# ALAFNA

## (Association of Latin American Nuclear Physics and Applications)

# NUCLEAR SCIENCE IN LATIN AMERICA

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São Paulo, Brazil

IUPAP-WG9 Meeting- Avignon - France
3 June 2023

# Historical background of Latin American Collaboration in Nuclear Physics: common workshops, symposia

**1995** László Sajo-Bohus organizes in Caracas, Venezuela 17 papers
**First Latin American Workshop on Nuclear and Heavy Ion Physics**

**Latin American Symposium in Nuclear Physics and Application LASNPA**
**Every 2 years in another Latin American country**
**1997 Caracas, Venezuela,** 22 plenary speakers
**1999 San Andres, Colombia** 60 participants, 20 countries
**2001 Ciudad de Mexico, Mexico** 125 participants, 20 countries, 83 talks,
**2003 Santos, Brazil** 230 participants, 13 countries
**2005 Iguazu, Argentina** 155 participants, 15 countries
**2007 Cuzco, Peru** 120 participants, 20 countries
**2009 Santiago, Chile** 170 participants , 22 countries **Foundation of ALAFNA**
**2011 Quito, Ecuador** 120 participants, 20 countries
**2013 Montevideo, Uruguay** 130 participants, 26 countries
**2015 Medellin, Colombia** 350 participants, 33 countries
**2017 Habana, Cuba** 261 participants, 32 countries
**2020 San Jose, Costa Rica**
**2024 Ciudad de Mexico, Mexico**

# Latin American Symposia on Nuclear Physics and Applications (LASNPA):

Scope: the dissemination of the major theoretical and experimental advances in the field of nuclear science and its applications in Latin America.

The main topics to be covered are:

- Nuclear Structure and Reactions,
- Nuclear and Particle Astrophysics, Cosmic Rays,
- Hadron Structure and Phases of Nuclear Matter,
- Tests of Fundamental Symmetries,
- Properties of Neutrinos,
- Nuclear Instrumentation and Facilities: Radiation Detectors and Sources,
- Applications in medical physics, biomedical imaging, art/archeology, energy, space and international security

- Strongly increasing international participation.

LASNPA Sponsorship:

CLAF (Centro Latino Americano de Fisica)
ICTP Trieste
IUPAP (since 2011)

# V Latin American Symposium on Nuclear Physics and Applications, V LASNPA Santos, Brazil 2003

2005

**VI Latin American Symposium on Nuclear Physics and Applications**

Iguazú, Argentina. October 3 to 7, 2005

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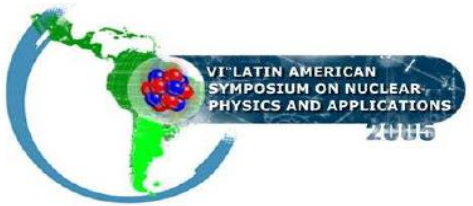


**Sponsors**

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**Organizing Institutions**

Departamento de Física Universidad Nacional de Buenos Aires

Departamento de Física Universidad Nacional de La Plata

Laboratorio TANDAR Comisión Nacional de Energía Atómica

Last Update: May 23 2022, 13:27:26 GMT.

Centro Atómico Constituyentes - Comisión Nacional de Energía Atómica
Av. Gral Paz y Constituyentes, San Martín, Pcia. de Buenos Aires, Argentina.
Tel: (54-11) 6772-7007/7088 - Fax: (54-11) 6772-7121

VIII LASNPA, Santiago, Chile, December 15-19, 2009

http://servicios3.ing.uchile.cl/slafna/


29 Plenary talks, 97 parallel talks, 40 posters

170 participants

**IX Latin American Symposium on Nuclear Physics and Applications**

Ecuador
IX. LASNPA, Quito 2011

LASNPA

July 18-22, 2011 - EPN, Quito, Ecuador

- IX Latin Symposium Site: Escuela Politecnica Nacional (EPN), a public university focused on science, technology, and innovation


Building Hall


Hall


Hemiciclo

- Symposi
- Logistical support: EPN, Arizona State University, Czech Technical University
- Registration Fee: $ 350 (general); $ 300 (LA scientists); $ 200 (students/postdocs). Fee covers meeting material, coffee breaks, five lunches, a banquet, and a copy of the proceedings.
- Expected Number of participants : 200+
- Accommodations : variety of good affordable hotels ($50 - $100 /night)

2013

## School on Medical Physics

November 29-30, 2013, Montevideo

• Treatment Technologies • New Imaging Technologies • Molecular Imaging Applications • Modeling

