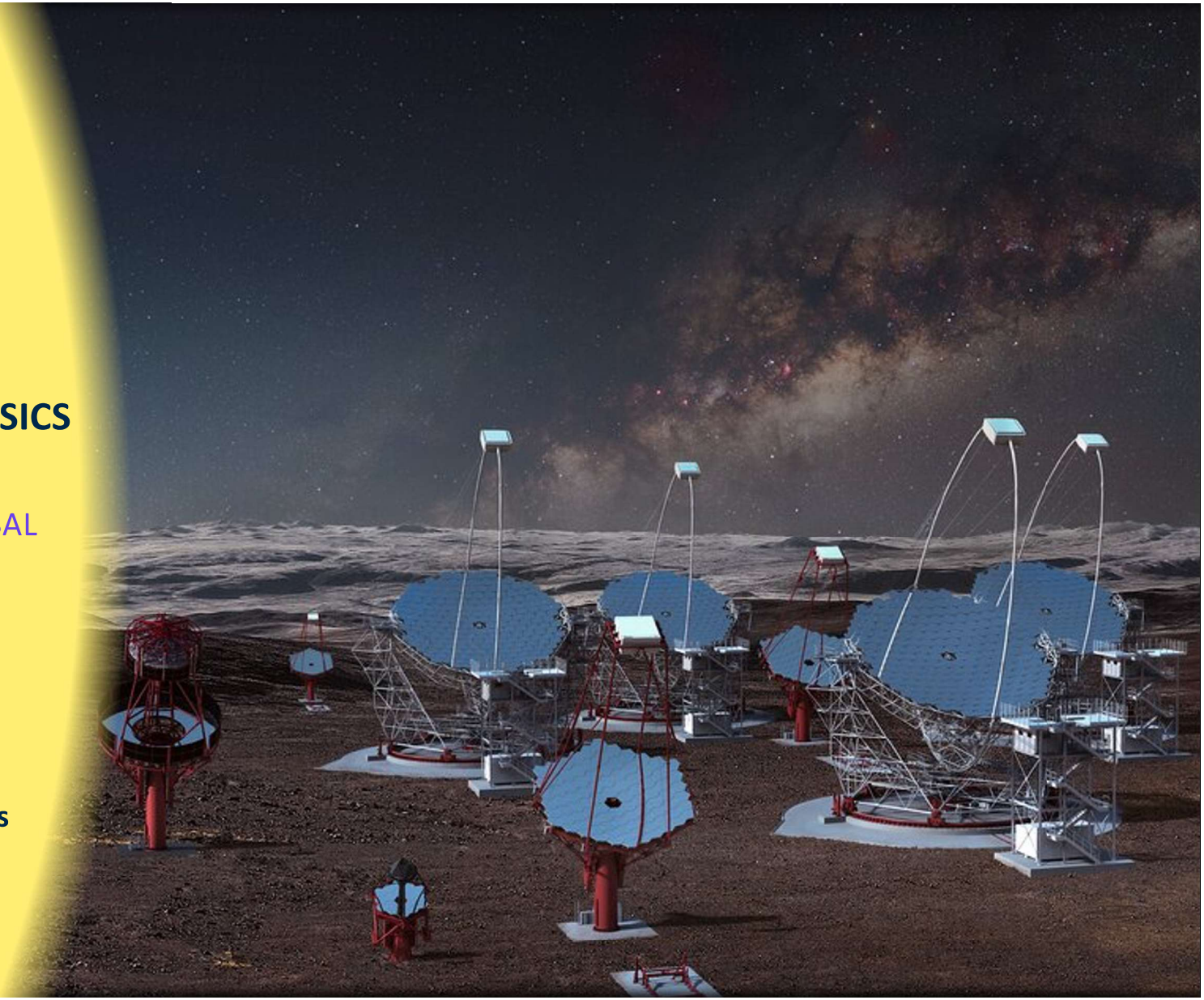
Nuclei & Particles

Strategic Vision for Nuclear & Particles Physics

Building new Cooperation schemes in a context of Global initiatives



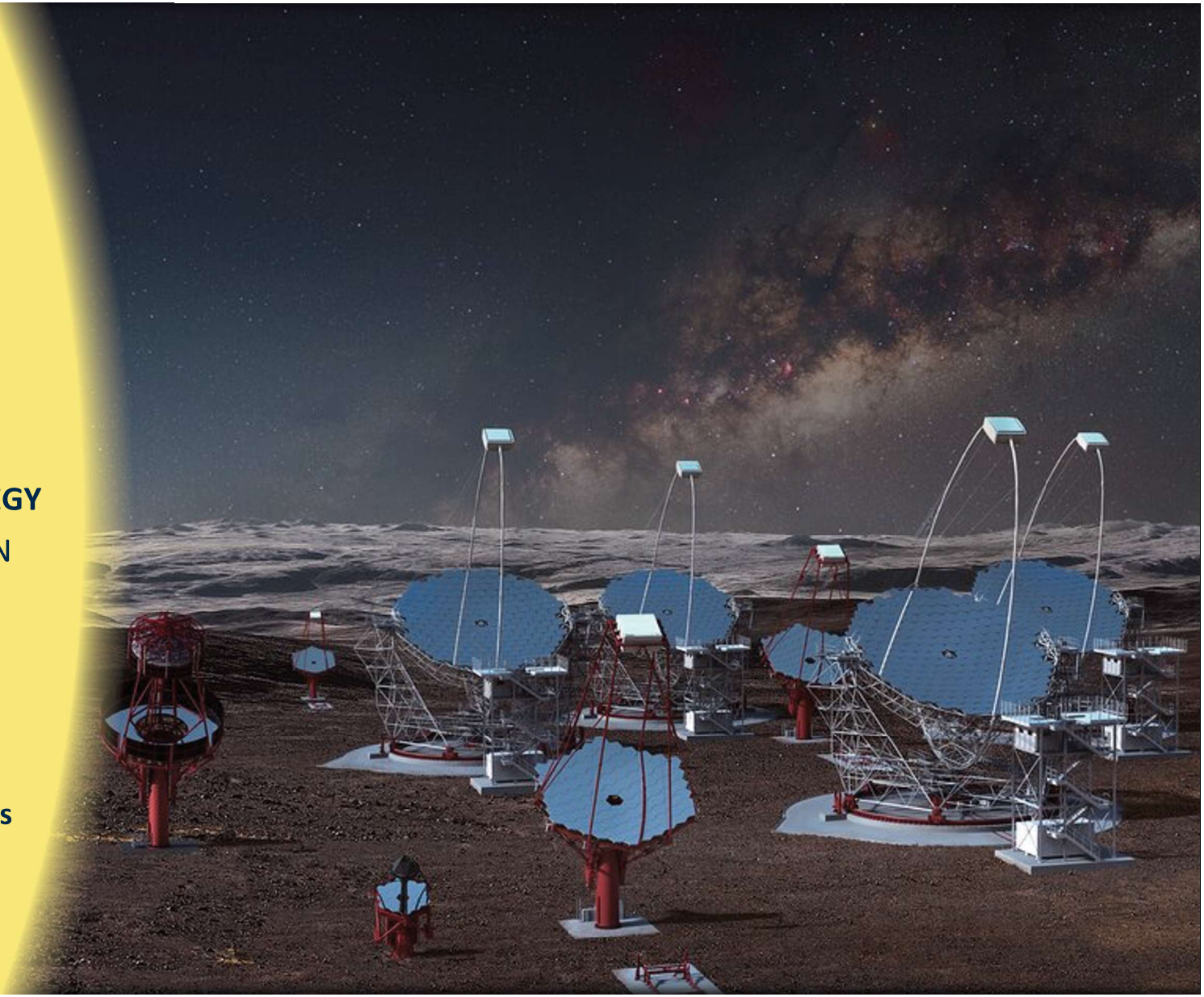
Centro Brasileiro de Pesquisas Físicas

Rio de Janeiro

→ 2026, January 27th

Nuclei
& Particles

- A **National** Institute…
  Inherently **International**
- Our **International Strategy**
  Goals and Implementation
- **Perspectives**



