

A Venezuelan input to the Latin American Strategy for Research Infrastructures (LASF4RI)

Thematic areas

- High Energy Physics
- Astronomy and Astrophysics
- Capacity Building and Education

A Scientific Venezuelan community ¹

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Abstract

This is a White Paper in the context of the Latin American Strategy for Research Infrastructures (LASF4RI). This proposal covers areas of importance for the region like High Energy Physics, Astronomy and Astrophysics, and Scientific Computing. It is supported by past experiences and current activities and expertise deployed by members of the Venezuelan community all over the world. The following pages summarise relevant scientific and educational efforts, infrastructure, collaborations and projects executed inside Venezuela and in research enterprises worldwide. It illustrates our position and ideas for this call -with the support of the international scientific community- showing our disposition to play a functional role in the LASF4RI efforts on the scientific and capacity-building areas in the region.

¹ **Authors** are listed at the end of this report.



Scientific context

Responding to the call of the Latin American Strategy for Research Infrastructures (LASF4RI)² a group of Venezuelan scientists decided to collect and present this White Paper that summarises scientific and educational efforts, infrastructure, collaborations and projects executed by this community inside Venezuela and in research enterprises worldwide. The following lines illustrate our position and ideas for this call:

Venezuelan education and research in the XX century

The recent Venezuelan activity related to the areas of Astronomy and Astrophysics (A&A), and High Energy Physics (HEP) has about 60 years of continuity since its formalisation in research institutes and public universities.

During this period, physics schools and physics departments have been established with study programs in physics in seven public universities: Universidad Central de Venezuela (UCV), the Universidad de Los Andes (ULA), the Universidad de Carabobo (UC), La Universidad del Zulia (LUZ), the Universidad De Oriente (UDO), Universidad Simón Bolívar (USB) and more recently at Universidad Centroccidental Lisandro Alvarado (UCLA).

Also, during that time the Instituto Venezolano de Investigaciones Científicas (IVIC) and the Centro de Investigaciones de Astronomía (CIDA) consolidated as promoters in Nuclear Science (including basic Nuclear Physics research, which was transferred to UCV & USB in the late 60s) and A&A research respectively. Another emblematic scientific endeavour during that time and until the early 2000's in the area of High-Performance Computing (HPC) is the Centro Nacional de Cálculo Científico (CeCalCULA) (see Figure 1).

The training programs of these institutions have continuously produced professionals with a five-years bachelor degree.

The Venezuelan physics researchers community has had a historical strength in the areas of theoretical HEP, A&A, Field Theory, Gravitation, General Analytical and Numerical Relativity, Strings and Membranes theories.

From the '80s of the 20th century, the postgraduate activity in Fundamental Physics began to become massive, and the local research activity in the areas mentioned above was consolidated. In the '90s, CeCalCULA takes centre stage as a national and international training centre and super HPC.

The creation of the Astronomy Research Center "Francisco J. Duarte" (CIDA), in 1975, marks a vital fact in the history of observational astronomy in Venezuela. This research centre quickly became a reference when starting an academic program, through agreements with the main universities of the country, for the training of researchers in the area of astronomy.

² The LASF4RI is calling for inputs on the next steps regarding the coordination of resources for large scientific infrastructures among countries in Latin America (<https://lasf4ri.org>)

In the field of theoretical astronomy (e.g. General Relativity) the ULA and the UCV constitute the most important reference points while the IVIC has played a vital role in the development of atomic data and computational models for use in astrophysical models.

It is important to note that the Venezuelan astronomical community has given importance, since its conception, to collaboration in international projects, enriching scientific work from both sides. This includes research visits, studies of post-graduate and post-doctorates in prestigious institutions such as NASA, Yale University, Harvard University, UNAM, Max-Planck Institutes, European Southern Observatory, among others.

Also, during that time, the Venezuelan astronomical community has made use of astronomical data obtained by the most important observatories available, such as the Hubble Space Telescope, the Chandra X-ray observatories, XMM-Newton and NuSTAR, the Herschel infrared observatories, Spitzer, among others.

