

# From LA-CoNGA Physics to EL-BONGO Physics:

an open science education capacity building  
collaboration between Latin America and Europe for  
High Energy Physics and Astrophysics

***Luis A. Núñez,***  
**Universidad Industrial de Santander-Colombia**  
on behalf of the LA-CoNGA and  
EL-BONGÓ consortia



**EL-BONGÓ**  
physics



Latin American alliance for  
Capacity building in Advanced physics  
**LA-CoNGA physics**



Cofinanciado por el  
programa Erasmus+  
de la Unión Europea





# LA-CoNGA physics: a virtual research and learning network



EL-BONGÓ  
physics

## Internationalization

collaborative international environment

## Accessibility



Each institution/group  
might not have  
all the resources/staff



## Modernization

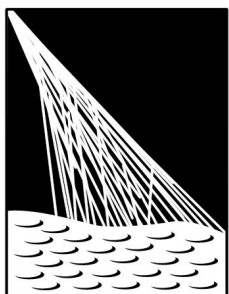


open educational resources,  
connectivity, acquisition  
of digital skills, and  
use/development of new  
learning methods

Sánchez, A., and Atlas Collaboration. "The CEVALE2VE case." PoS ICHEP2016 (2016) 322

Caicedo, M., et al. "Virtual research and learning communities in Latin America: The CEVALE2VE case." Interciencia 42.11 (2017): 733-738

High energy, cosmology and Multimessenger Astronomy physics community has grown in Latin America in the last decades



PIERRE  
AUGER  
OBSERVATORY



High Energy Physics  
Latinamerican European Network



The European Particle  
physics Latin America NETwork

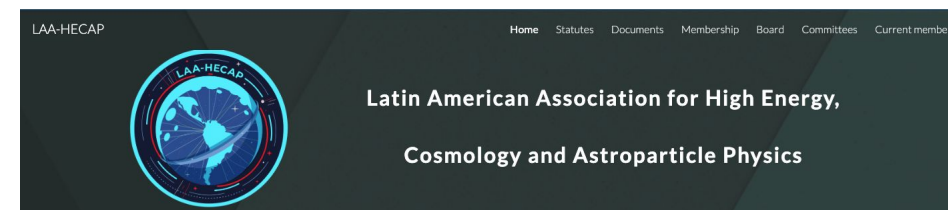


Latin American Giant  
Observatory



The HECAP development is nuanced and variable country-by-country, but it has huge potential thanks to:

- Critical mass of teachers/researchers in several universities
- Diversity of interests and skills
- A young generation with potential and eagerness to learn
- Collaborative work make us stronger





# LA-CoNGA physics *in a nutshell*

- LA-CoNGA physics is an **Erasmus+** project, **CBHE** category (Capacity Building in Higher Education)
  - 4-year EU funding: 900 k€, in the 2020-2023 period
- Main objectives :
  - **contribute to the modernization** of higher education in the Andean region
  - Strengthen collaboration between **Latin America** and **Europe** in Higher Education
  - with support of universities and research centers in Europe and Latin America
- Proof-of-concept : setup a **Master-level** complete year in **Advanced Physics**
  - **common, cross-institutional** program
    - **inserted** in the already-existing **local Master** programs
  - modern, **interconnected** instrumentation laboratories
  - **innovative e-learning platform**, fully based on open-access contents and tools
  - problem-solving pedagogical approach, structured in mini-modules
  - **3-month internships** in research labs or industrial partners (in Europe or LA)
  - Syllabuses calibrated on the EU **Bologna process** (i.e. 60 ECTS = 1 full year)

Co-funded by the  
Erasmus+ Programme  
of the European Union





## Program Partners in Europe:

- Université Paris Cité (UPC), France (Coordinator)
- Université Paul Sabatier Toulouse, France (UPS)
- Technische Universität Dresden (TUD), Germany

## Program Partners in Latin America:

- Colombia : UIS (Bucaramanga), UAN (Bogotá)
- Ecuador : Yachay Tech (Ibarra), USFQ (Quito)
- Peru : UNI, UNMSM (Lima)
- Venezuela : UCV, USB (Caracas)