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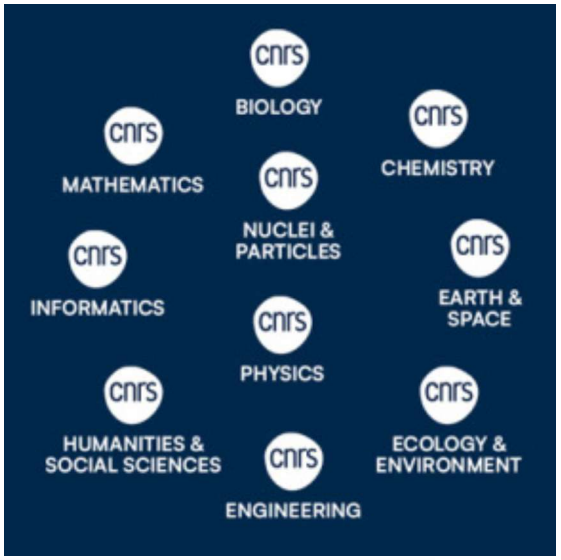
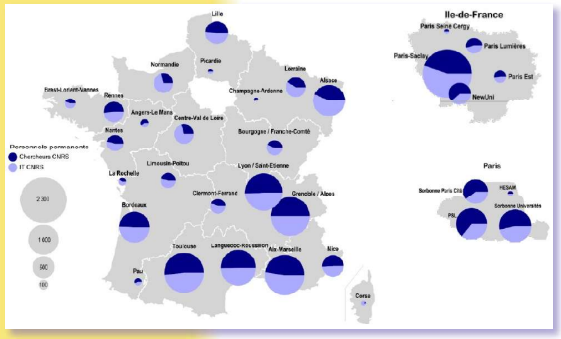
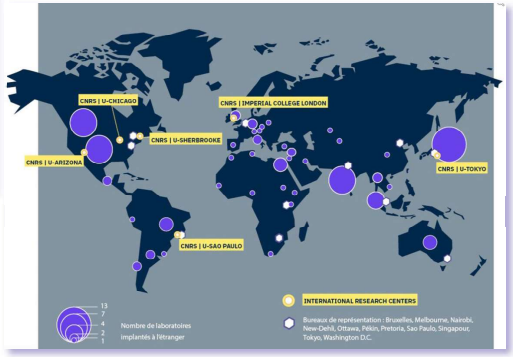
CNRS, basic research for the benefit of the society

To mobilize all disciplines to tackle the challenges of the contemporary world.

- 34 700 employees
  →30 400 scientists
- 10 disciplinary divisions
- 1100 laboratories in France
- 80 international research laboratories (IRL)







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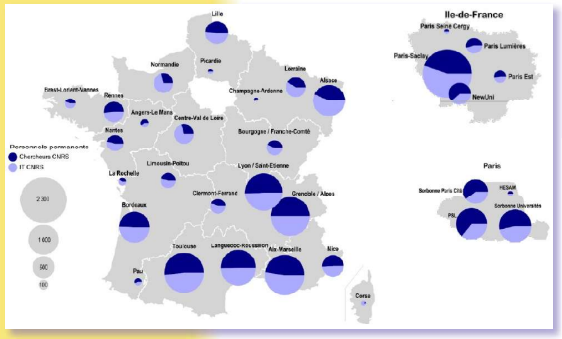
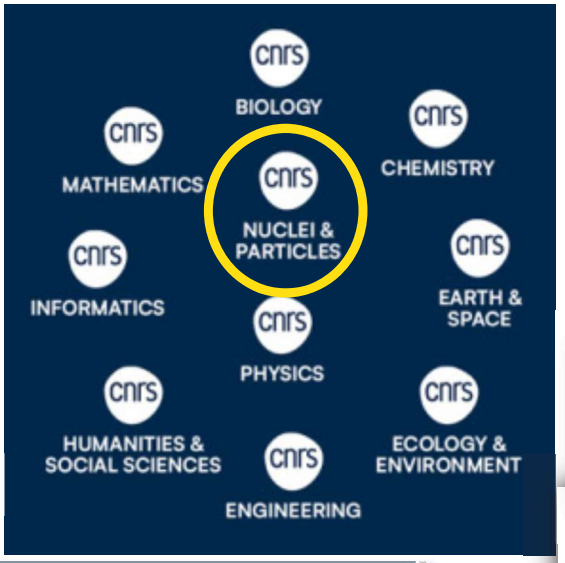
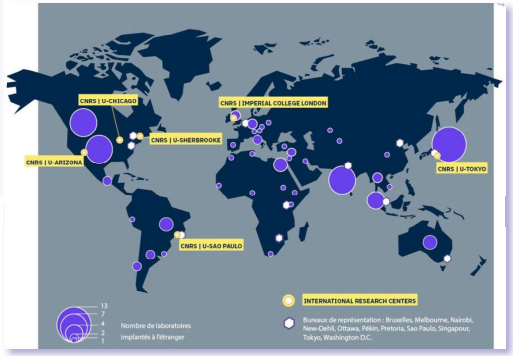
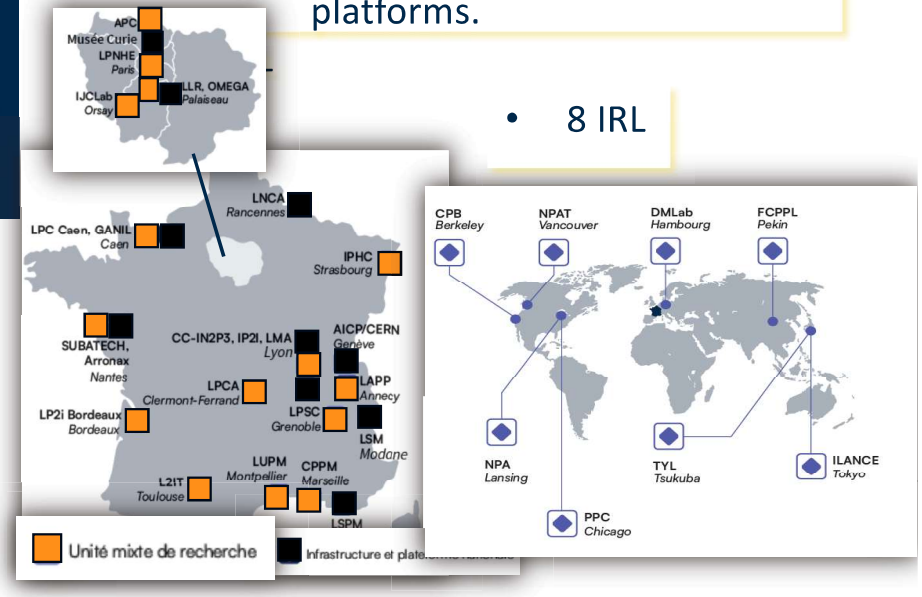