## X Latin American Symposium on Nuclear Physics and Applications

December 1-6, 2013, Montevideo

Nuclear and Hadron Structure and Interactions • Nuclear Reactions and Phases of Nuclear Matter • Nuclear and Particle Astrophysics • Fundamental Symmetries and Neutrinos • Nuclear Applications • New Facilities and Instrumentation

www.fing.edu.uy/lasnpa

2015


## TOPICS

NUCLEAR STRUCTURE, NUCLEAR REACTIONS AND EXOTIC NUCLEI

NUCLEAR ASTROPHYSICS, COSMIC RAYS, HADRON STRUCTURE

PHASES OF NUCLEAR MATTER, QCD, NUCLEAR INSTRUMENTATION AND FACILITIES

TEST OF FUNDAMENTAL SYMMETRIES AND PROPERTIES OF NEUTRINOS

APPLICATIONS IN MEDICINE, ART/ARCHAEOLOGY, ENERGY SPACE AND SECURITY

Universidad de los Andes · Universidad Nacional de Colombia · Universidad de Antioquia

IUPAP International Union of Pure and Applied Physics · ICTP International Centre for Theoretical Physics


# Main Auditorium

XIII LASNPA 2020 — San José, Costa Rica, 20-24 January, 2020

| | Monday<br>January 20, 2020 | Tuesday<br>January 21, 2020 | Wednesday<br>January 22, 2020 | Thursday<br>January 23, 2020 | Friday<br>January 24, 2020 |
|---|---|---|---|---|---|
| 8:30 | | IAEA 1 Sotirios Charisopoulos | Role of Nuclear Physics 28 Paula Toroi | Superheavy elements 36 Michael Block | |
| 8:45 | Registration + Snacks | | 29 Rachel-Debora Werner | | |
| 9:00 | | Nuclear Structure 15 Roelof Bijker | Internal Target Technology 30 Marco A. Rodriguez-Jiron | Nuclear Analytical Techniques and Applications 37 Marcilei Guazzelli | |
| 9:15 | Opening | | 31 Daniel Arroyo | | |
| 9:30 | | 16 Moshe Gai | 32 Maxime Chauvin | | |
| 9:45 | | Coffee Break | Coffee Break | Coffee Break | Snacks |
| 10:45 | Hadron Structure, Phases of Nuclear Matter, QCD 2 Nikos Sparveris | | | 38 László Sájo-Bohus | |
| 11:00 | 3 Roelof Bijker | Nuclear Structure 17 Nilberto Medina | Radiotherapy and Radiobiology 33 Patricia Mora | Nuclear Analytical Techniques and Applications 39 Haydn Barros | Nuclear Instrumentation and Facilities 47 Bernd Surrow |
| 11:15 | | 18 Parviz Gulshani | | 40 José C. Castillo Fallas | 48 Daniela Fabris |
| 11:30 | 5 Varese S. Timóteo | 19 Henry Monge | 35 J. Alfonso Leyva | 41 Johnny A. Salas | 49 M. Guazzelli |
| 11:45 | | | 34 E. Munévar | 42 Óscar A. Herrera | 50 Mariela Porras |
| | LUNCH | LUNCH | LUNCH | LUNCH | Education on Physics 51 J. Pawlowski & D. Torres |
| | | | | | Closing |
| 13:30 | Precision Measurements with Nuclei and Nuclear Theory 53 Jorge López | | | | |
| 13:45 | | Nuclear Reactions 27 Alinka Lépine-Szily | | Nuclear Instrumentation and Facilities 43 Ricardo Alarcón | |
| 14:00 | 7 Xavier Fléchard | 21 Marcos Alvarez | | 44 Gaia Pupillo | |
| 14:15 | | | | | |
| 14:30 | 8 Gilles Ban | 22 Leandro Gasques | | 45 Felix Pino | |
| 14:45 | | | | | |
| 15:00 | HEP, QCD 9 Daniel Tapia Takaki | 23 Alejandro Sonzogni | | 46 Samira Sanchez | |
| 15:15 | | | | 4 Poster presentations of 3 min. | |
| | Coffee Break | Coffee Break | Social Program | Coffee Break + ePoster | |
| 16:15 | Astrophysics and Cosmology 10 Maxime Chauvin | | | | |
| 16:30 | | Nuclear Reactions 24 Adamian Gurgen | | | |
| 16:45 | 11 Jhoan Perez | | | | |
| 17:00 | 12 José Trujillo | 25 Nikolai Antonenko | | | |
| 17:15 | | | | | |
| 17:30 | 13 Eduardo Greaves | 26 Modesto Montoya | | | |
| 17:45 | | | | | |
| 18:00 | | 20 Magda Cicerchia | | | |