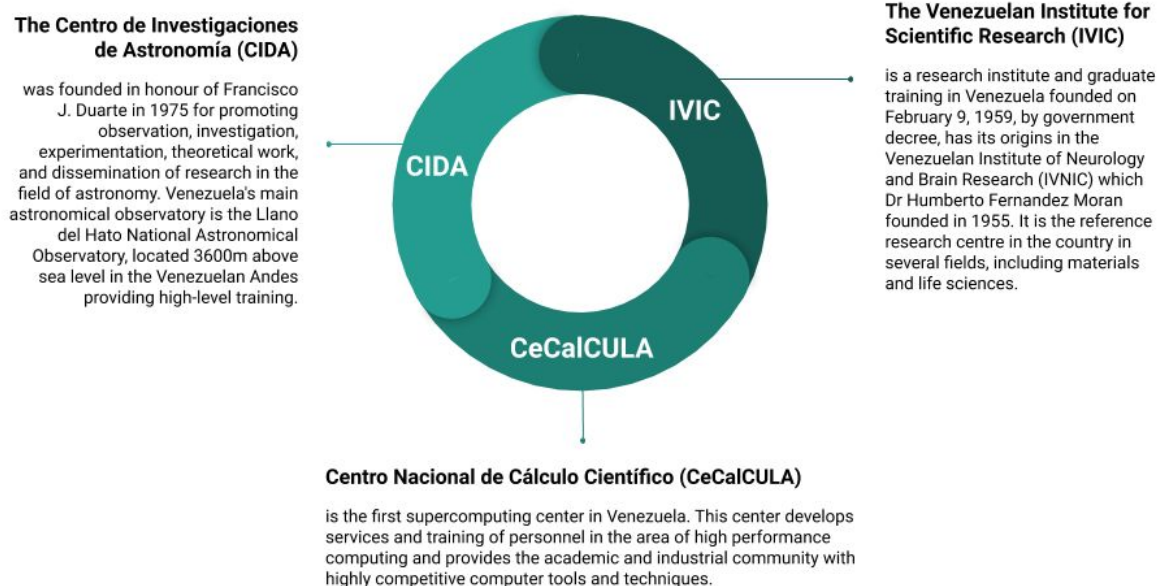


Figure 1: Some Venezuelan emblematic scientific infrastructure in A&A, Nuclear Physics and HPC.



Venezuelan education and research in the XXI century

Stronger collaborations begin with new partners in Mexico, Colombia, Ecuador, Peru, among others. New generations -in academic training- begin to venture into new areas.

Experimental HEP

The community of Venezuelan physicists members of projects in this area from their doctoral studies -thanks to programs such as High Energy Physics LatinAmerican-European Network (HELEN) (see Figure 2)- begins to grow. An important part of the community is associated with collaborations at CERN based on their postgraduate projects in European and North American countries.

However, while still being able to maintain institutional ties, Venezuela as a partner country currently does not officially participate in these collaborations, since it is not part of the consortium and other inter-institutional cooperation projects are dismantled.

Astroparticles

Venezuela was part of AMANDA, and then for a while in the ICE CUBE experiment. During the respective participation periods (2002 to 2004) staff from our universities were actively involved in the project. The same situation occurs in the LAGO collaboration, for which the installation of astroparticle observatories begins.

However, they are not completed or kept active due to the decrease in research staff. To date, the activity related to this collaboration is reduced to the direction of degree projects in the area (see Figure 2).

Other related areas

The construction of the RV-1 research nuclear reactor in the IVIC, operating between 1960 and 1991, gave a great boost to the development of Nuclear Science (basic physics and chemistry, applications in biosciences, engineering, geology and Earth sciences) in our country.

With the new millennium Nuclear Physics in Venezuela has been focused mainly on the development of nuclear technology with applications in medicine, geosciences, material science physics, oil and other areas of industry. This R&D has been a supporter of the initiatives developed in recent years in HEP and Astroparticles (LAGO collaboration) for their experience in data acquisition.

From the mid '90s onwards, Medical Physics began to be formalised in Venezuelan higher education from the bachelor's level and with the appearance of postgraduate programs in medical physics at the UCV and IVIC.

In the past two decades there was a sustained increase in professional personnel with training in fundamental physics, associated with clinical activity and research in specific service areas. However, this trend was reversed in the last decade.

Unfortunately in the last years, the activity of the community in the consolidated areas, theoretical HEP, Gravity and Astrophysics began to suffer a considerable decrease due to the loss of staff in universities and research institutes. This depletion of the trained human resource

has also impacted the training of human resources, compromising the continuity of the entire research ecosystem in the country.