CNRS Nuclei & Particles = IN2P3

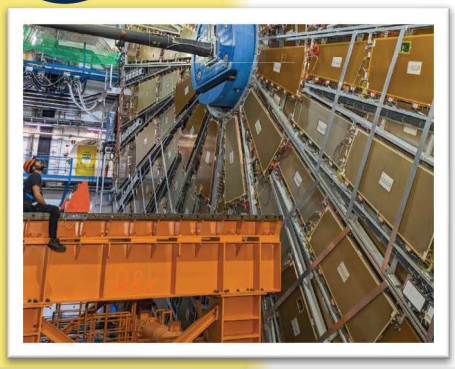
- 2 650 employees
  →1 050 scientists (450 faculties)
  →1 600 engineers and technicians
- Network of 15 laboratories in France most of them with infrastructures or platforms.

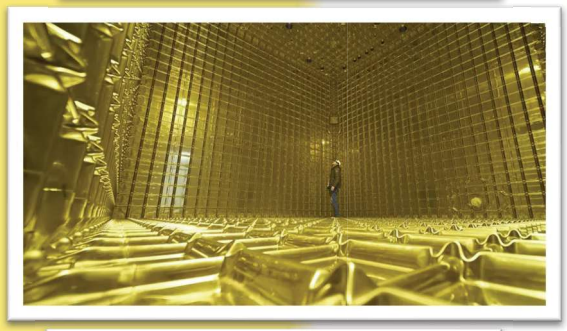


- 8 IRL

Nuclei & Particles

Creation by decree in 1971
revised on May 27, 2016





A National Institute whose missions are:

« **animation** and **coordination** in the fields of **nuclear physics, particle physics and astroparticles**, developments of associated technological applications, in the domains of **health** , **environment** and **energy**, including radiochemistry »

EXPLORES

Physics of the two infinities :
from elementary particles to cosmology

Theory & Experiments

BUILDS

National and international research programs
- usually at large scale long life cycle -

Research infrastructures

LEADS and OVERSEES

Labs, most of them shared with universities, high schools and other research national organisms.

High education

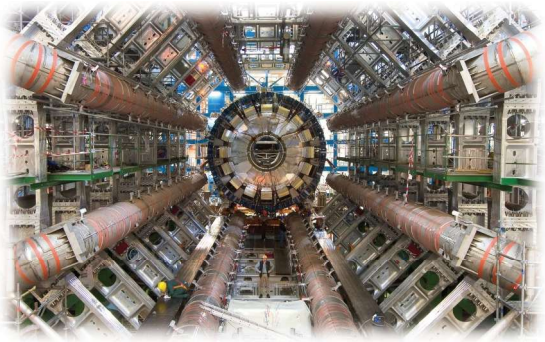
Major areas of research

- To promote basic research
- To play a driving force in societal challenges
- To leverage our expertise in service of society

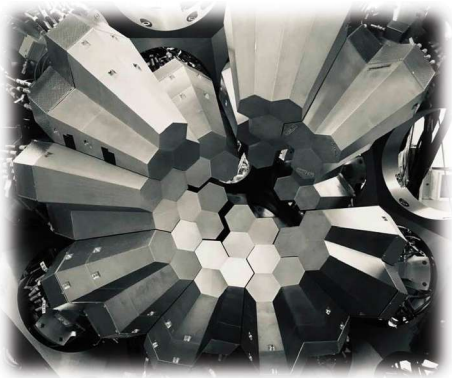
Through many co-constructed programs with :