## Associated Partners:

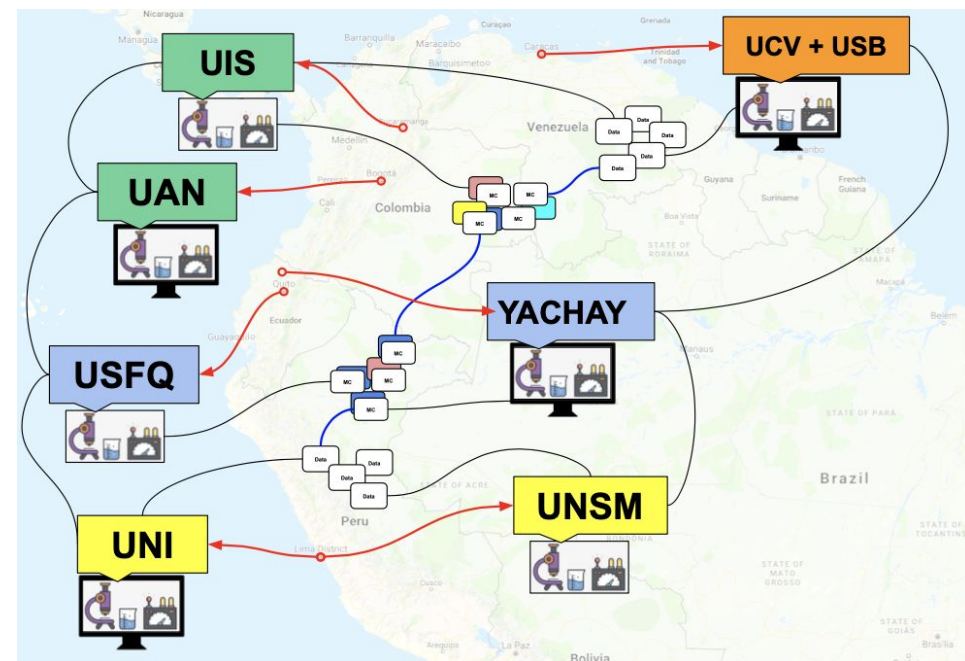
- International research centers: CERN and ICTP
- National research centers: CNRS (FR), CEA (FR) DESY (GE)
- Industrial partners in Latin America and Europe
- Other academic partners in the Americas