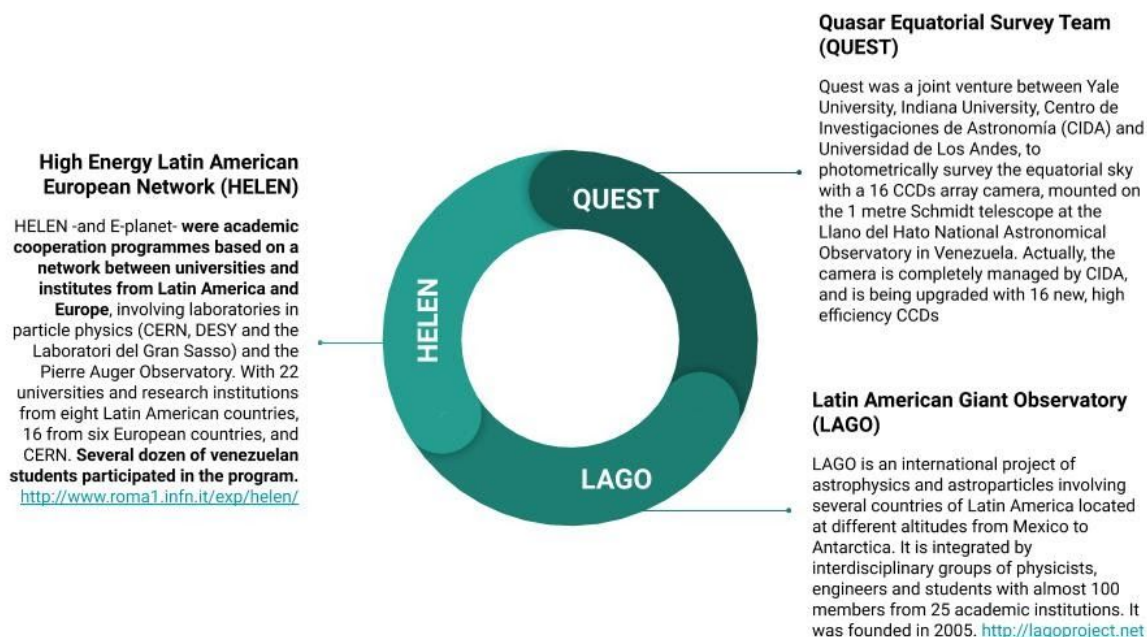



Figure 2: Some international scientific collaborations where Venezuelans individuals and institutions were participating worldwide.

Nevertheless, different research groups based in Venezuela and their colleagues abroad are looking for ways to strengthen collaborative ties between peers that allow maintaining the production of human talent, as an essential part of the research activity in the country and views of a posteriori recovery.

These activities have allowed the development of a global training activity through the use of Information and Communication Technologies (ICT), and it has been a practical support for the coordination of activities among other regional partners in the area of Particle Physics. Some emblematic projects in this regard are:

- **CEVALE2VE**

The Centro de Altos Estudios de Altas Energías (CEVALE2VE) is a virtual research and learning community initially created in 2014 to support the new generation of Venezuelan researchers in HEP. In the last years CEVALE2VE has expanded their activities and now includes several academic institutions in Venezuela, Colombia, Peru, Guatemala, Ecuador and Mexico, to reach a broad regional audience and to contribute to the knowledge transfer of fundamental physics and the regional modernisation of university education with the promotion of scientific communities in Latin America.



Although geographically scattered in different academic institutions of Europe and North America, CEVALE2VE integrates a group of Latin-American researchers (many of them from Venezuela) currently involved in HEP related projects or working in the data science industry (see Figure 3).

Its main goal is to stimulate and widen regional physics postgraduate education and research, the first step of which has been the implementation of the online university course “Introduction to Particle Physics” with the use of modern Open Access ICT.

Currently, there have been conversations with members of the scientific community in other areas like A&A, mathematics and biology with the aim of having similar courses' proposal under the CEVALE2VE platform and support. To know more of the members and more details, the current platform is www.cevale2ve.org.

- **BrainGain**

This ICTP Physics Without Frontiers (PWF) pilot programme (see Figure 3) -proposed by a team of Venezuelan researchers- is supporting physics teaching and research in Venezuela in the form of fellowships to university professors. Four fellowships were attributed in 2019 in an effort to foster the development of higher-level physics education and research carried out in our country. Two of the fellows additionally received a travel budget to support scientific visits to other institutions in the region.

The first call was already completed. To learn more on the program format, execution and the awarded fellow professors here:
<https://www.ictp.it/physics-without-frontiers/braingain-venezuela.aspx>

- **LA-CoNGA Physics**

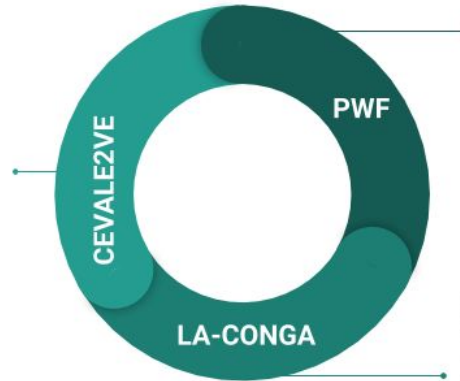
The Latin American Alliance for Capacity building in Advanced Physics (LA-CoNGA Physics) is a European Union Erasmus+ Capacity Building project (approved and under development) with the primary objective to modernise the educational platform in eight Latin-American targets higher education institutions from the Andean region (Colombia, Ecuador, Peru, and Venezuela) using HEP as a model. This multinational initiative has 12 partner institutions, and two of them (UCV and USB) are Venezuelan, showing once again the strong and constant commitment of the Venezuelan community to partner and support the creation of virtual communities in the Latin-American region.