XIII LASNPA 2020
13th Latin American Symposium on Nuclear Physics and Applications


# Association of Latin American Nuclear Physics and Applications (ALAFNA)

http://www.alafna.net/

# What is ALAFNA?

"Association of Latin American Nuclear Physics and Applications" formed in **Santiago, Chile on Dec. 19, 2009, during the VIII LASNPA,** by 15 representatives of Argentina, Brazil, Chile, Colombia, Mexico, Peru and Venezuela. The original Steering Committee.

**Chairs of ALAFNA**: Andrés Kreiner (Argentina)
Alinka Lépine-Szily (Brazil)

ALAFNA Website Since 2012: http://www.alafna.net
Country organizing LASNPA → ALAFNA member: Ecuador (2011), Uruguay (2013), Cuba (2017), Costa Rica(2020).

Latin American nuclear physicists working abroad, members of ALAFNA Steering Committee:
Ricardo Alarcon (USA/Chile), Carlos Bertulani (USA/Brazil), Jorge Lopez (USA/Mexico), Carlos Granja (Czec Rep./Ecuador), Oscar Naviliat-Cuncic (France/Uruguay)

# Objectives of ALAFNA

1. To strengthen existing ties among the Latin American communities doing nuclear research and applications and to foster collaborations and the promotion of activities. The official activity supported by ALAFNA is the LASNPA, Latin American Symposium on Nuclear Physics and Applications, that takes place every two years. Other activities are the organization of symposia, workshops, schools, university-institution cooperation and exchange programs for students, and the production of educational and outreach material.
   **Recent example: online seminars on Nuclear Physics for MSc level students, organized by Modesto Montoya from Peru. Large number of students from LA**

2. To do periodic overall assessments of nuclear science in Latin America in the context of worldwide activities.

3. To represent the Latin American Nuclear Physics and Applications communities in other expert communities such as NuPECC, ANPhA, and other similar scientific international bodies.

# Members of ALAFNA Steering Committee

(enlarged by inclusion of chairs/organizers of LASNPA)

Argentina: Andrés Kreiner, Alberto Pacheco, Norberto Scoccola, Alejandro Valda

Brazil: Alinka Lépine-Szily, Rubens Lichtenthäler, Nilberto Medina, Roberto Ribas

Chile: Hugo Arellano

Colombia: Fernando Cristancho, Diego Torres, Stella Veloza

Venezuela: Haydn Barros, László Sajo-Bohus

Costa Rica: Mario Cubero

Cuba: Ana Cabal

Ecuador: Edy Ayala

Mexico: Maria Ester Brandan, Roelof Bijker

Peru: Modesto Montoya

Uruguay: Raul Donangelo

**All come from Low Energy and Applied nuclear physics communities**

**International recognition of ALAFNA**

**WG9 –IUPAP** Since 2010

**NuPECC** Since 2012

**IAEA** In 2020 **ALAFNA is invited** to a virtual Consultancy Meeting by IAEA. Needs governamental recognition from all countries

# Nuclear Science in Latin-America

# Nuclear installations in Latin America

## 1. Research reactors in operatiom

Argentina 6 , 1 in construction .
Brazil 4; 1 in project phase
Chile 2
Colombia 1
Mexico: 3
Peru: 2

## 2. Nuclear power plants:

Argentina : 3 in operation, 1 SMR (CAREM) under construction, 2 planned (?). 5-6 % of total energy production.

Brazil : 2 in operation, 1 in construction, 4 planned 4% of energy production, 70% is hydroelectric.

Argentina-Brazil cooperation: ABACC agency for mutual inspection.