# LA-CoNGA physics : *methodology and tools*

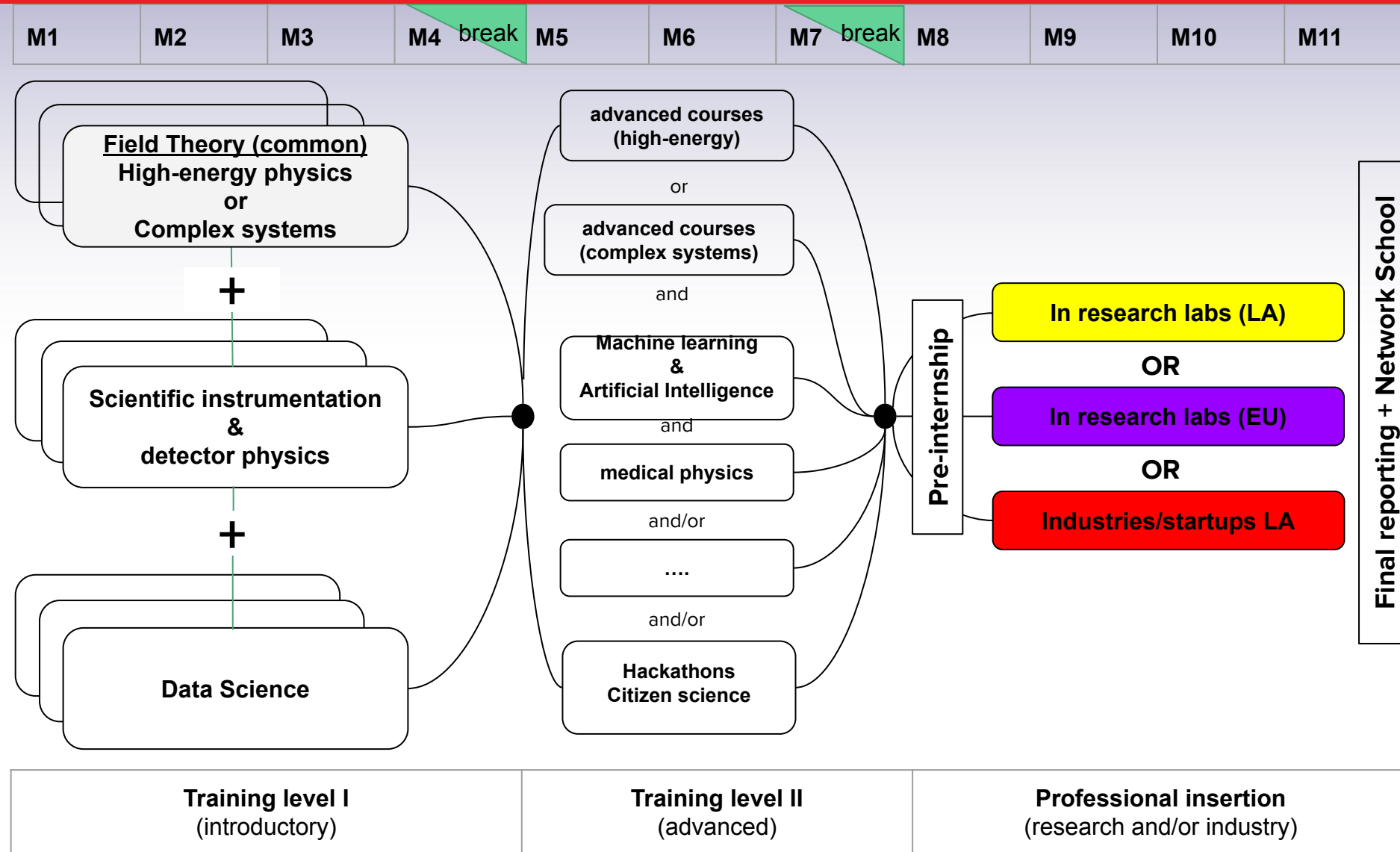
- LA-CoNGA physics reproduces a **modern, cross-institutional, international**, working environment
- MiLAB : our **e-learning** platform, intensively based on **open-access** tools
- module-structured courses, taught in “**semi-presencial**” mode
  - partly remotely from Europe, partly from Latin America
- Academic support: individual mentorships, discussion forums, office hours, discussion sessions...
- **interconnected** instrumentation labs in **remote access**
- teaching material in **Spanish**
  - all **available online** : videos, courses, docs, notebooks...





# LA-CoNGA physics as a *matrix-structured syllabus*

Peña-Rodríguez, J., & Núñez, L. A. (2022). LA-CoNGA physics: an Open Science Collaboration in Advanced Physics between Latin-America and Europe. *arXiv preprint arXiv:2201.02256*.



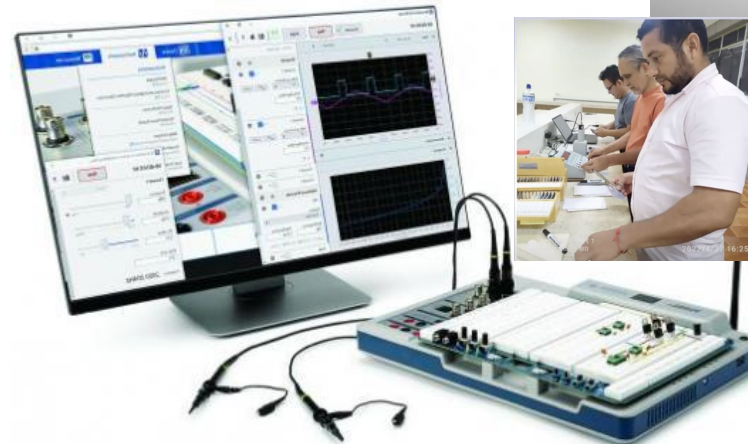
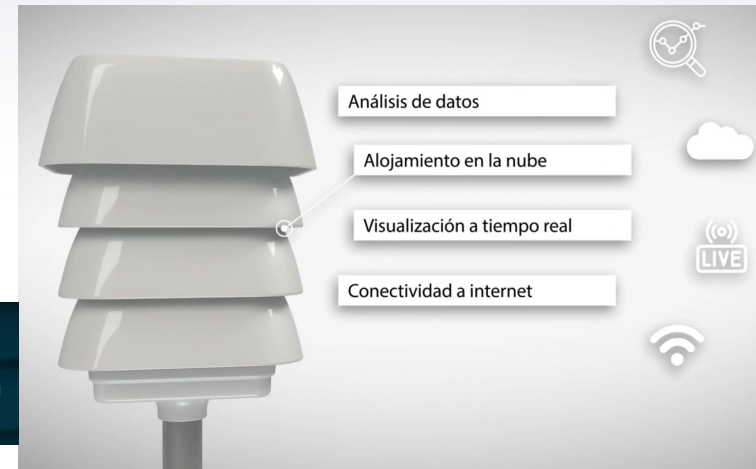
<http://laconga.redclara.net/wp-content/uploads/2020/07/preguntas-frecuentes-LACoNGA.pdf>



