The 5.5 MV Single-ended Van de Graaff accelerator in Mexico.

Efraín R. Chávez L.

Instituto de Física, UNAM
on sabbatical leave at FLNR-JINR

- UNAM
- IFUNAM
- The 5.5 MV single ended Van de Graaff Accelerator Laboratory
- Material Sciences
  - Ion beam análisis of surfaces and films
  - Material modification by ion implantation
- Fundamental interactions and symetries (Standar model).
  - Fast tagged neutrons
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- Nuclear physics
  - Structure: Cluster states. Hadronic Radius
  - Dynamics: Nucleus-Nucleus interaction potential. Stellar Nucleosynthesis
- Present and future: the ECRIS Project.


unesco
World Heritage Convention
UNAM:
a
university
with a
special
mandate
Statistics 2024.
Students 373,682
107,061 High school (10-12)
233,346 Undergraduate
32,578 Grad schools (200 Physics)
Academia 42,615
(Professor, teachers, technicians)
12,919 full time
2,717 Researchers (140 IF)

Facultad de Arquitectura	U. Multidisciplinarias
Facultad de Artes y Diseño	Facultad de Estudios Superiores Acatlán
Facultad de Ciencias	Facultad de Estudios Superiores Aragón
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Facultad de Contaduría y Administración	Facultad de Estudios Superiores Iztacala
Facultad de Derecho	Facultad de Estudios Superiores Zaragoza
Facultad de Economía	Escuela Nal de Estudios Superiores, U. Juriquilla
Facultad de Enfermería y Obstetricia	Escuela Nal de Estudios Superiores, U. León
Facultad de Filosofía y Letras	Escuela Nal de Estudios Superiores, U. Mérida
Facultad de Ingeniería	Escuela Nal de Estudios Superiores, U. Morelia
Facultad de Medicina	Escuelas Nacionales
Facultad de Medicina Veterinaria y Zootecnia	Escuela Nal de Artes Cinematográficas
Facultad de Música	Escuela Nal de Ciencias de la Tierra
Facultad de Odontología	Escuela Nal de Ciencias Forenses
Facultad de Psicología	Escuela Nal de Lenguas, Lingüística y Traducción
Facultad de Química	Escuela Nal de Trabajo Social

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UNAM 2024. I.S. C.S Y Pg.S DE INVESTIGACIÓN

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I. de Biotecnología	I. de Matemáticas
I. de C. Aplicadas y Tecn.	I. de Neurobiología
I. de C. del Mar y Limnología	I. de Química
I. de C. Físicas	I. de Radioastronomía y Astrofísica
I. de C. Nucleares	I. de C. de la Atmósfera y Cambio Climático
I. de Ecología	C. de C. de la Complejidad
I. de Energías Renovables	C. de C. Genómicas
I. de Física	C. de C. Matemáticas
I. de Fisiología Celular	C. de Física Aplicada y Tecnología Avanzada
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I. de Geofísica	C. de Nanociencias y Nanotecnología
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I. de Geología	Pg. Espacial Univ
I. de Ingeniería	Pg. Univ de Alimentación Sostenible
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I. de Inv en Ecosistemas y Sustentabilidad	Pg. Univ de Inv Riesgos Epidem y Emergentes

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I. de C. Nucleares	**I. de C. de la Atmósfera y Cambio Climático**
I. de Ecología	C. de C. de la Complejidad
I. de Energías Reno	
I. de Física	C. de C. Matemáticas
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36 Institutes, Centers and Programas

UNAM 2024, I.S, C.S Y Pg. S DE Humanística

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I. de Inv Bibliotecológicas y de la Información	C. de Inv y Est de Género
I. de Inv Bibliográficas	C. Peninsular en Humanidades y Ciencias Sociales
I. de Inv Económicas	C. Regional de Inv Multidisciplinarias
I. de Inv Estéticas	Pg. Univ de Est sobre Asia y África
I. de Inv Filológicas	Pg. Univ de Est sobre Educación Superior
I. de Inv Filosóficas	Pg. Univ de Est sobre Democracia, Justicia y Sociedad
I. de Inv Históricas	
I. de Inv Jurídicas	Pg. Univ de Bioética
I. de Inv sobre la Universidad y la Educación	Pg. Univ de Derechos Humanos
I. de Inv Sociales	Pg. Univ de Est de la Div Cult y la Interculturalidad
C. de Inv Interdisciplinarias en Ciencias y Humanidades	Pg. Univ de Est del Desarrollo
C. de Inv Multidisc. Chiapas y la Frontera Sur	**Pg. Univ de Est sobre la Ciudad**
C. de Inv sobre América del Norte	Pg. Univ de Gobierno

