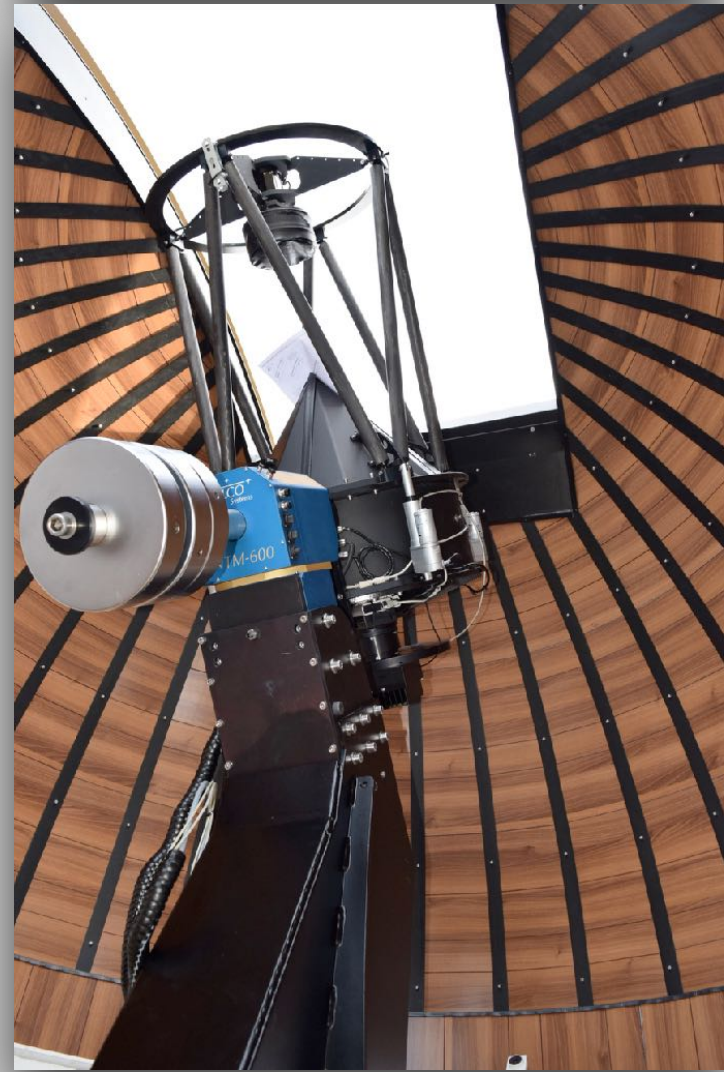




Plateforme Éducative **Rayons cosmiques et muONS**



Damien Dornic (CPPM) - IPhU Days

# Introduction

In the context of the Labex OCEVU, 2 platforms have been created to promote the science for high-school students as well as University students:

- IRiS: promote observational astronomy with one professional telescope.
- ePERON: promote cosmic ray physics with some professional particle detectors.



Resp. : Stephane Basa  
Location: OHP  
1 telescope 50cm  
Budget: ~120 k€



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Resp. : Damien Dornic / Jose Busto  
Location: OMP  
~20 detectors  
Budget: ~60 k€

**Motivation:**

To enable students to become familiar with the methods and tools of astronomical research in the context of educational and scientific projects, and thus bring teaching closer to research.

**The method:**

To put at the service of the educational community a modern, high-performance and versatile teaching tool: a telescope whose operating mode and technical features are in every way similar to the telescopes currently used by professional astronomers.

**The targeted audience:**

Secondary school students (middle and high schools), as well as higher education (bachelor and master degrees).

## The project was designed and is managed jointly with the rectorship:

- Have been involved from the start of the project to define the technical requirements.
- Allows us to continue to adapt the system to the evolutions of the French educational system.
- Organization of training days for the teachers (typically in May).
- Organization of special events with the rectorship.
- Members of the Time Allocation Committee.
- Etc.