Mexico : 2 in operation, 4% of total energy production


Nuclear power plants in Latin America:

Brazil:
ANGRA I (657 MW)
ANGRA II (1350MW)
in operation,
ANGRA III in construction

Argentina:
Atucha I (1974) 362 MW
Atucha II (2014) 745 MW

## 2. Research Accelerators:

**Argentina:** at Commision Nacional Energia Atomica (CNEA)

-**Tandar 20MV Pelletron tandem** Buenos Aires, **exp. nucl. phys., AMS**

- 8MV FN tandem CNEA Ezeiza **AMS**
-0,72 MV high-intensity accelerator for Boron Neutron Capture Therapy
-25 MeV Electron Linac CNEA Bariloche **neutron production**
-1.7 MV Tandem accelerator CNEA Bariloche **IBA**

**Brazil:** installed at Universities

-**8 MV Pelletron tandem** at University Sao Paulo (USP-IF) Sao Paulo
**RIBRAS** **exp. nucl. phys. stable/radioact. beams, irrad. electr. Devices**

-1.7 MV Pelletron tandem at USP-IF Sao Paulo, **IBA**
-4 MV Van de Graaff at PUC-Rio de Janeiro **astrophysics**
-1.7 MV Pelletron tandem at LACAM-UFRJ Rio de Janeiro, **atom collisions**
-3 MV HVEE tandetron installed at LII-UFRGS Porto Alegre **IBA**
-250 kV SSAMS electrosatic accelerator at UFF Niteroi **14C AMS**

## 2. Research Accelerators (cont.):

**Chile:** installed at University

-0.3-3.7 MV Van de Graaf accelerator Universidad Tecnologica Metropolitana UTEM. M Sc in nuclear technology.

**Mexico:**

-5.5 MV Van der Graaff Accelerator (p, d, $^{3,4}$He) at Universidad Nacional Autonoma de Mexico UNAM - IF. **exp. nucl.atom. phys., astrophys**

-6 MV Tandem Van de Graaff at Instituto Nacional de Investigaciones Nucleares (ININ) **exp nucl phys, IBA**.

-3.3 MV Pelletron Tandem (NEC) UNAM-IF **IBA**

-1MV Tandetron UNAM-IF **AMS, exp. nucl. phys.**

-2 MV Tandetron at ININ **IBA**

-1 MV Pelletron accelerator for electrons at ININ

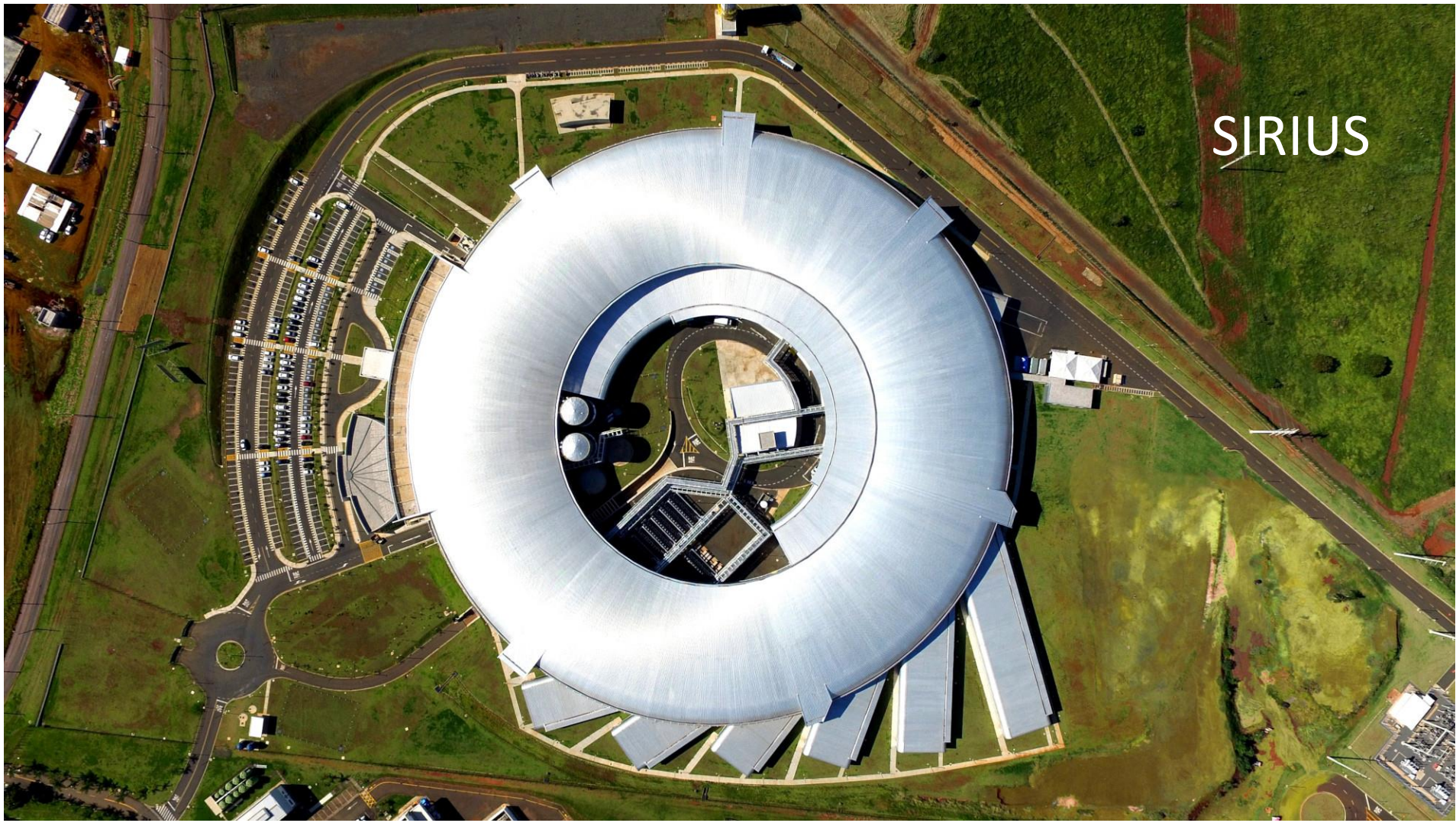
# CNEA - ARGENTINA
## Development of accelerator technology

