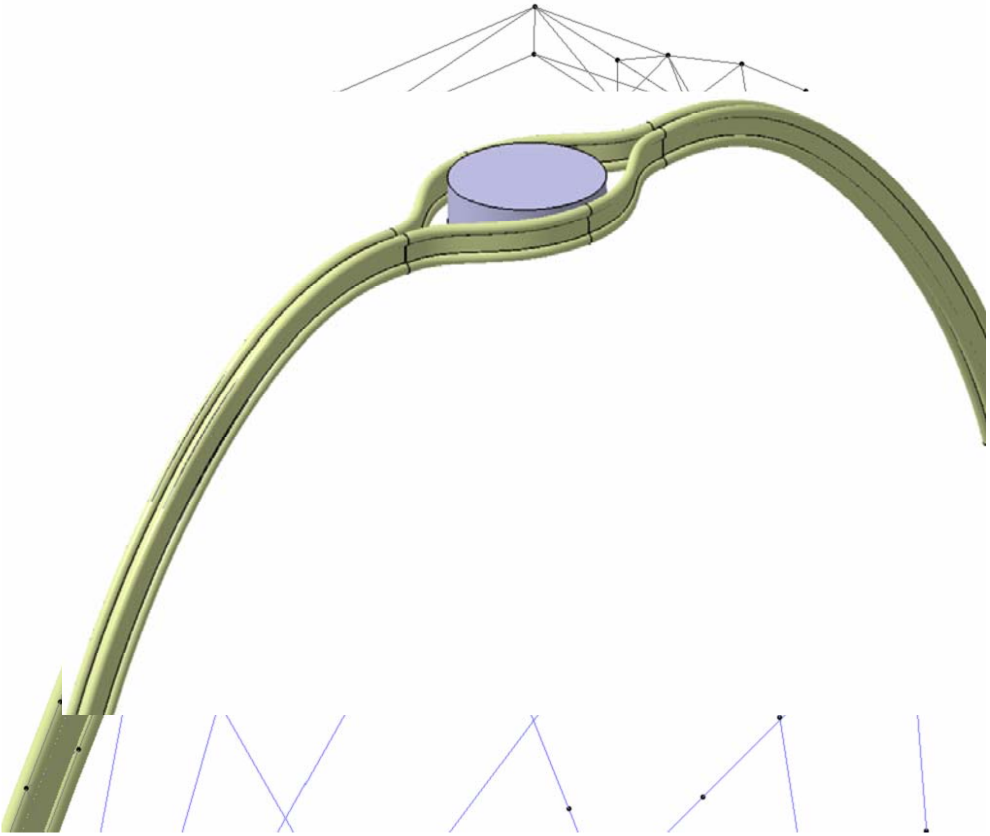
Ø Shape optimization :
- Beam model with varying inertia
- Topological optimization

↳ *Get the inertia where it is needed*

Ø*More detailed FE model for sizing*

LST arch design & camera interfaces

Ø "Monolithic" arch concepts



Design, calculations, feasibility studies and prototyping are in progress

Why LAPP would be a major actor of the CTA drive system ?

✓ Great experiences in Control science :

- **HESS : loading / unloading of the camera & autofocus**

Test of unloading in the lab with the dummy camera and a dummy end of the telescope.

- Some data :

•14 motors – 7 motions (synchronization of axes)

•PLC dedicated to the drive

•Different networks (Ethernet, profibus DP, profibus Iso…)