# the LA-CoNGA physics curriculum : scientific instrumentation

- Advanced teaching lab in **Nuclear Physics** :
  - **CAEN** Premium Kit and **CAEN** EasyPET
    - scintillators, SiPMs, spectrometers...
- Laboratory toolkits: **Multi-purpose, interconectable** and **remote-accessible**
  - **National Instruments** Virtual Instrumentation Suite ELVIS III
  - **Keysight** EDU Series for Ecuador
    - oscilloscopes, function generators, protoboards...
- Air-quality monitoring stations for **high-school science labs**
  - **Made in Colombia** by **MakeSens** startup
- Remote-controlled experiments on chaos (Chua circuit, double pendula...)
  - by **e-pisteme Tech**, a startup from Spain
  - <https://grupohalley.gitlab.io/labs/>

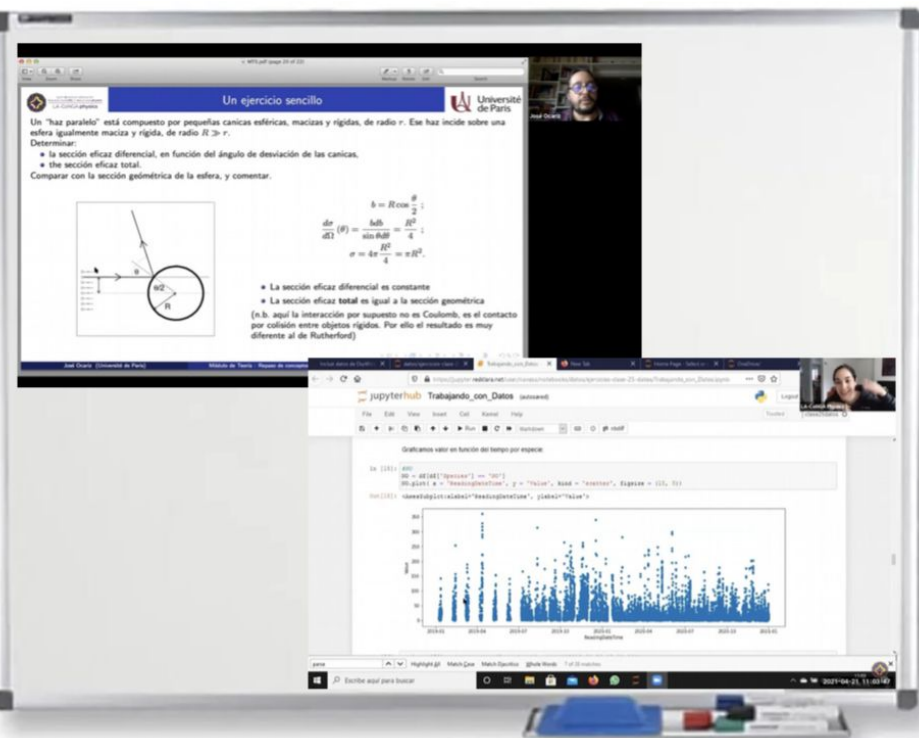
Material deployed in all 8  
Latin American partner Universities





# LA-CoNGA physics: courses

- **LA-CoNGA physics community is composed by 3 cohorts so far: 2021, 2022, 2023**
- **30 instructors** from Latin America and Europe
- More than **50 students** from 4 countries completed at least one full course in each cohort
  - Between 10-15 students in internships each year
- More than **200 classes** available open access (videos, documents, notebooks, datasets...)
- **But also challenges** like COVID, difficulties in accessing universities (instrumentation from home), internet connection bandwidth and postgraduate time dedication conditions in the region