Low energy, high current accelerator for n-production for BNCT

# Brazilian Light Sources

1. UVX designed in 1983, Brazilian technology, operational since 1997, 1500 regular users

2. SIRIUS 3 Gev electron energy - 4th Generation light source-one of brightest in energy class. Operational



# Research Activities

# Argentina


**Comission Nacional de Energia Atomica (CNEA)**

**Tandar:** 20MV Pelletron Tandem, stable beams, low energy nuclear reaction studies, fusion, break-up reactions.
Staff: 12 experimentalist, pos-docs, students

**Depart. Technology Applications of Accel.**:
Medical applications, Boron Neutron Capture Therapy-construction of a dedicated accelerator.
Applied phyics, Microanalysis with heavy ion beams, radiation damage
Staff: 25 experimentalists+ technicians

**Universidad Nacional de La Plata**
**Universidad Nacional de Rosario**

**Theoretical studies:** Nuclear structure, QCD phase transitions and nuclear equations of state.
Staff: 15 theoreticians, pos-docs, students

**Bariloche** (**Tandem, cyclotron, medical physics**)
**Pierre Auger** (**cosmic rays**)
**Connie** (**neutrinos**) at Angra dos Reis research reactor: Arg.-Braz. collaborationStaff: 7 theoreticians, 14 experimentalist, pos-docs, students

# Research Activities

BRAZIL

## High Energy Nuclear Physics in Brazil

**Theory: 68 researchers** **Experiment: 77 researchers**

- Hadron theory, effective models, QCD sum rules etc. (**17 researchers)**
- Stars, EOS with quarks and hadrons, Magnetic field etc. (**14 researchers**)
- Heavy ions, hydrodynamics, Quark Gluon Plasma etc. (**18 researchers)**
- QCD phenomenology, low x and Color Glass Cond. etc. (**9 researchers)**
- QCD theory, lattice, eq. Dyson-Schwinger etc. (**9 researchers)**

**experiment - researchers - students**

| | | |
|---|---|---|
| Alice | 9 | 8 |
| Alpha | 3 | 0 |
| Atlas | 16 | 35 |
| CMS | 30 | 4 |
| LHCb | 19 | 9 |

# Nuclear Structure and Reactions activity in Brazil:

## Theory: 16 researchers

- **Direct reactions/breakup** radioactive/stable weakly bound nuclei (**7 res.)**
- Description of light exotic nuclei using **few-body models** (**3 researchers**)
- **Dirac-Hartree-Fock-Bogoliubov and Dirac-Brueckner** approximations for nuclear matter and finite nuclei
- Studies of stable and exotic nuclei, including **pairing effects** (**2res.**)
- Effective theories for weakly bound nuclear systems (**3 researchers** )

## Experiments: 29 researchers

- Measurement of nuclear reactions with **radioactive/stable** beams **25res**
  Measurement of nuclear reactions with **astrophysical interest** (**3r.**)
- Measurement of isomeric states and half-lives using gamma spectroscopy(**1r**.)