•Monitoring

•Security

•Instrumentation

•Cabling

•Pneumatic system

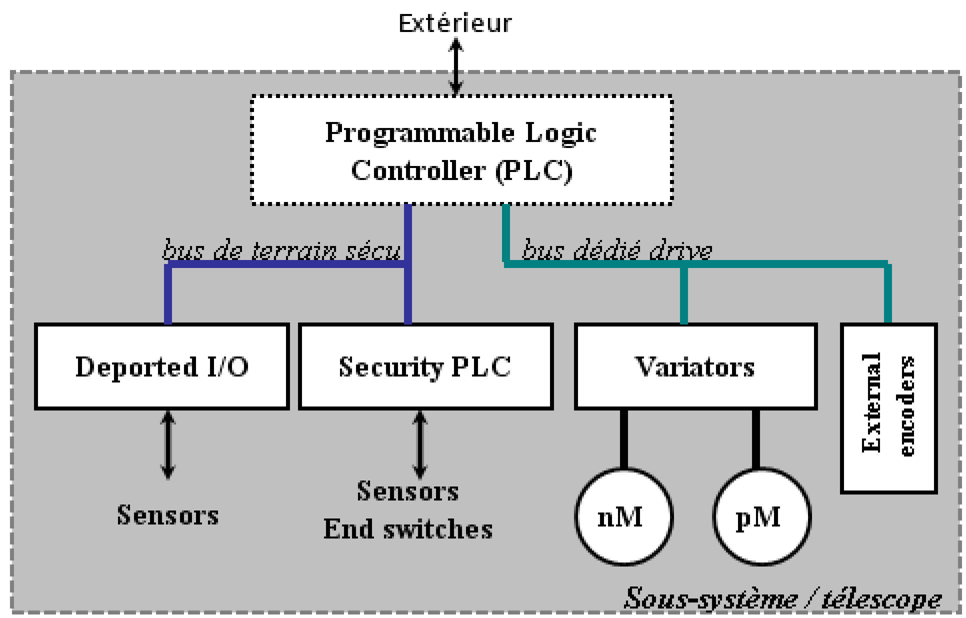
Large Size Telescope: Asservissement

Drive Control / a set of 4 telescopes

✓ **The tracking mode requires a rotation of 180° in 20 seconds**

➡ *To perform the synchronization of the 4 telescopes*

SYSTEME ASSERVISSEMENT ET CONTROLE AUTOMATIQUE:



Drive Control / telescope

✓ **Configuration of a sub-system (2 axes : elevation and azimuth)**

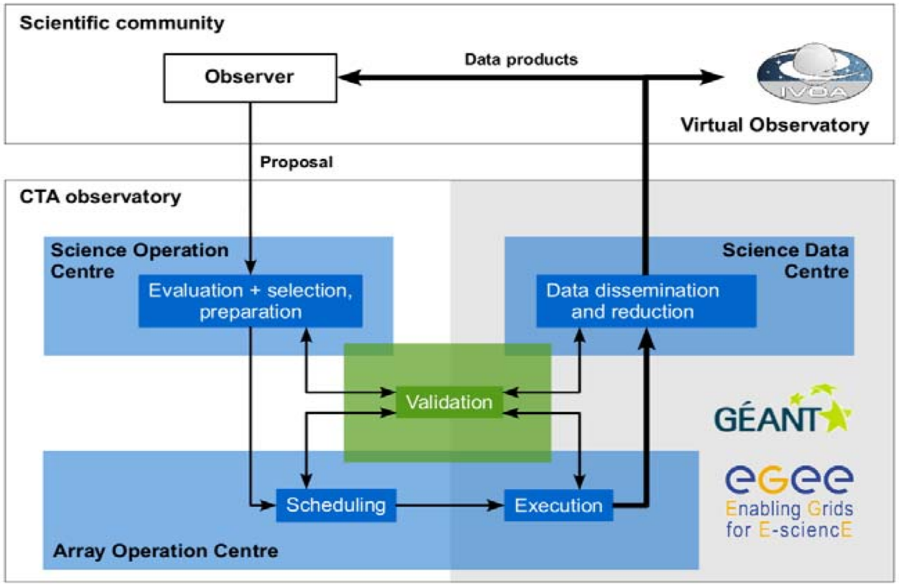
Prospective CTA au LAPP

The CTA *Mecatronic* international platform for integration and tests of the LST prototypes and control systems

CTA E-Infrastructures

The CTA Observatory main logical units :

- Science Operation Centre: organisation of observations
- Array Operation Centre: the on-site service
- Data Centre:
  - Software development
  - Data analysis
  - Data reduction
  - Data archiving
  - Data dissemination to observers



