

# **ALAFNA**

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

## **NUCLEAR SCIENCE IN LATIN AMERICA**

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IUPAP-WG9 Meeting- Washington - SURA  
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# 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 **Creation 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 count

**2020 San Jose, Costa Rica**

**2023 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)

# LASNPA & WONP-NURT 2017

XII LATINAMERICAN SYMPOSIUM ON NUCLEAR PHYSICS AND APPLICATIONS  
organized in cooperation with the International Atomic Energy Agency (IAEA)  
and the International Union of Pure and Applied Physics (IUPAP)

III SCHOOL ON MEDICAL PHYSICS

XII WORKSHOP ON NUCLEAR PHYSICS

X INTERNATIONAL SYMPOSIUM ON NUCLEAR & RELATED TECHNIQUES

**Havana, Cuba, October 23-27, 2017**

## SCOPE

- Nuclear Structure, Nuclear Reactions and Exotic Nuclei
- High Energy Physics, Astrophysics and Cosmology (Hadron Structure, Phases of Nuclear Matter, QCD, Precision Measurements with Nuclei, Fundamental Interactions and Neutrinos)
- Nuclear Analytical Techniques and Applications in Art, Archeology, Environment, Energy, Space and Security
- Nuclear Instrumentation and Facilities
- Medical Physics

## Organizing Committee

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Lenzi, Silvia (Italy)	Van Remortel, Nick (Belgium)

In this edition the Symposium  
NURT is celebrating its  
**20<sup>th</sup> Anniversary**



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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, Lászlo Sajo-Bohus

**Costa Rica:** Mario Cubero

**Cuba:** Ana Cabal

**Ecuador:** Edy Ayala

**Mexico:** Maria Ester

Brandan, Roelof Bijker

**Peru:** Modesto Montoya

**Uruguay:** Raul Donangelo

## International recognition of ALAFNA

**WG9 –IUPAP** Since 2010 ALAFNA is member WG, participates at AGM annual meetings to report on Nuclear Physics activities in Latin America

**NuPECC** Since 2012 ALAFNA is observer member of NuPECC (Nuclear Physics European Collaboration Committee) and invited to its meetings

**IAEA** In 2020 **ALAFNA is invited** to a virtual Consultancy Meeting by IAEA. Very fruitful meeting with good perspectives of future interaction.



# **Nuclear Science in Latin-America**

# Nuclear installations in Latin America

## 1. Research reactors in operation

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

ANGRA II ANGRA I



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 (basic and applied) Accelerators:

### Argentina: Commission 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, irradi. 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 electrostatic accelerator at UFF Niteroi 14C AMS



## 2. Research (basic and applied) Accelerators (cont.):

### **Chile:** installed at University

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

### **Mexico:**

-5.5 MV Van der Graaff Accelerator (p, d,  $^3,^4\text{He}$ ) 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

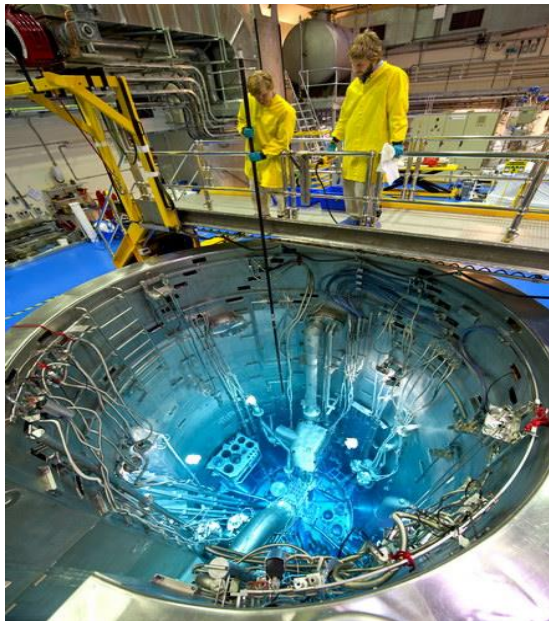
# Argentina: autonomy in nuclear research reactor technology



CNEA: Comisión Nacional de Energía Atómica

**INVAP** has built several Nuclear Research Reactors as well as important parts of others, in Argentina, Peru, Algeria and Egypt.

July 2000 **INVAP** awarded international tender for the construction of a Replacement Research Reactor (**OPAL**) by ANSTO, the Australian Nuclear Science and Technology Organisation. **OPAL** is a multipurpose facility particularly oriented toward radioisotope production, Power 20MW, Operational in November 2006 and inaugurated in April 2007.





# 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 physics, 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. collaboration  
Staff: 7 theoreticians, 14 experimentalist, pos-docs, students

# Research Activities

BRAZIL



## High Energy Nuclear Physics in Brazil

### Theory: 68 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: 12

Heavy ions, hydrodynamics, Quark Gluon Plasma etc.

**8 researchers** at ALICE@CERN,

**3 researchers** at CMS@CERN

**1 researcher** at STAR@RHIC and SPHENIX@RHIC



## 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 5 A MeV**
- **Radioactive Ion Beams in Brasil (RIBRAS)**
  - 2 superconducting solenoids
  - In-flight Production of light, radioactive beams  ${}^6\text{He}$ ,  ${}^7\text{Be}$ ,  ${}^8\text{B}$ ,  ${}^8\text{Li}$ ,  ${}^{10}\text{Be}$  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 crystals for  $\gamma$ -detection with SiPM (arrays in scattering chamber)
- neutron wall (position/energy sensitive)
- Fully digital electronics, acquisition systems

# Applied Nuclear Physics: ~92 researchers



+ 40 (CNEN)

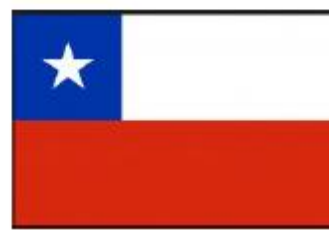
Spectroscopic Methodologies, Natural Radiation; Radiation Damage; Imaging and Archaeometry; AMS

## Medical Physics Research : 49 researchers +20 (CNEN)

At Universities: In 7 states of Brazil, 49 researchers work in Medical Physics at 15 campi of 13 universities. At CNEN 20 researchers work in Medical Physics.

<b>Total number of researchers</b>	Exp.	Theory	Sum
Low energy nuclear physics	29	16	45
High energy /hadron physics	12	69	81
Applications			132
Medical physics			69
Total			327

# 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	%	Students	%	PostDocs
	Exp + Theory		PhD + M Sc		
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
CVTVVal	11 + 12	53	20 + 21	62	15
TOTALS	25 + 18	100	26 + 40	100	15

## MEXICO MAP



# 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                      SNO Lab  
 ALICE@LHC              INFN, Italy  
 HAWC                      ISOLDE@CERN  
 Auger                      ILL Grenoble

NICA  
 JPAC@JLab  
 Notre Dame  
 Yale  
 Oak Ridge  
 TRIUMF

	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.
5. ALAFNA-IAEA collaboration should help to increase the latin american collaboration.



# Thank you for your attention!