The aimed modernisation relies strongly on the development of innovative e-learning platform, based on low-cost open-access tools, a flexible problem solving oriented syllabus structured on nano modules and strengthening of inter-institutional relations among the target institutions (see Figure 3).

A dedicated White Paper regarding LA-CoNGA Physics project was submitted to the LASF4RI call, and more details can be found in such a document.

Centro Virtual de Altos Estudios de Altas Energías (CEVALE2VE)

A virtual research and learning community. Created with the goal of promoting the scientific dissemination, education and research in the field of particle and high energy physics in the Venezuelan and Latin American scientific community. Its vision is in the education and training in fundamental and experimental research to positively influence and stimulate physics student's interest in HEP research. Awareness of opportunities in physics and possible career paths in research. It has been looking to boost policy making working towards formalising the involvement of Venezuela institutions in HEP experiments.



ICTP Physics Without Frontiers (ICTP-PWF)

The Latin American section of the ICTP Physics Without Frontiers program is an effort leading by the ICTP, Venezuelan and Colombian researchers. It is an outreach program in a tight relationship with the ATLAS Outreach group at CERN, that look for the dissemination of the HEP field and the career opportunities. It is executed once a year and since the last three years it has been adding countries and cities in South America. With the aim of including more institutions, including some in Central America countries.

Latin American Alliance for Capacity building in Advance (LA-CONGA) Physics Initiative

The primary objective of the project is to modernise the educational platform in eight Latin American higher education institutions (HEI) from the Andean region using HEP as a model. It relies on the development of innovative e-learning platforms, based on low-cost open-access tools, and flexible nano modules. Strengthening the relations among the target HEI's.

Figure 3: Some emblematic and known capacity-building projects created, managed and executed by the Venezuelan community and its partners.

The overall aim of the mentioned projects resides in the building of talent training capacity using cooperation networks that brings opportunities to maintain human capital and local research lines and bring a benefit to the region.

The proposal: five-year goals

Giving the mentioned experiences and know-how of the Venezuelan community inside and outside of the country and its partners in the Latin-America region and beyond, we have the following proposals for the LASF4RI call:

- **Continue developing, partnering in and executing capacity-building projects** in physics and related areas for talent training through networks of communities involved in Venezuela and at the regional level.
- **Continue to maintain local research groups and postgraduate programs** in traditional areas, mainly in the areas of Gravity, Field Theory, Strings, Astrophysics, Medical Physics and Nuclear Physics.
- **Develop projects in data analysis with a focus on reproducible research practices** (Open Access Big Data, Machine Learning techniques, and Hybrid Cloud Computing) associated with the requirements of the areas of Particle Physics and A&A, with applications in A&A and the industry, like computer vision -and other novel analysis approaches- for images' studies of archived and future datasets.
 - It is relevant to mention that several members of the community have several decades of combined expertise in those crucial transversal areas.
 - Also relevant is the fact that the needed infrastructure -hardware and software related- is relatively minimal (e.g. an Internet connexion and standard commodity computers), making practical to get involved in an early and steadily way in those research activities for a large number of institutions and individuals.
- **Make available to the venezuelan community practical help, consultancy and support in transversal areas** like ICT for capacity building, Open Access and Open Source HPC-related know-how. Thanks to the expertise of some of the members of the Venezuelan scientific diaspora in the co-coordination and development of international projects like CEVALE2VE, the ATLAS Open Data at CERN, and the ICTP PWF for Latin-American.

Threats

At present, the development of the state policy regarding the promotion and support of university research and education has several years of stagnation. In addition, there are no discussion mechanisms, with a broad call, to address the issue in the near future.

This situation throws uncertainty about the future of research institutes directly dependent on the central government. Some key issues would be the continuity of the research lines and the possibility of recovering their human capital to the fullest.

As another direct consequence of this situation of uncertainty and stagnation of national policy, the continuity of the current autonomous regime of Venezuelan public universities is

subject to the resolution of conflicts that prevent the renewal of their governing bodies, following their regulations. Changes in this autonomy regime may have an impact in the near future on the curricular structure, in the areas of research and projects that can be developed effectively.

Summary

The Venezuelan scientific community, inside the country and around the world, is prepared to play an active role in the LASF4RI efforts, including a substantial number of professionals and students to support scientific and capacity-building programs in the region. Our proposal covers areas that are of importance for the region (HEP, A&A and HPC), and in those we can have a sizable impact, supporting the mobility of students and researchers. We expect that through our work we can be instrumental in the development of the long-term scientific activity in the country.

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