Total expected data volume from CTA: 1 to 3 PB per year

MC requirements: tens of CPU years, hundreds of TB

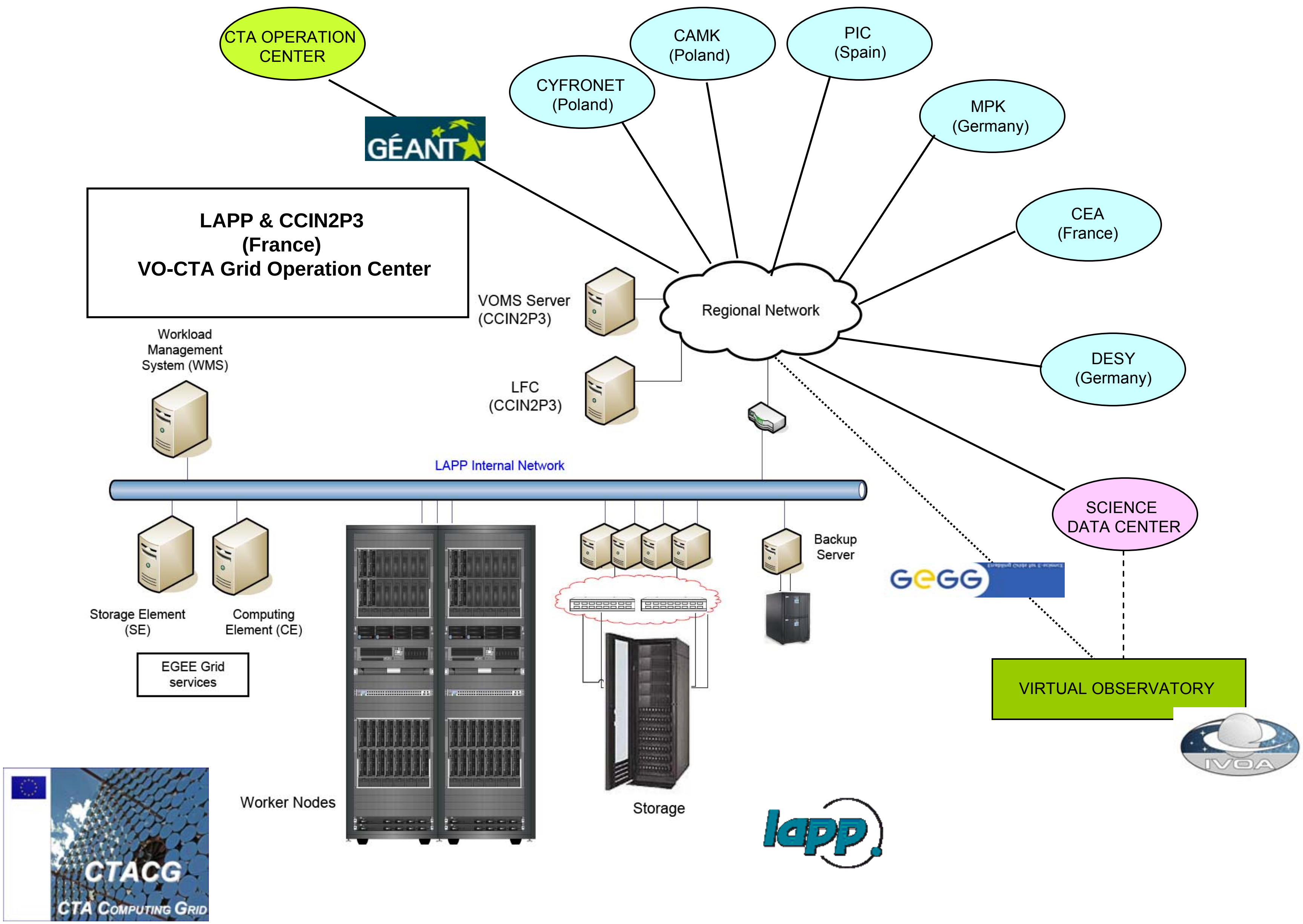
Existing ICT-based infrastructures, such as EGEE and GEANT, are potential solutions to provide the CTA observatory with best use of e-infrastructures.

This possibility is studied within a dedicated sub-project of the CTA Design Study: the CTA Computing Grid (CTACG) project.