- other CNRS divisions
- other inter-/national research organizations

Particles & Hadronic



Nuclear physics



Astroparticles & Cosmology

Nuclear physics for the benefit of the society

Energy, Health, Environment

Accelerators & Technologies

Research & Development

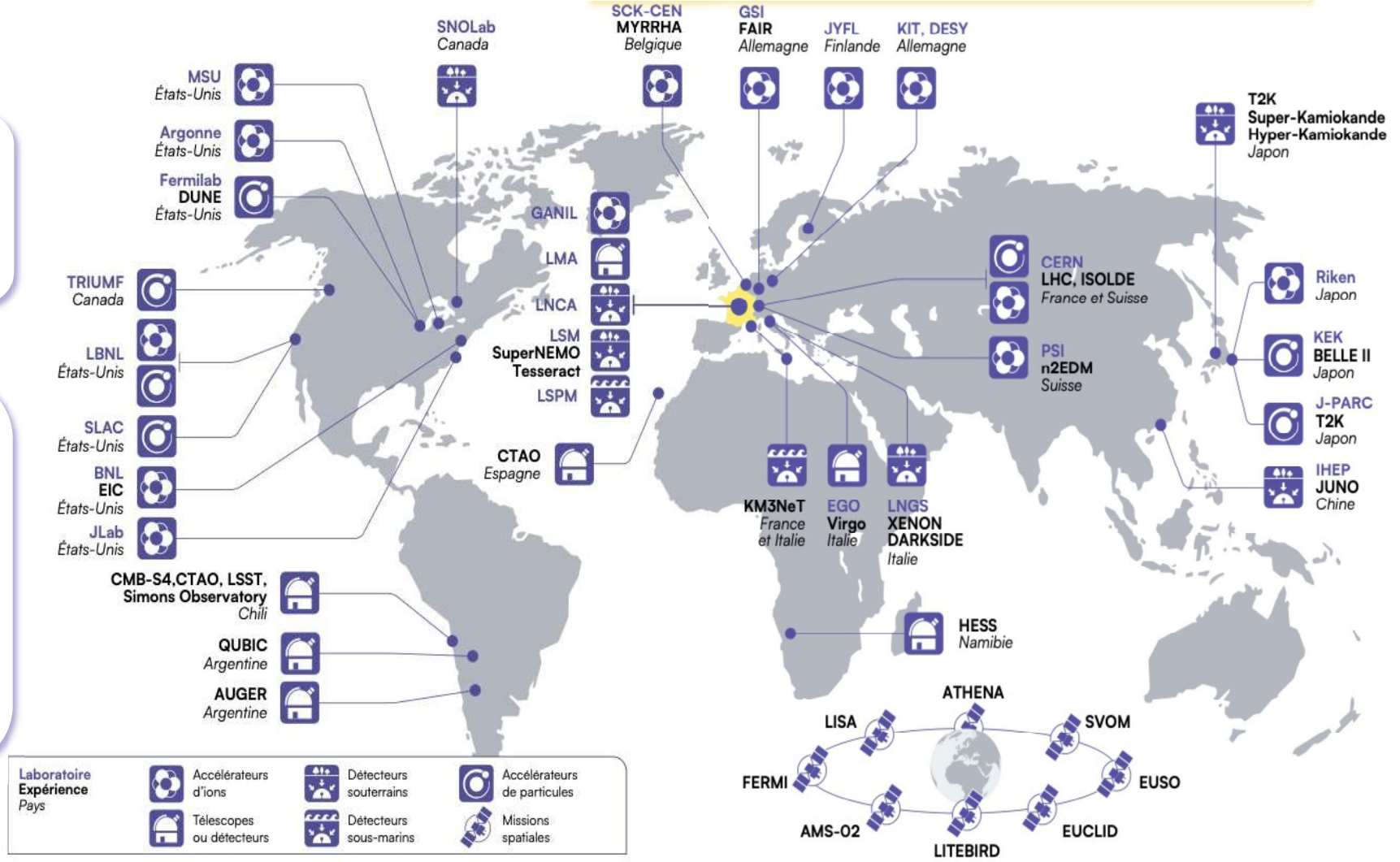
Computing & Data

Our presence in the world (main labs and research projects in which we are involved)

Involvement in ~40 big programs at large research infrastructures

Themes

Particle Physics
Accelerators
Neutrino Physics
Gravitational waves
Dark matter and Dark energy
Gamma and Cosmic Rays
Primordial universe
Nuclear structures, reactions and astrophysics
Nucleon Structure



Nuclei
& Particles

INTERNATIONAL STRATEGY

→ 2026, January 27th

Nuclei
& Particles

Or...
How can we Add Value to our Presence Abroad ?

→ 2026, January 27th

The globalization of the 2 infinity physics

Observations :

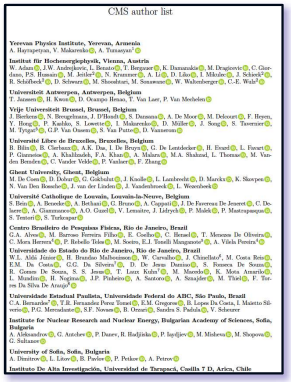
Human

- Multipartnership collaborations / publications to support “big sciences”
- Numerous international conferences (from invited talk to poster session…)

→Complicated to detect / highlight talents, especially early careers researchers

→Competitivity, attractivity issues

CMS@CERN


CMS author list

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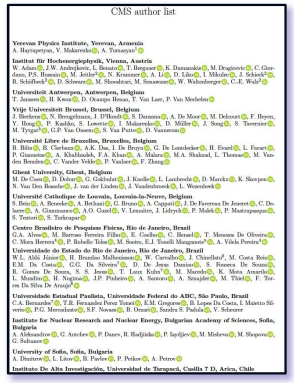
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Projects

- Preparation of the science of tomorrow (10-30-.. years)

…and, at the same time :

- Return on investments (data analyses, publications)

→How to reinforce specific partnerships to define, together, what can be done better ?

→How to take more benefit from all big infrastructures (correlations, multimessager observables) ?

→In a context of growing constraints on science (funding, geopolitics, scientific skepticism, etc.)

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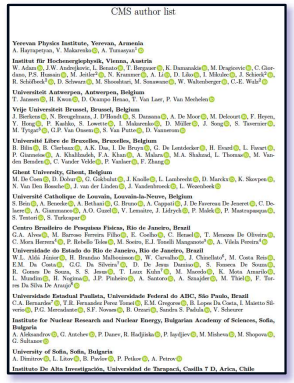
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→How to reinforce specific partnerships to define, together, what can be done better ?

→ **To take benefit from CNRS set of international cooperation (DEI & Foreign offices)**

→ **To use the appropriate cooperation tools**

CNRS Tools : 5 years (renewable) : International Research Lab / Project / Network

Our collaborations

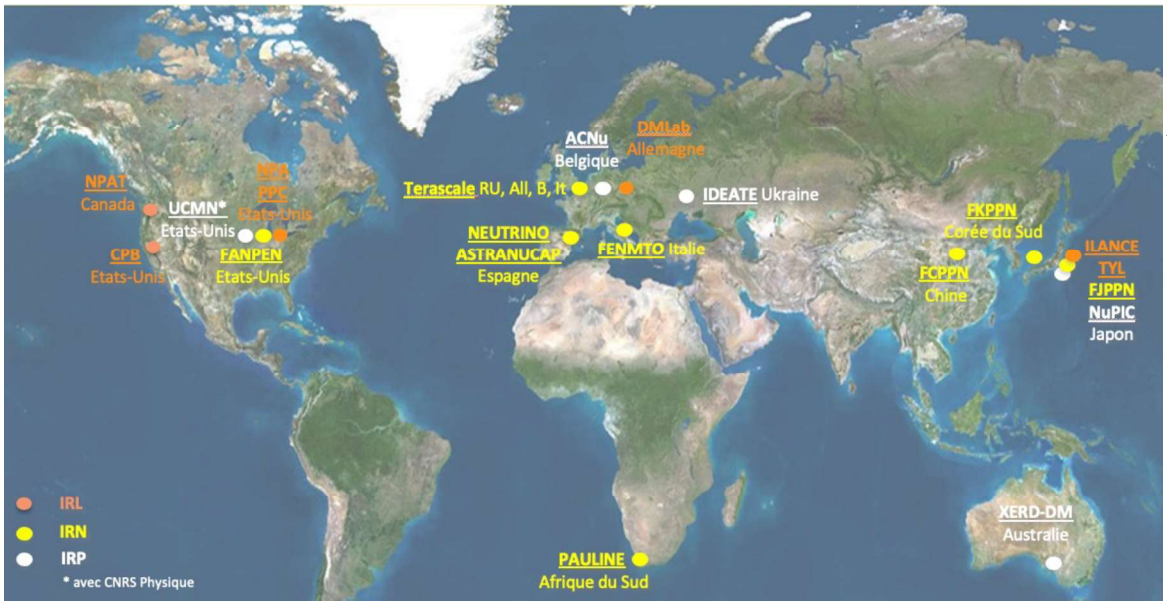
Example of IJCLab (CNRS/ Paris Saclay University)

Our collaborations

Example of IJCLab (CNRS/ Paris Saclay University)