# Nuclear Structure/Reaction facility: Open Laboratory for Nuclear Physics (LAFN) University of São Paulo (USP)

- About **60-70 users**, staff members, pos-docs, graduate students and external users.
- **Project Advisory Committee (PAC)**
- Nuclear reactions with stable or **radioactive beams 5AMeV**
- **Radioactive Ion Beams in Brasil (RIBRAS)**

  **2 superconducting solenoids**

  **In-flight Production of light, radioactive beams $^{6}$He,$^{7}$Be,$^{8}$B,$^{8}$Li,$^{10}$Be etc**

8MV Pelletron Tandem Accelerator

Several beamlines:

1.Radioactive Ion Beams in Brasil (RIBRAS)

2.Large multipurpose scattering chamber

**Investment in new detectors/electronics:**

-thin Single/Double Sided Strip Detectors (DSSD) of Si for charged particle detection

-Lyso crytstals for γ-detection with SiPM (arrays in scattering chamber)

-neutron wall (position/energy sensitive)

-Fully digital electronics, acquisition systems

## Applied Nuclear Physics: ~92 researchers

## + 40 (CNEN)

Spectroscopic Methodologies, Natural Radiation; Radiation Damage; Imaging and Archaeometry; AMS

| **Total number of researchers** | Exp. | Theory | Sum |
|---|---|---|---|
| Low energy nuclear physics | 29 | 16 | 45 |
| High energy´/hadron physics | 77 | 68 | 145 |
| Applications | | | 132 |
| | | | |
| Total | | | 322 |

# Chile:

**Valparaiso:** Universidad Tecnica Federico Santa Maria

CENTRO CIENTÍFICO TECNOLÓGICO DE VALPARAÍSO

**Theory**: High energy hadron physics, origin of the proton spin. Neutrino physics.

**Experimental**: Activity at Jefferson Laboratory, Fermi Lab. USA, CERN - LHC, Atlas, Switzerland

| Institution | Researchers Exp + Theory | % | Students PhD + M Sc | % | PostDocs |
|---|---|---|---|---|---|
| CCHEN | 3 + 0 | 7 | 1 + 3 | 6 | 0 |
| U T Metropolitana | 5 + 0 | 12 | 0 + 3 | 12 | 0 |
| U Chile | 0 + 2 | 5 | 2 + 4 | 9 | 0 |
| U Concepcion | 1 + 1 | 5 | 0 + 1 | 2 | 0 |
| U Santa Maria | 5 + 3 | 19 | 3 + 8 | 17 | 0 |
| CVVTVal | 11 + 12 | 53 | 20 + 21 | 62 | 15 |
| TOTALS | 25 + 18 | 100 | 26 + 40 | 100 | 15 |


# MEXICO

## Research Programs

Nuclear structure and reactions
Nuclear astrophysics
Fundamental symmetries and neutrons
Relativistic heavy ion collisions
Hadronic physics
Dark matter
Instrumentation for nuclear and hadronic physics

Atomic Mass Spectrometry
Applications
Medical physics

## International Collaborations

NUMEN
ALICE@LHC
HAWC
Auger
NICA
JPAC@JLab
Notre Dame
Yale
Oak Ridge
TRIUMF

SNO Lab
INFN, Italy
ISOLDE@CERN
ILL Grenoble

| | Faculty | Graduate Students | Institutions |
|---|---|---|---|
| Nuclear Physics | 30 | 20 | 6 |
| Hadron Physics | 15 | 25 | 10 |
| Medical Physics | 30 | 25 | 10 |
| Total | 75 | 70 | |

# Conclusions

1. Most Latin American countries have small number of local activity in Nuclear Sciences, mainly in applications and medical physics. Most of them have some representatives working in USA and Europe in Nuclear physics/High Energy Physics (LAS4RI).
2. Exceptions are Argentina, Brazil, Mexico and Chile, with more local activity in Low / High Energy Nuclear Physics, aswell as applications. But even these are not strong when compared to Europe or North America.

**Number of LA authors publishing in Nuclear Physics = 313 (Inspire)**

3. The low energy accelerators dedicated to basic research in Argentina, Brazil and Mexico are active and should attract more students from the other LA countries.
4. The lack of funding for Science is dramatic in most Latin American countries. Brazil had a very strong decrease in the last years (Bolsonaro gov.) Hope for recovery with the new government.

# Thank you for your attention!

INCT-FNA
INSTITUTO NACIONAL DE CIÊNCIA E TECNOLOGIA
FÍSICA NUCLEAR E APLICAÇÕES

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Científico e Tecnológico


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à Pesquisa do Estado do Rio de Janeiro