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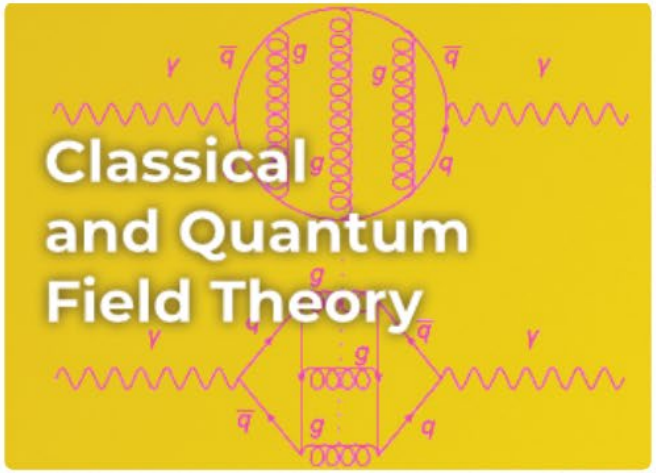
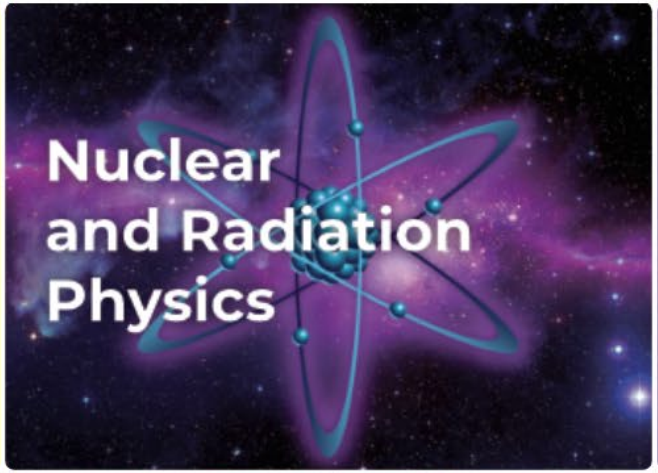
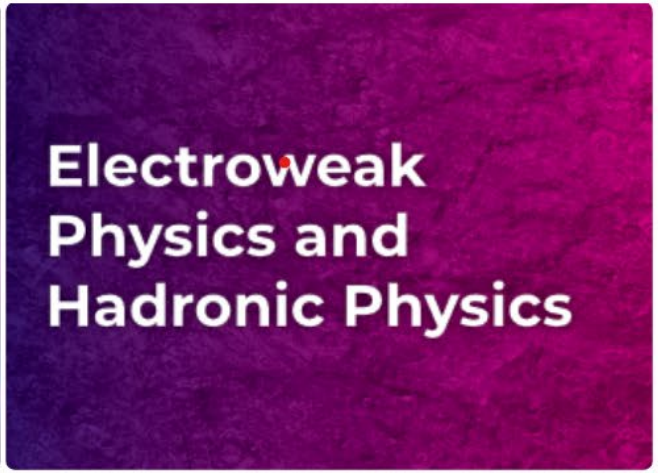
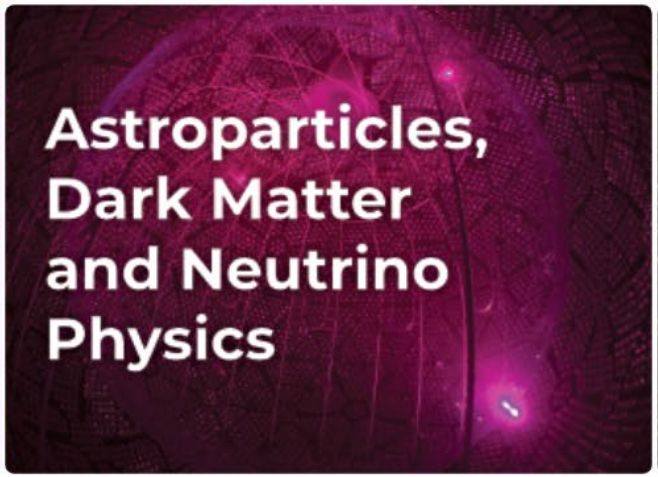
Institute of Physics, UNAM.