Our structured actions

7 IR-Labs/9 IR-Networks/5 IR-Projects (octobre 2025)



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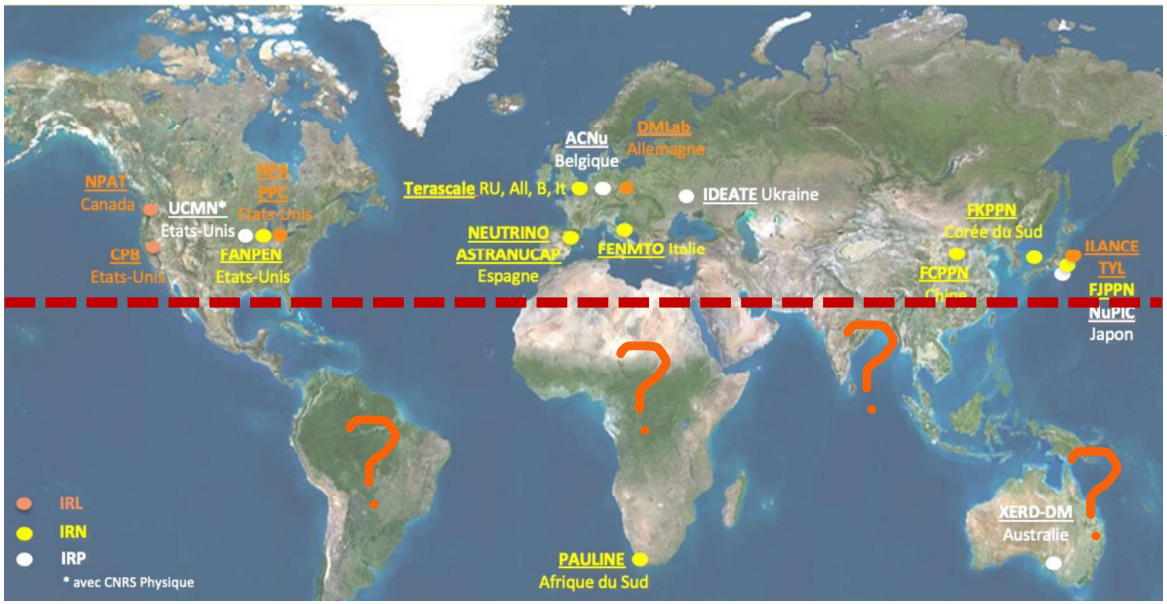

→ Structured actions surprisingly inexistant :

- In South hemisphere
- With countries which produce excellent sciences

Our international strategy

❑ For International research labs (8 IRL)

- At location near by very high infrastructures / excellent universities : **mobilities of scientists** for experiments (mounting, data taking…), privileged dialog with partners
- Directors invited to develop their financial ”autonomy” and the IRL visibility on their site :

  - **Application to the EU calls** for mobilities (Marie-Curie staff exchange (ex. NPA @MSU in US with NPAT@TRIUMF in Canada and our French labs)

CNRS is the first beneficiary of Eu funds in Europe

Our international strategy

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❑ International research network (9 IRN) : efficient tools to reinforce specific cooperation

- **A strategic adding-value to existing global collaboration. Examples :**

  - IRN Neutrinos (under construction) to link IRL with U Chicago (DUNE experiment), U Tokyo (SuperK, HyperKamiokande) and French Labs
  - Particle physics : from France-China Particle Physics Network→ Lab in China (LoI signed in Oct. 2025)
  - Astroparticle physics : PAULINE Network of underground labs in South Africa / Argentina (?) / France
  - **Our CLAF-CNRS IRN Project in astroparticles and cosmology !**

CNRS remarkable international network

Nuclei
& Particles

PERSPECTIVES

→ 2026, January 27th

CNRS Astroparticles and Cosmology

❑ **3 major fields of investigation at CNRS**, from theoretical aspects to experiments, with strong links with France space agency :

- **Cosmology :** Cosmic microwave Background - dark matter – dark energy – ~160 FTE
  - Dark energy through large scale structures with DESI, VRO, Euclid
  - CMB : Simons Observatory, LiteBIRD
  - Direct dark matter search (from ueV to TeV) : XENONnT, DarkSide, TESSERACT, DAMIC, MADMAX – one key element with our underground lab (LSM)
- **High energy astrophysics :** gamma-rays and cosmic rays - ~100 FTE
  - Understanding nature and origins of CR up to 10^21 eV: Auger Observatory
  - Gamma-ray sky above keV :
    - Space based : Athena, SVOM, Fermi – looking to future mission as THESEUS
    - Ground based : HESS and CTA
- **New messengers :** neutrino and gravitational waves - ~160 FTE
  - Using gravitational wave as a new probe in astrophysics and fundamental physics : Virgo, moving to next steps with Einstein Telescope and LISA space mission
  - Opening new window with neutrinos : KM3NeT, SuperK/HyperKamiokande

CNRS Astroparticles and Cosmology

NUCLEI & PARTICLES | EARTH & SPACE | PHYSICS

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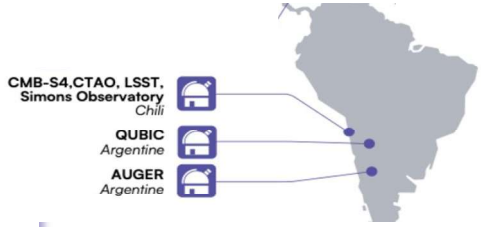
➢ **Building a bridge** between South America Observatories/Labs wit CNRS labs/partners thanks to the **new CLAF-CNRS network**

Some of the sites with the clearest skies in the world, therefore a prime re for installations of several high-precision astrophysical observatories.



➢ **A strategic partnership in South America for the CNRS :**

A new partnership, source of multiple opportunities

10 Labs

❑ Valorization of the complementarity of the two divisions

- Different ways of working which complement each other

Nuclei and particles	Earth and Space
An institute with a strong involvement in construction	An institute used to the "Observer mode" (based on habits in astronomy)
Master projects	Services nationaux d'observation – National service of observation via Observatoires des Sciences de l'Univers
Activities funded via recurrent fundings on a multi-year basis	Activities funded via yearly competitive calls
Methods of analysis inspired by high-energy physics	Method of analysis inspired by astronomy
Has its own computing centre – CCIN2P3	

- Scientific directors of both institutes meet monthly
- GDR and "Programmes Nationaux" where both institutes participate
- Some labs have the other division as secondary "tutelle" (supervision)
- Crossed permanent positions between the two institutes

A new partnership, source of multiple opportunities

NUCLEI & PARTICLES

EARTH & SPACE

10 Labs

6 Labs

Argentina
Brazil
Chile
Colombia
Mexico
Peru

- ❑ Valorization of the complementarity of the two divisions
- ❑ Possible development of the project through specific tools
  - From IR-Network to specific IR-Projects
  - Phd thesis, workshops, Eu calls
  - Links to other CNRS IRL (astro/cosmo, dark matter & energy, gravitational waves…)
- ❑ Co-construction of the (our) future projects

Nuclei
& Particles

International Conference on High Energy Physics

"For over 50 years, ICHEP has been the premier conference in particle physics, serving as the leading forum for presenting the most significant results in the field.

At ICHEP, physicists from around the globe converge to share the latest advancements in particle physics, astrophysics, cosmology, and accelerator science.