⇒ **Two teachers participate closely to the project: J. Strajnic & G. Montagnier.**



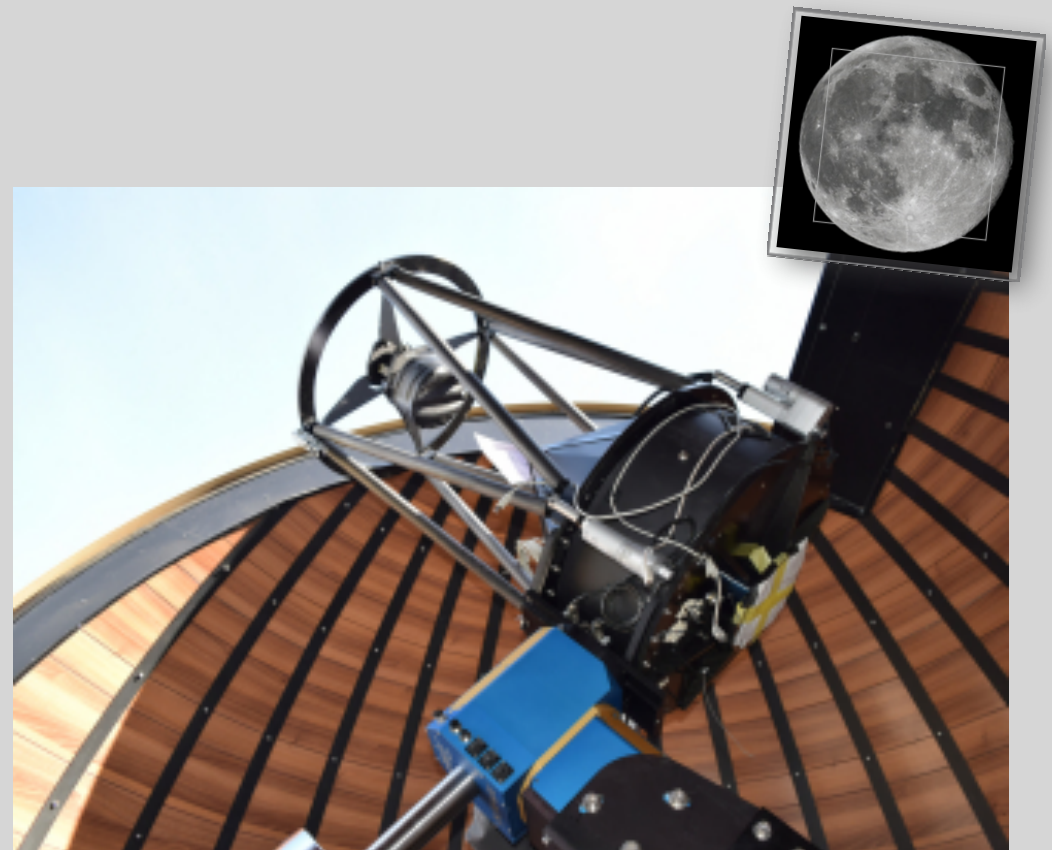




## At OHP

## The telescope

Particularités	
Diamètre du miroir primaire	50 cm
Ouverture du télescope	F/8
Taille du pixel spatial	0.7 arcsec/pixel
Champ de Vue	24 arcmin
Précision du pointé	< 1 arcsec RMS
Précision du suivi sans autoguidage	< 1 arcsec/10 min
Vitesse de la monture	> 20 °/sec
Vitesse d'accélération de la monture	> 20 °/sec <sup>2</sup>
Poids maximal de l'instrumentation	10 kg



### Focal plane:

- Professional CCD camera with an E2V sensor (E2V 4240).
- Filter wheel: Clear, SDSS filters (g, r, i and z), CH4, H-alpha and OII