gh Energies, Nuclear Physics, Astroparticles and Cosmol

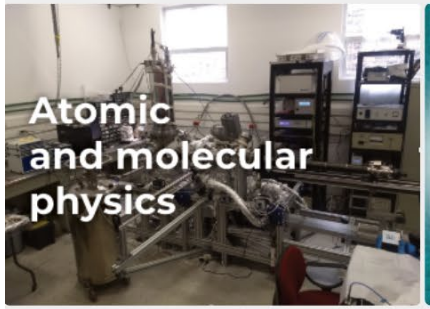


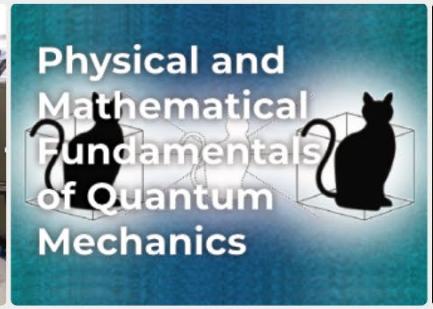


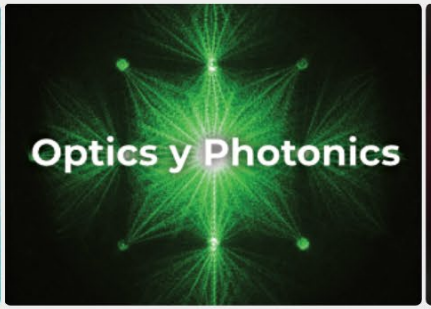


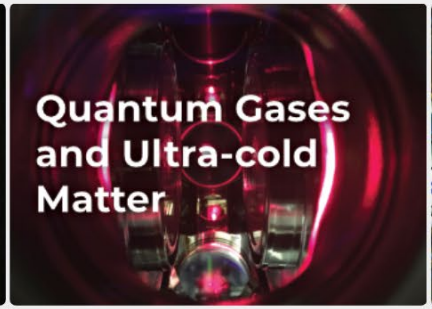


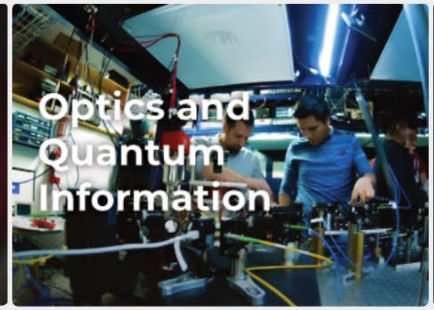
Optics and Quantum Physics



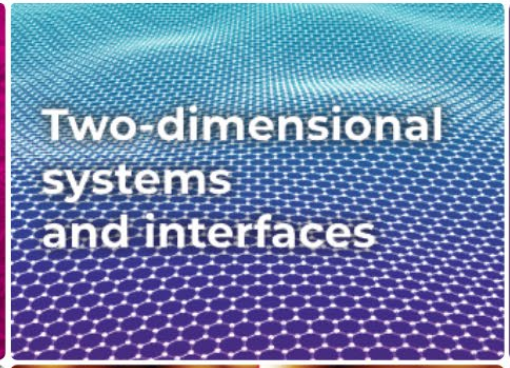


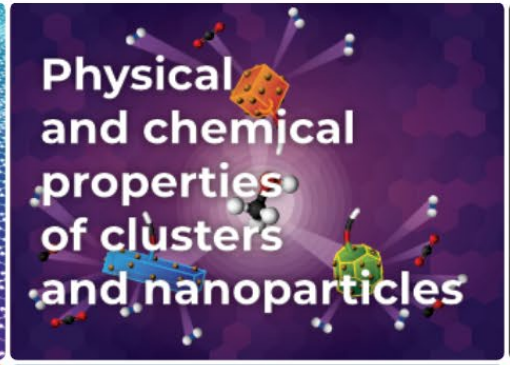


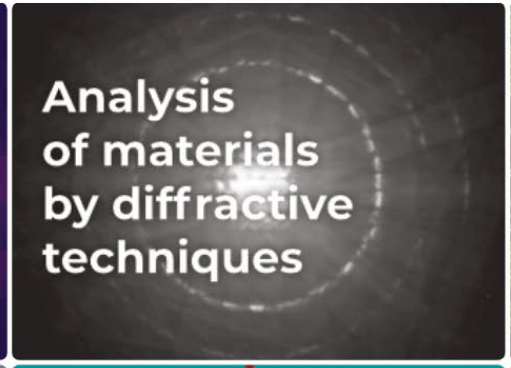


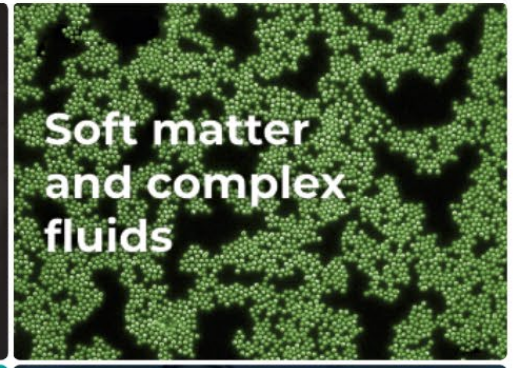


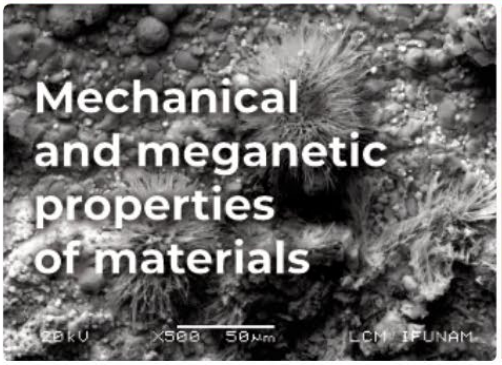