Attendees also engage in discussions concerning plans for major future facilities, shaping the direction of cutting-edge research".

https://ichep2026.org

→ 2026, January 27th

OBRIGADA

→ 2026, January 27th

Few projects with CNRS-CLAF collaborations

Pierre Auger Observatory

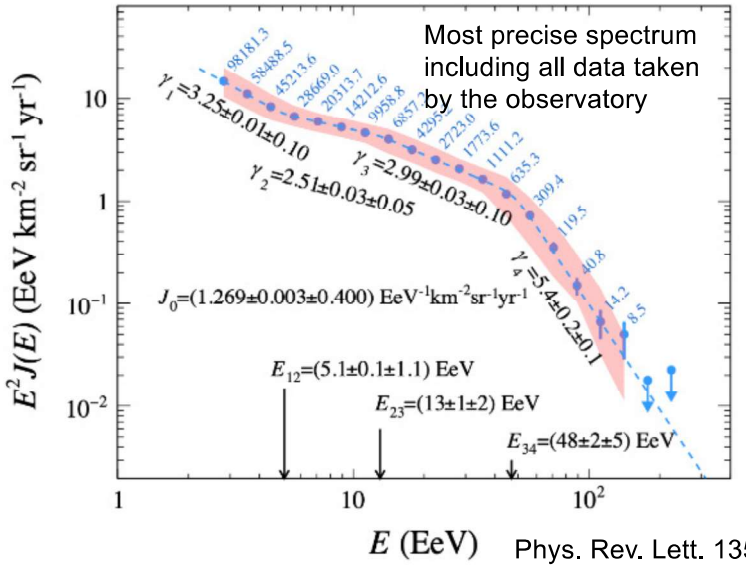
Studying the nature, origin and spectrum above 10^{18} eV for the cosmic rays

3000 km^2 instrument with Cerenkov water tanks and fluorescence telescopes since now 20 years

After a very important implication, we have reduced our contributions with now essentially one laboratory (IJCLab)

But still strong interactions with CLAF institutions on spectrum, search for anisotropies, …

View of a water-filled tank and fluorescence building in the background

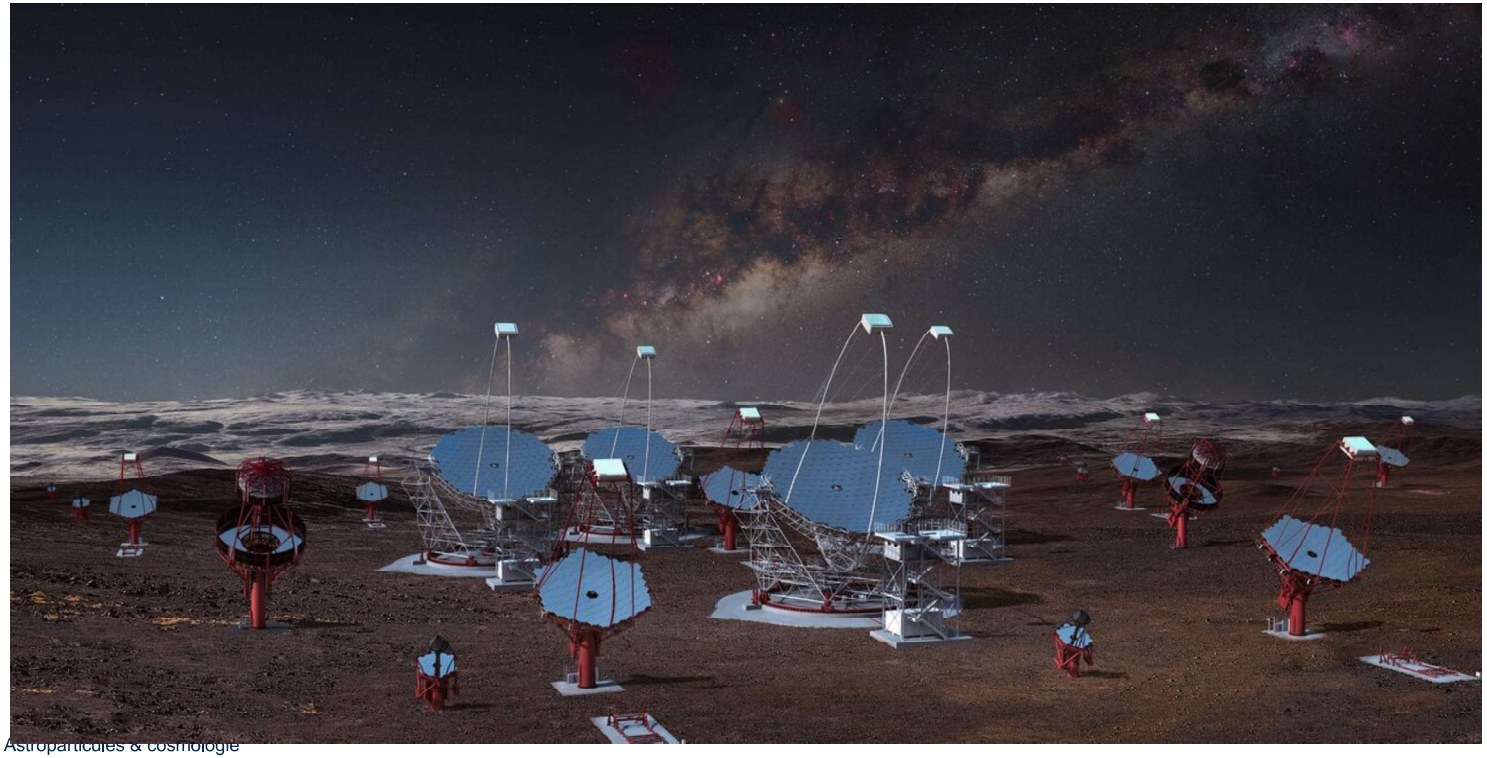


Phys. Rev. Lett. 135, 241002 (2025)

Cerenkov Telescope Array (CTA)

Next generation of gamma-ray (E> 10 GeV) observatory

French leadership for the installation of NectarCAMs for the MST – first installation in the south site end of 2026/beginning 2027 !



Artist view

Our main priority for the next years

2 sites :

North @ la Palma
South @ Chile

119 persons from

CNRS Nuclei and Particles
CNRS Earth and Universe

Possible common contributions to a very large panels of subjects/expertise

continue with what has been done on H.E.S.S.