LA-CoNGA physics  
International  
Network  
School

6 - 8 diciembre 2021  
Universidad Industrial de Santander  
Bucaramanga - Colombia



Cómo diseñamos un trigger? Estrategia de L1 trigger

Ejemplo:  
taus en L1  
CANDIDATO 1

Large activity in had calo  
EM3 empty

Active poll

¿Qué técnicas puede usar NOvA (un detector segmentado) para rechazar neutrinos y rayos cósmicos que no vienen del acelerador localizado en Fermilab a 810 km de distancia? Marca todas las opciones que te parezcan válidas

Join at  
slido.com  
#776445

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# LA-CoNGA physics : *internships in international mobility*

## Objectives:

- Immersive professional experience
  - in research labs or industries
  - mostly in another LA country
  - some internships in Europe
- Results of the internship presented in the end-of-year **Network School**
- 4 cohorts so far : 2021, 2022, 2023
  - the 2024 courses are ongoing

## LA-CoNGA physics International Network School 2022

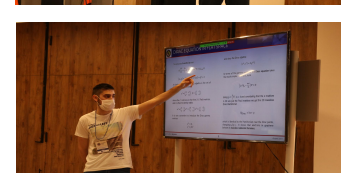
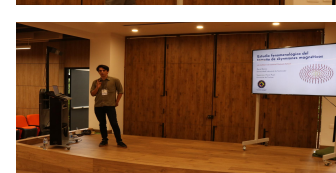
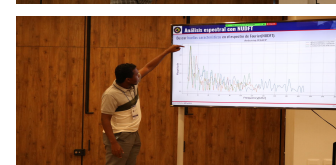
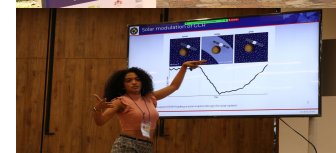
Dec 5, 2022, 2:00 AM → Dec 7, 2022, 5:30 PM America/Bogota

Escuela de Física (Universidad del Magdalena)

Jose Ocariz (Université de Paris Cité) , Reina Camacho (CERN)

**Description** LA-CoNGA physics Network School is an international event to share experiences and practices with students and instructors of the LA-CoNGA Physics project. In this event, the students will have the opportunity to discuss the results of their internships with classmates and experienced researchers from the institutions' members of the consortium

LA-CoNGA physics (Latin-American alliance for Capacity building in Advanced physics) is an ERASMUS+ CBHE project aiming to support the modernization of university infrastructure and its pedagogical offer in advanced physics in four Latin-American countries: Colombia, Ecuador, Perú and Venezuela. This project is co-funded by the Education, Audiovisual and Culture Executive Agency of the European Commission. Our teaching and research network comprises three partner universities in Europe and eight in Latin America; high-level scientific partners (CEA, CERN, CNRS, DESY, ICTP), and several and two industrial partners.





# LA-CoNGA physics : *beyond lectures*

## Capacity is built beyond the zoom and lab rooms


- Bi-weekly **seminars**: by guest scientists, on topics related to HEP/CS or of general interest
- **Mentorships**: close individual interactions with students
- Scientific **outreach**: workshops about science communication or specific topics
- Transversal to other communities:
  - hackatons (co-Afina 2022 and 2023, soon 2024)
  - citizen science projects with high-schools in the region




Latin American alliance for  
Capacity building in Advanced physics  
**LA-CoNGA physics**

**Seminarios LA-CoNGA physics**  
31 de mayo de 2021, 14.00 (Col, Ec, Pe), 15.00 Ve, 19.00 UTC  
Transmisión en el canal de YouTube de LA-CoNGA physics : [link](#)

**Una trayectoria teórica**  
Leticia Cugliandolo, Sorbonne Université, Paris, Francia

Latin American alliance for  
Capacity building in Advanced physics  
**LA-CoNGA physics**

**Seminario especial**  
LA-CoNGA physics  
Lunes 13 de septiembre de 2021  
14:00 (Col, Ec, Pe), 15:00 Ve, 19:00 UTC  
Transmisión en el canal de YouTube de LA-CoNGA physics

Steven Weinberg: El Modelo Estándar  
Fernando Quevedo  
Department of Applied Mathematics and Theoretical Physics (DAMTP)  
University of Cambridge