# Actual status

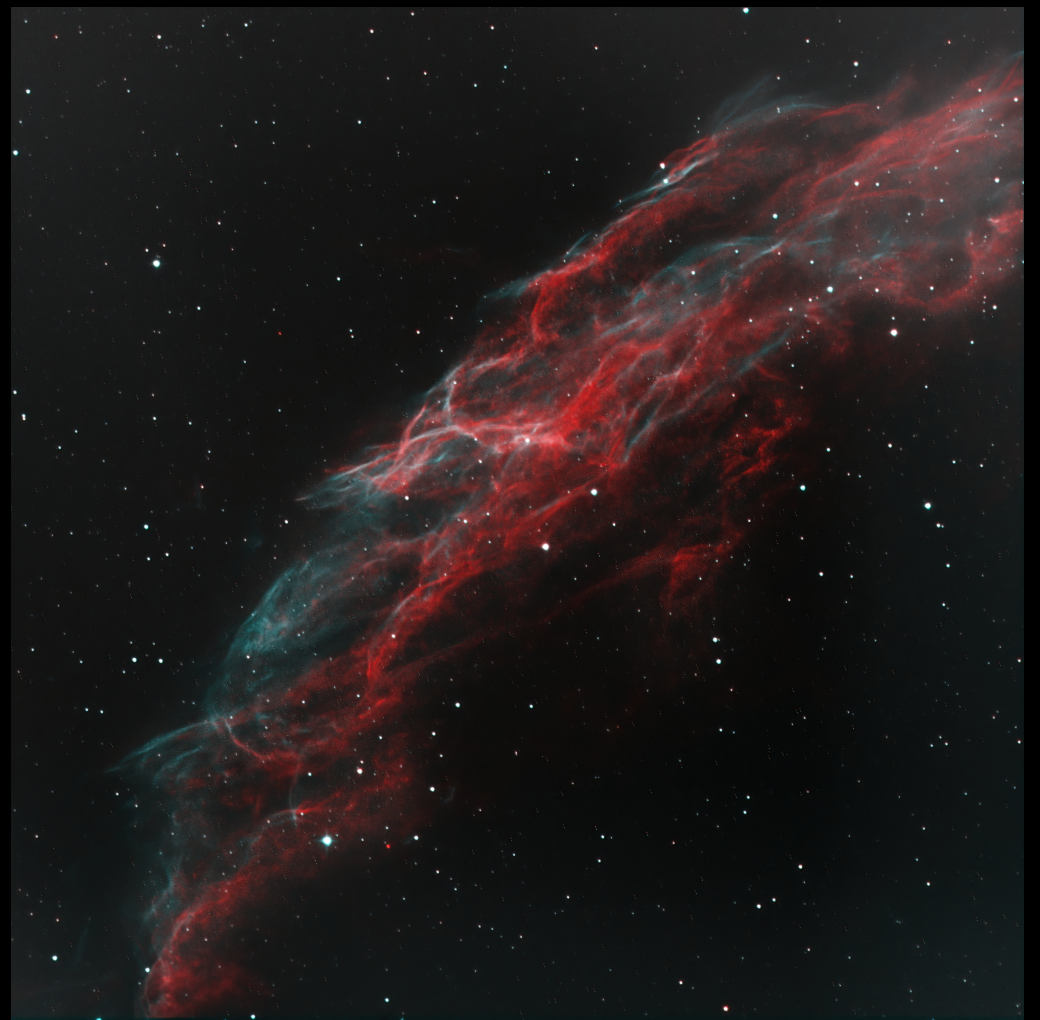
## Major update in 2020-2021:

- M1 barrel change to remove astigmatism: now we are seeing limited on our images!
- Change of mount and pillar: no more meridian flip, satellite tracking possible, etc.
- Maintenance of the camera (required after 6 years).
- Web site cleaned and upgraded.

## Current use:

- Observations have returned to normal despite the Covid.
- About 4-5 classes per week are using it (still the most requested telescope@OHP).







Plateforme Éducative Rayons cosmiques et muONS

- Goal: Get in touch with modern (particle) physics
- Several experiments to characterize the cosmic rays @ Pic du Midi Observatory
- Real particle detectors (still used in research)
- Online experiment and data access via the web (Virtual Laboratory)
- Education / formation: from high-school to University

Altitude 2877m  
Flux x 4

Historical place for  
the CR studies

Scientific and technic  
infrastructure + Link to the  
actual science at the Pic  
(atmosphere, solar,  
neutron...)