Southern Wide-field Gamma-ray Observatory

Setup a large water Cerenkov observatory

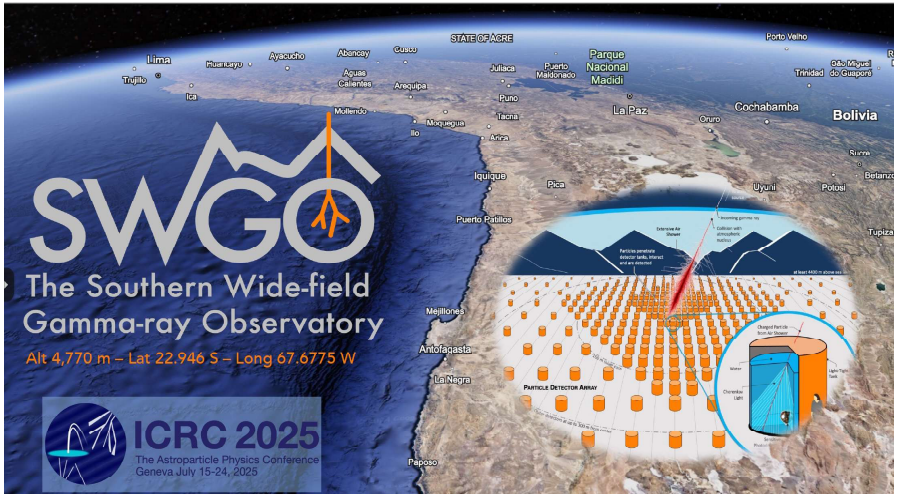
– allow monitoring of the gamma-ray sky
– complementary to CTAO

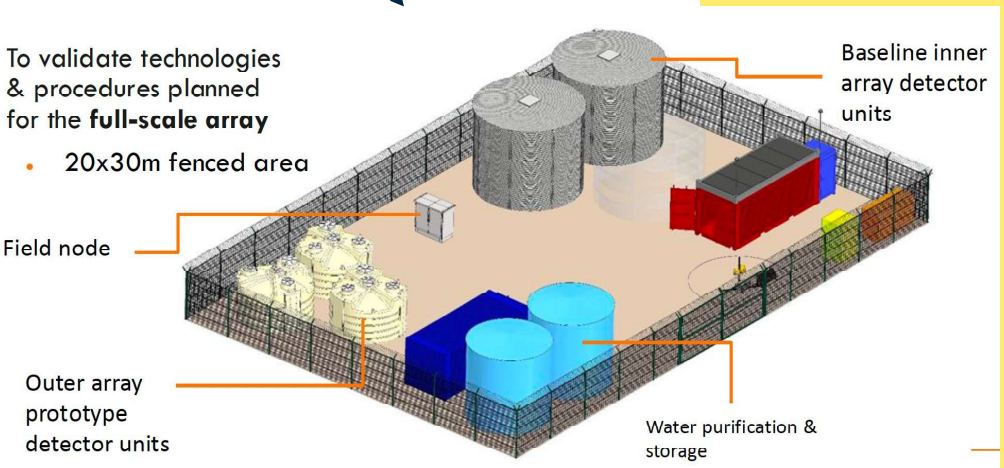
Project to be funded – proposal for a pathfinder

Connections with CTAO will be possible

- 2 CNRS laboratories interested

- strong interactions with CLAF groups





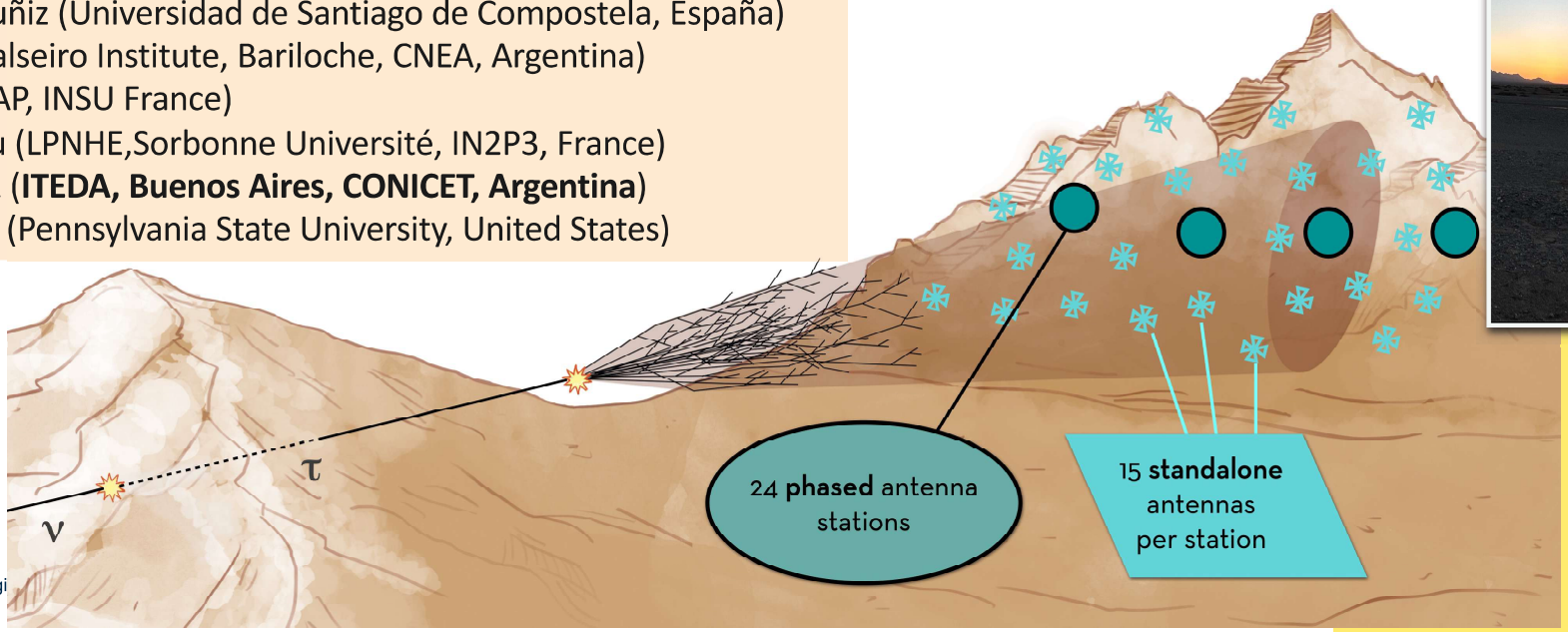
The Hybrid Elevated Radio Observatory for Neutrinos (HERON)

A hybrid setup combining **phased array** and sparse **standalone antennas** for air shower radio detection - 2 technics proven by on-going experiments (BEACON & GRAND)

HERON detector to be deployed in the San Juan province, Argentina

Simulated sensitivity allow detection of UHE astrophysical neutrinos and their sources within next 6 years

HERON collaboration Principal Investigators:
Jaime Alvarez-Muñiz (Universidad de Santiago de Compostela, España)
Ingo Allekotte (Balseiro Institute, Bariloche, CNEA, Argentina)
Kumiko Kotera (IAP, INSU France)
Olivier Martineau (LPNHE,Sorbonne Université, IN2P3, France)
Federico Sanchez (**ITEDA, Buenos Aires, CONICET, Argentina**)
Stephanie Wissel (Pennsylvania State University, United States)