#SeminariosLACoNGA #AuLACoNGA




**Mujeres que hacen Física**  
Historias de mujeres académicas en América Latina y Europa: trayectoria y vida  
#QueremosSerMás

11 febrero 2022 | 9h00 Col - Per - Ecu / 10h00 Ven / 15h00 CET

**Día Internacional de la Mujer y la Niña en la Ciencia**

Moderado por:  
Reina Camacho Toro (CNRS, Francia)  
Joany Manjarrés (TU-Dresden, Alemania)

Invitadas que hacen vida científica en Ecuador, Colombia, Suiza y Francia

Latin American alliance for Capacity building in Advanced physics  
**LA-CoNGA physics**

Cofinanciado por el programa Erasmus+ de la Unión Europea

Sigue la actividad vía **YouTube**  
LA-CoNGA Physics

LA-CoNGA physics presenta **#Higgs10**

**Testimonios y reflexiones:**  
una conversación con América Latina  
15 julio 2022 | 09:00 Co, Ec, Pe; 10:00 Ve; 14:00 UTC

Antes y después de un gran descubrimiento 2012-2022



**iVolvemos a sonar juntos!**  
<https://laconga.redalicia.net/hackathon/>



**LA-CoNGA physics**  
Hackathon  
Datos Abiertos en América Latina 2023

**Fase 1**  
Llamado a retos  
22 Ago al 22 Sept

**Fase 2**  
Inscripciones  
01 sept al 01 oct

**Fase 3**  
Hackathon  
20 al 22 octubre

ICTP International Centre for Theoretical Physics  
cedia  
creative commons  
CLARA

- **Some scientific outputs:**
- Fernández, N., et al. [Eur. Phys. J. B 96, 68](#) (2023)
- Suarez-Urango, D. et al. [Eur. Phys. J. C 83, 1018](#) (2023)
- Martínez-Rivero, R.A. [et al arXiv 2504.15103](#) (2025)
- Rico-Aparicio, S et al [Arxiv 2505.00856](#) (2025)



# LA-CoNGA physics : *some lessons learned*

- Our **balanced syllabus** (data science, instrumentation and theory) :
    - suitable training framework for various academic communities.
  - The e-methodology developed through the LA-CoNGA physics
    - can be **extended to other regions**, sharing experiences among near partners
  - Active interaction with our **scientific Diasporas**
    - through courses, coaching, and mentorships can be extended to other communities
- 
- Many of our students have **part-time jobs**, often as the unique source of **financial support**
    - a **full-commitment** to a one-year program is a **challenge** for them
  - Our community-built training program :
    - should be designed through a **more flexible** series of **self-contained short modules**
  - Our Instrumentation laboratories
    - would benefit from **augmented**/virtual reality
    - and from **improved** remote controlled equipments from different locations and connecting devices
  - Digital fabrication skills and an open-hardware approach
    - should be **incorporated early** into the training framework
    - to ensure that laboratory equipment can be **manufactured** (fully or partially) **on-site**
  - Our course certificates
    - should evolve into official **equivalence** of the courses among institutions
    - should be easy to be interpreted by potential employers

# EL-BONGÓ: E-Latin America Digital huB for Open Growing cOmmunities in physics



**EL-BONGÓ**  
physics



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# EL-BONGO Physics: E-Latin America Digital huB for Open Growing

## cOmunities in physics

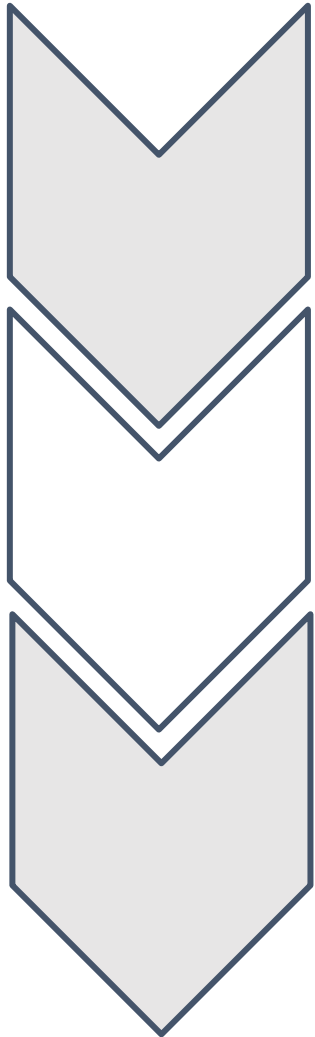
**Foster the digital transformation of Higher Education by promoting virtual research communities in Latin America**