# Virtual laboratory

Experiments / data

Data base

Website / Data access

High-school  
Visualisation  
of the results

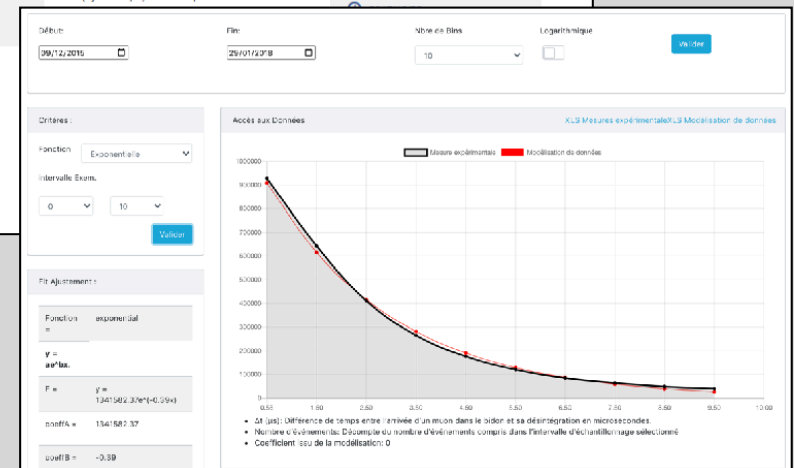
High-school/  
DUT  
Access to pre-  
processed data

University  
Access to raw  
data



<https://eperon.omp.eu>

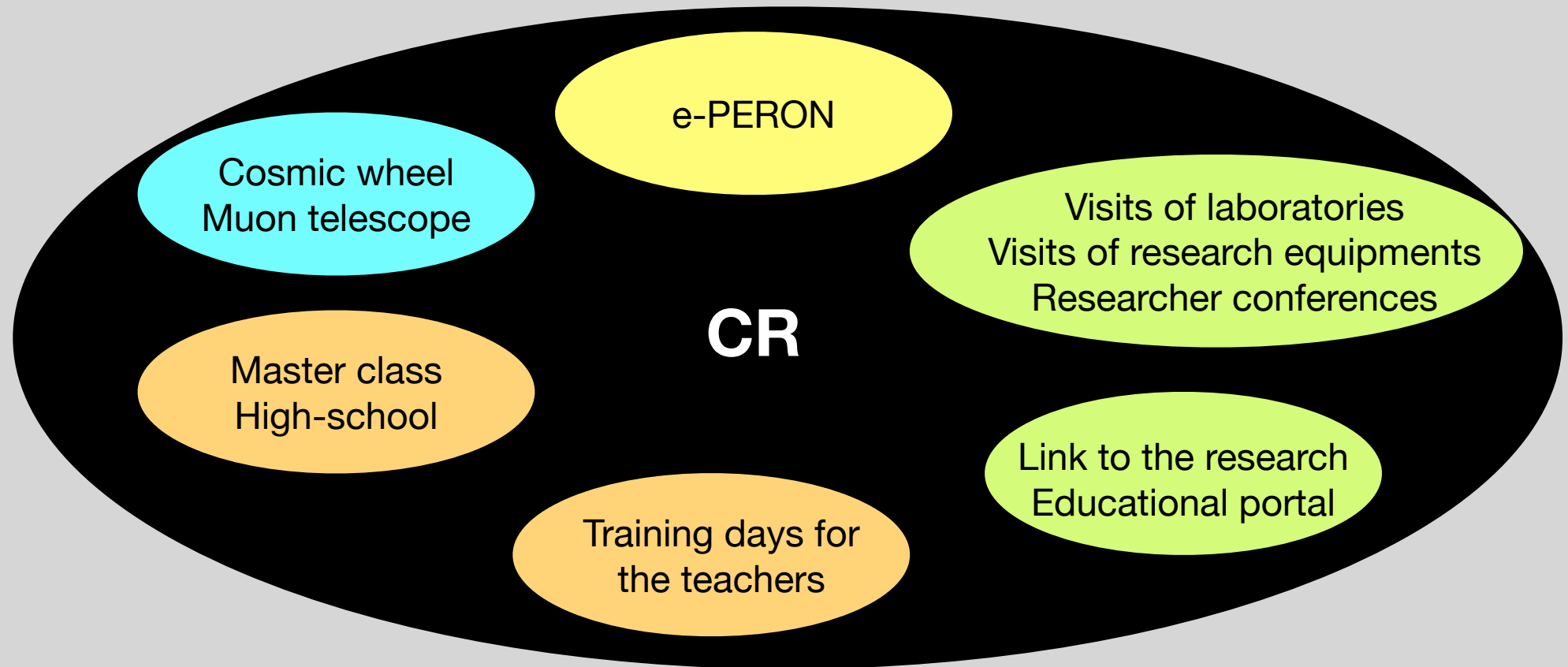
(P. Vert / C. Baudouin)