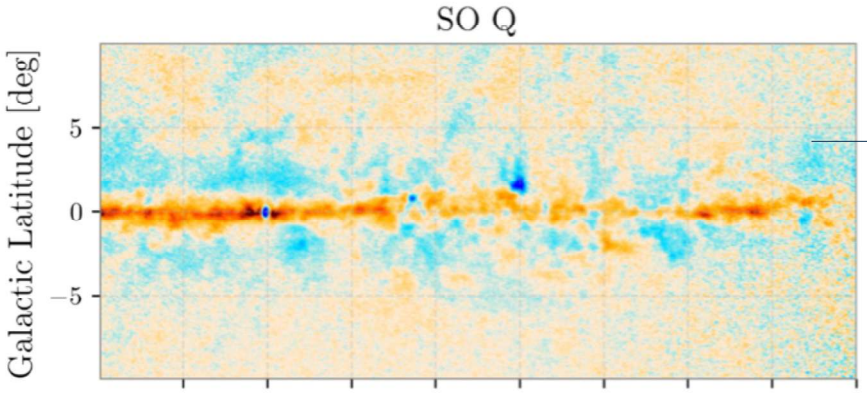


Testbench for HERON:
The GRAND@Auger prototype

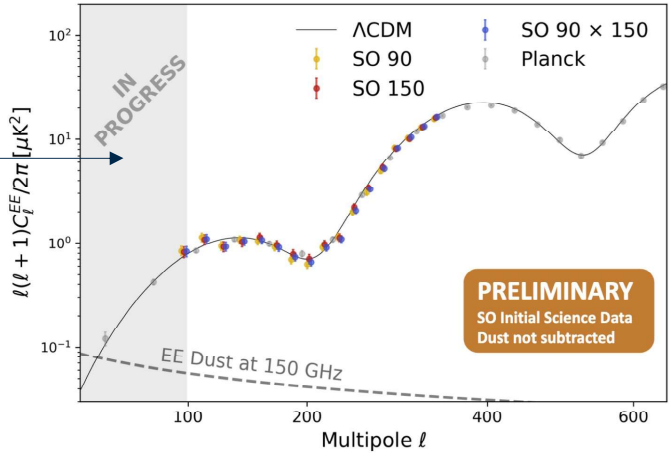
Simons Observatory (SO)

- **Goal:** Measure the Cosmic Microwave Background with high angular resolution – currently 4 telescopes
- **Complementary with Planck data**
- **Inflation model of the origin of the Universe:** a small fraction of the intensity of the temperature is polarized by primordial gravitational waves in the form of “B-Modes”

Simons Observatory site



Galactic plane observed by SO



Power spectrum and comparison with Planck data

6 CNRS labs involved

5 Chilean institutions

Strong implications on both side in the analysis

The Q & U Bolometric Interferometer for Cosmology (QUBIC)

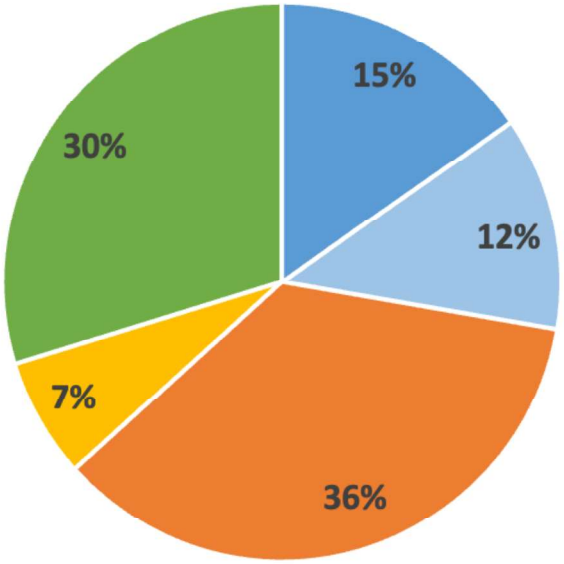
- **Goal:** Measure the “B-Mode” of the polarization angle in the Cosmic Microwave Background with a novel technique
- **Inflation model of the origin of the Universe:** a small fraction of the intensity of the temperature is polarized by primordial gravitational waves in the form of “B-Modes”

4 labs in CNRS

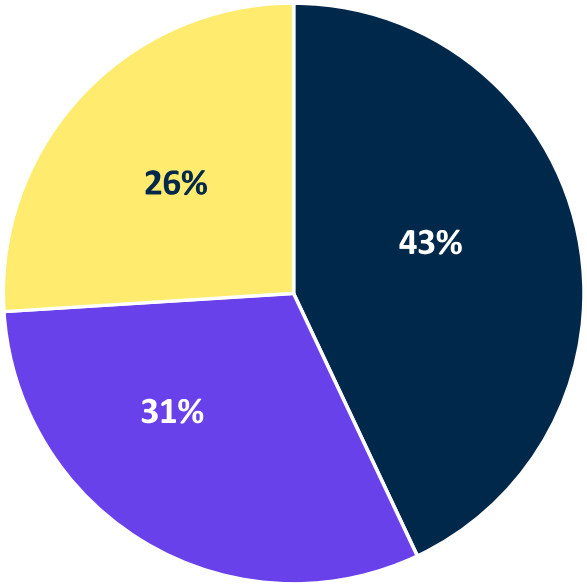
7 labs in Argentina

strong interactions on site and data analysis

Staff & programmes



- Chercheurs CNRS
- Chercheurs non CNRS / EC
- IT CNRS
- IT non CNRS
- Non permanents



- Particules
- Nucléaire
- Astro&Cosmo

1 050 permanent researchers including **600** CNRS **450** faculties

1 600 permanent staff including **600** research engineers

800 doctoral and post-doctoral fellows

15 startups

10 national platforms and infrastructures

16 large research infrastructures

13 interdisciplinary platforms

28 international actions and research projects

21 national and international laboratories

Nos 7 International Research Laboratories

Des IRL auprès de grands centres / infrastructures de recherche

Etats-Unis

Centre Pierre Binetruy (CPB)
Partenaire : UC Berkeley
Thématiques : cosmologie, DM / DE, neutrinos
Direction : James Bartlett (CNRS) / Saul Perlmutter (UCB)

Nuclear Physics and Astrophysics (NPA)
Partenaire : Michigan State University
Thématiques : physique et astrophysique nucléaire
Direction : Jérôme Margueron (CNRS) / Oscar Naviliat-Cuncic (MSU)

Particle Physics & Cosmology (PPC)
Partenaire : University of Chicago
Thématiques : neutrinos, DM, physique des particules, cosmologie
Direction : Cédric Cerna (CNRS) / Bonnie T. Flemming (Chicago)

Canada

Nuclear Physics, Astrophysics and Accelerator Tech. (NPAT)
Partenaire : TRIUMF
Thématiques : physique & astro nucléaire, accélérateurs & tech.
Direction : David Lunney (CNRS) / Rituparna Kanungo (TRIUMF)

Japon

International Laboratory for Astrophysics, Neutrino and Cosmology Experiments (ILANCE)
Partenaire : University of Tokyo
Thématiques : neutrinos, DM / EN, GW, physique des particules
Direction : Michel Gonin (CNRS) / Takaki Kajita (UTokyo)

Toshiko Yuasa Laboratory (TYL)
Partenaire : KEK
Thématiques : physique des particules
Direction : Karim Trabelsi (CNRS) / Shoji Hashimoto (KEK)

Allemagne

DarkMatter Laboratory (DMLab)
Partenaire : Helmholtz Association (DESY, GSI, KIT)
Thématiques : matière noire (DM)
Direction : Dirk Zerwas (CNRS) / Thomas Schörner (Helmholtz/DESY)