- **Learning-by-doing research in digital communities** using MiLAB professional digital platform and open methodologies
- **Developing do-it-yourself digital fabrication skills** for building scientific instruments in FABLab environments
- Creating a flexible hybrid Bologna Master Program based on mini-training modules with **institutional validation through a blockchain infrastructure**
- **Building an Open Science Collaborative Hub/Science Gateway** designed to cater not just to the academic and research community but also to be inclusive of the broader society, encouraging lifelong learning and public engagement with science and education.
  - Digital Infrastructure: Digital platforms for e-learning, research databases, and virtual laboratories.
  - Open-Access Educational Resources: A repository of open-access materials
  - Collaboration and Networking Platforms for students, educators, researchers, and industry professionals across Latin America and beyond.
- **Transferring the experiences and best practices from LA-CoNGA Physics** in Internationalization, Digital Education and Open Science
  - Hybrid Bologna master training program
  - **Academic Life** Workshops, Seminars, Mentorships/Internships
  - **Global community** engaged with the Latin American Diaspora



# The concept: *Learning by doing research*

Research learning communities



**Research based learning**, integrates research activities into the core of the learning process

**Learning by doing** implies collaborative projects, real-world problem-solving, large collaboration culture, the use of open data *and digital fabrication laboratories (FABLab)*

**Do-it-by-yourself (DIY)** completes the learning environment providing the capabilities to build and repair scientific sensors/equipments

# E-Latin American huB for Open Growing cOmmunities in physics (EL-BONGO physics)

3-year EU funding: 700 k€, in the 2025-2027 period



## Program Partners in Europe:

- **France:** Université Paris Cité; Université Paul Sabatier, Toulouse; The Institut Nationale de Sciences Appliquées Lyon (INSA Lyon)
- **Spain:** Universidad de Salamanca (Spain)

## Program Partners in Latin America:

- **Colombia:** Universidad Industrial de Santander; Universidad Antonio Nariño, Universidad Autónoma de Bucaramanga
- **Ecuador:** Universidad San Francisco de Quito; Escuela Superior Politécnica Chimborazo
- **El Salvador:** Universidad Francisco Gavidia, Universidad El Salvador
- **Honduras:** Universidad Nacional Autónoma de Honduras
- **Guatemala:** Universidad San Carlos de Guatemala,
- **Perú:** Universidad Nacional Mayor de San Marcos
- **Venezuela:** Universidad Central de Venezuela, Universidad Simón Bolívar

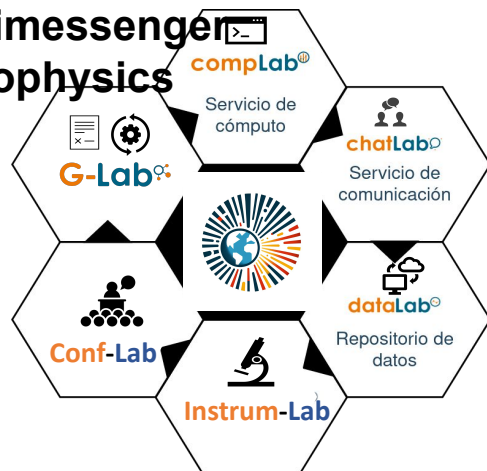


## Associated Partners:

- International research centers: CERN and ICTP
- National research centers: CIEMAT(ES), CNRS (FR), CEA (FR) DESY (GE), IPEN (PE), IVIC (VE)
- Industrial partners in Latin America and Europe:  
E-Pisteme Tech (Spain), Frontier X, RedCLARA, DBAccess, CEDIA, LACChain, SCALAC