- **CTACG (CTA Computing Grid) aims at:**
  - optimising the application of grid technologies for the CTA:
    - Simulation
    - Data processing
    - Storage
    - Offline analysis
    - Virtual Observatory interface

  - Run simulations for other CTA collaborators:
    - Enable them to get existing output files

From CTACG to CTA E-Infrastructures



… to VHE γ-ray Science GATEWAY

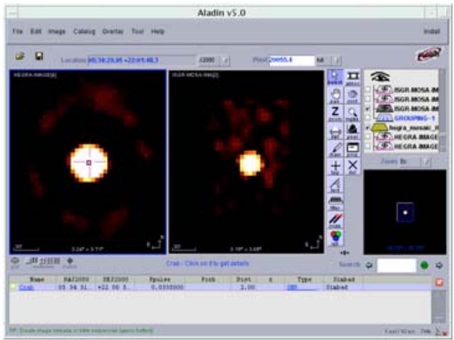
VSG, through a Web-interface will provide:

P.Buncic

- A complete, portable and easy to configure user environment for developing and running CTA data analysis locally and on the Grid (login, proxy on demand, selecting data level, data sets, software, and computing);

- Grid services for jobs and resources monitoring, archive access, telescope and observations monitoring, and support to scientist to port their software to the GRID;

- MC datasets and open production for deeper analysis of intermediate level data, On-the-fly reprocessing from the Archives Instruments calibration monitoring and trend analysis;

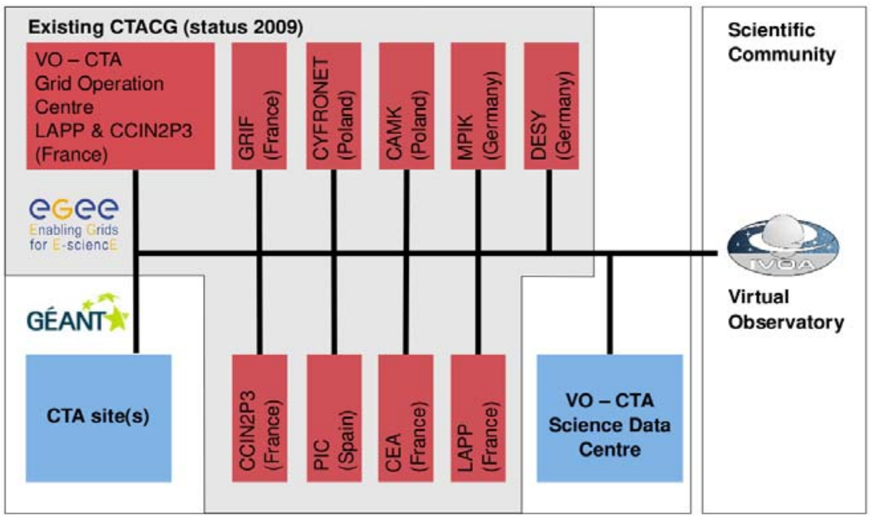


- Astronomical tools and services integrating VObs standards and gLite-EGEE middleware for analysis of high level data sets;

- Tools and IVOA interfaces for multi-wavelength A&A analysis;

- Forum and scientific documentation for an up-to-date scientific outreach and strengthening of the VHE gamma ray community.

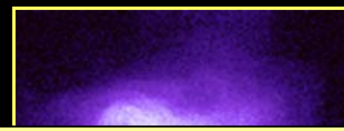
Prospective CTA au LAPP



Capitaliser sur les acquis (CTACG) pour jouer un rôle central international

DATA ET *E-INFRASTRUCTURES*: réalisation d'un **Tier 2 Astroparticules** - développement des outils pour fournir un accès à la puissance de calcul et aux données sur la grille

Science topics



Origin of
cosmic ray

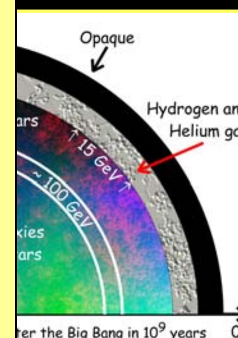
LAPP-LAPTH-LAOG-(…et al.)

<u>Research axes:</u>

e.g. AGN astro. and cosmol., Binary systems, Multiwav.,..

<u>Teaching axes:</u>

e.g. Instrument. / detection, Astroparticle Phys., HE Astro.,…



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