(H. Benamar/ D. Dornic)

→ **On the experiments:** all are perfectly working since mid 2015, ~2300 days of continuous data. (Thanks to Olivier and the technical plateforme of OMP for the operation and the maintenance)

# Structuration of the CR offer



⇒ Discussion group with the rectorship:

[auguste.levansuu@osupytheas.fr](mailto:auguste.levansuu@osupytheas.fr)  
[busto@cppm.in2p3.fr](mailto:busto@cppm.in2p3.fr)  
[dornic@cppm.in2p3.fr](mailto:dornic@cppm.in2p3.fr)  
[eric.kajfasz@univ-amu.fr](mailto:eric.kajfasz@univ-amu.fr)  
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[olivier.espagnet@obs-mip.fr](mailto:olivier.espagnet@obs-mip.fr)  
[renaud.blyweert@obs-mip.fr](mailto:renaud.blyweert@obs-mip.fr)  
[stephane.basa@lam.fr](mailto:stephane.basa@lam.fr)

# Communication of the ePERON project and list of data usages

**Jan. 2021:** Practical work with M2 students from Toulouse at Pic du Midi Obs. (8 students) [Olivier]

**Jan. 2021:** Lesson on Numerical methods and Practical work II [21-22]-CTES for M1 students in Sciences (~30 students) [Zineb]

**Mar-Apr 2021:** Discovery of the research module for L3 student in Physics (~30 students) [Zineb]

**Aug 2021:** Summer school of CLEA: presentation, demonstration of the ePERON use and of the muon telescope for college and high school teachers (~30 profs) [Olivier]

**Oct 2021:** Fête de la science : practical work with the muon telescope (~ 16 classes over one week) [Olivier]

**Oct 2021:** Fête de la science (college/highschool) [Damien]

**Oct 2021:** Virtual day of the 2 observatories: ePERON presentation (~40-60 classes) [Olivier/Renaud/Damien]

**Jan 2022:** Pedagogical visit for the teachers of the Toulouse academy: presentation of ePERON (~30 teachers) [Olivier]

**Jan. 2022:** Lesson on Numerical methods and Practical work II [21-22]-CTES for M1 students in Sciences (~30 students) [Zineb]

**Fev 2022:** Summer school of CERN/IN2P3 (ONLINE French Language Teacher Programme). Presentation and demonstration of ePERON for high school teachers (ONLINE French Language Teacher Programme) (50-80 profs) [Olivier]

**Mar-Apr 2022:** Discovery of the research module for L3 student in Physics (~30 students) [Zineb]

**Apr 2022:** Cordée de la réussite avec le Lycée René Char (32 élèves) [Damien]

**Jun 2022:** 2 high school students for the TIPE project: practical work around the Rossi experiment [Olivier]

**2021/2022:** Presentation of ePERON for high school students that are visiting the Pic du Midi Observatory (~10 classes) [Olivier]

**2021/2022:** Presentation of ePERON and practice works with the muon telescope for College students (3ème) (~30 students) [Olivier]

# Virtual day of the 2 observatories



Organization of a special day with the Rectorat d'Aix-Marseille to promote astronomy and astroparticle:

- October 2021.
- Between Observatoire de Haute-Provence and Pic du Midi.
- 5 animations broadcasted in live to the schools:
  - 4 presentations/discussions during the day.
  - 1 night of interactive observations with IRiS.
- Between 40 and 70 classes connected at the same time.
- Excellent feedback from the schools that want more of this type of animation.



# Summary

Within IPhU, maintain and develop these two educative platforms:

- IRiS is operational since a few years and well used.
- ePERON is taking continuous data since 2015, the educative offer still needs to be consolidated.

Reinforce the link with the rectorship through a convention (still be done).

Set up new activities for schools