# EL-BONGO Physics: E-Latin america digital huB for Open Growing cOmMunities

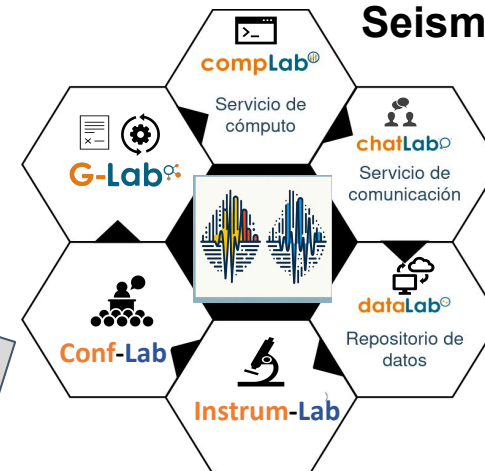
## Space Weather Multimessenger Astrophysics



- Courses
- Workshops
- Data
- Codes
- Publications
- Chats
- Visualizations



## Seismology



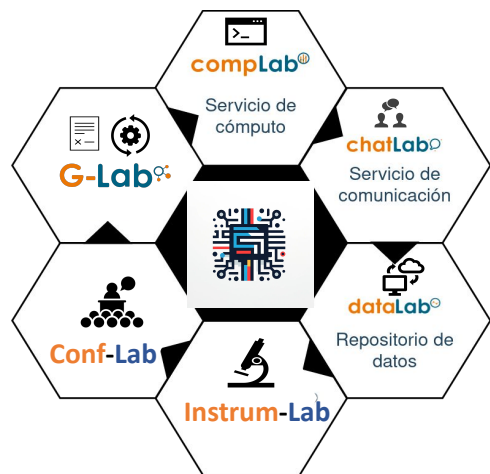
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USC(GT), UIS(CO), UCV(VE), UMG(GT), USFQ(EC), UPC(FR), UNMSM (PE)

UES(SV), UIS(CO), USB(VE), USC(GT), UNMSM(PE)

## Inter Community Open Science Hub

## AI-HPC Tools

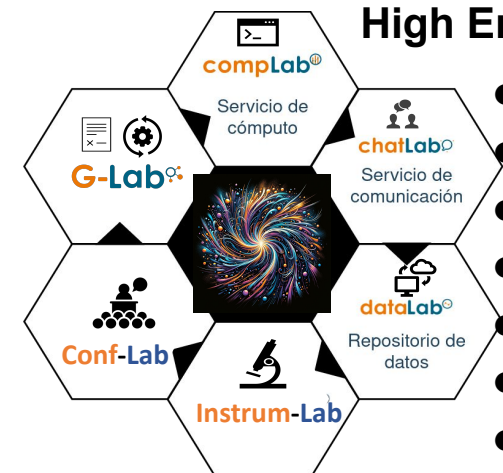


- Courses
- Workshops
- Data
- Codes
- Publications
- Chats
- Visualizations

USal(ES), UIS, ULyon, UFG(SV), UNMSM(PE), UP(PA)



## High Energy Physics



- Courses
- Workshops
- Data
- Codes
- Publications
- Chats
- Visualizations

UNAH (HN), USC(GT), UPC(FR), UPS(FR), USFQ(EC), UNI(PE), UAN(CO)

# EL-BONGÓ physics *in construction* : a flexible training scheme



HighEnergy  
Physics



Seismology  
GeoHazards



Artificial Intelligence  
HighPerf  
Computing



Space Weather  
Astronomy

Basic Disciplinary modules				Optative modules			
SA.W1->W4	SA.W5->W8	SA.W9->W12	SA.W13->W16	SB1.W1->W4	SB1.W5->W8	SB2.W1->W4	SB2.W5->W8
Mod1	Mod2	Mod3	Mod4	Mod5	Mod6	Mod7	Mod8
Mod1	Mod2	Mod3	Mod4	Mod5	Mod6	Mod7	Mod8
Mod1	Mod2	Mod3	Mod4	Mod5	Mod6	Mod7	Mod8
Mod1	Mod2	Mod3	Mod4	Mod5	Mod6	Mod7	Mod8

## Skills in demand in/out of academia

- Data Science
- Topic-specific Instrumentation
- Topic-specific Basic Course
- Topic-specific Advanced Course
- Hackathon & Citizen Science experiences
- Internship (12 weeks)
- Community research projects

## A flexible syllabus for each Community

- each module corresponds to 32h (8h/week) ~5 ECTS
- combines Topic-specific and Elective modules
- students can select personalised training routes





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