Nanosciences and Condensed Matter

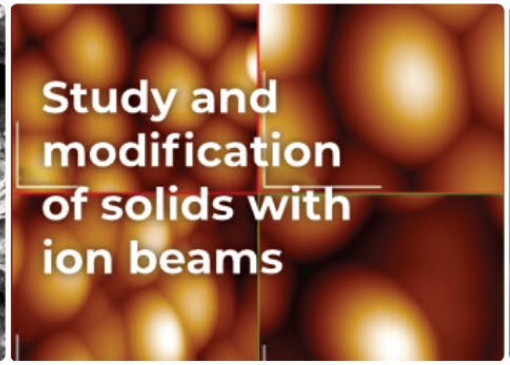


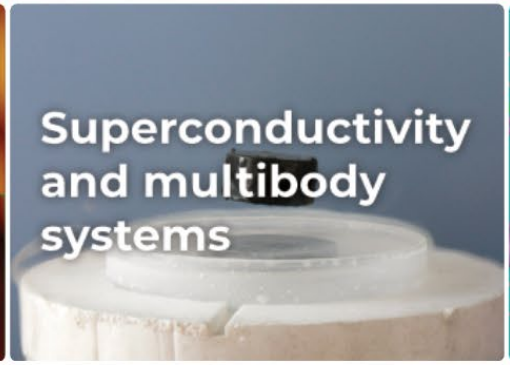


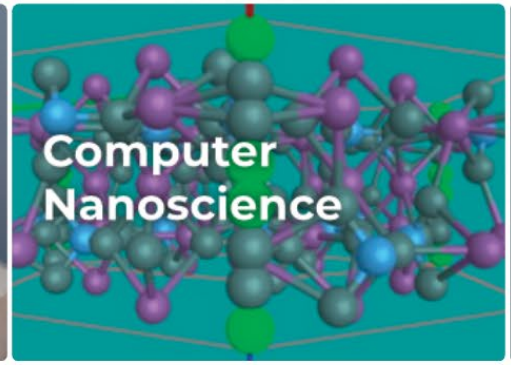




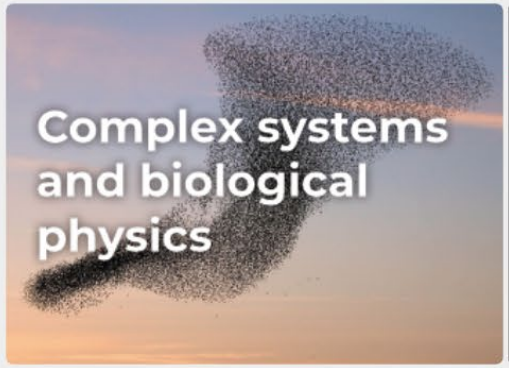


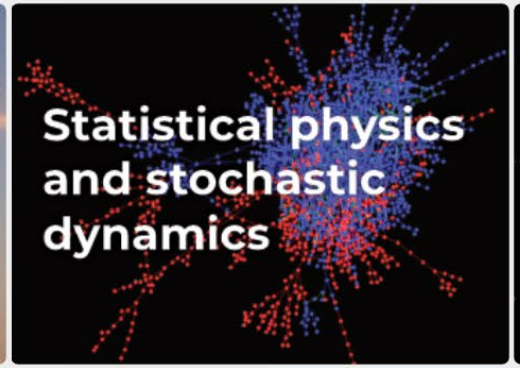


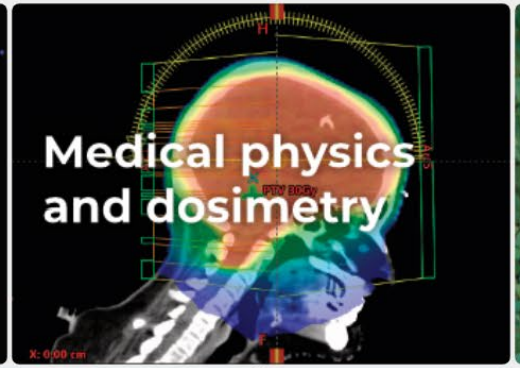




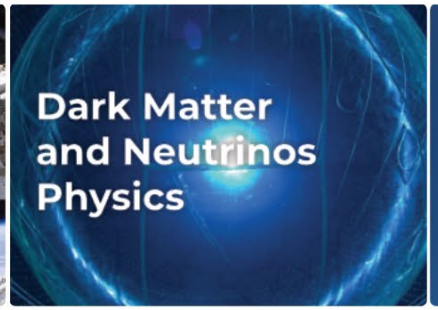
Applied Physics and Interdisciplinary Topics

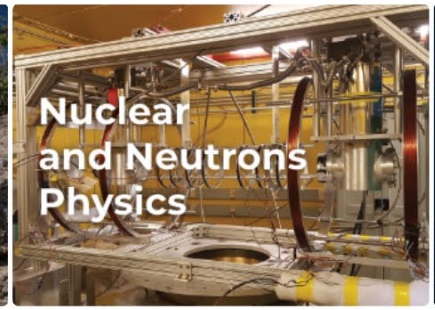






International Experiments





Engineering design and mechanical shop with computer aided machines and qualified personnel.


4 National Laboratories
(Over 50 laboratories in total)

The **HAWC** site is inside the Parque Nal Pico de Orizaba, a Mexican national park. The park contains Citlaltepetl (or Pico de Orizaba), the highest peak in Mexico at 5610 meters, and Sierra Negra, a 4600-meter extinct volcano 7 km southwest of Citlaltepetl. Pico de Orizaba is a dormant volcano. A relatively flat saddle point between the two peaks is the location of the detector.

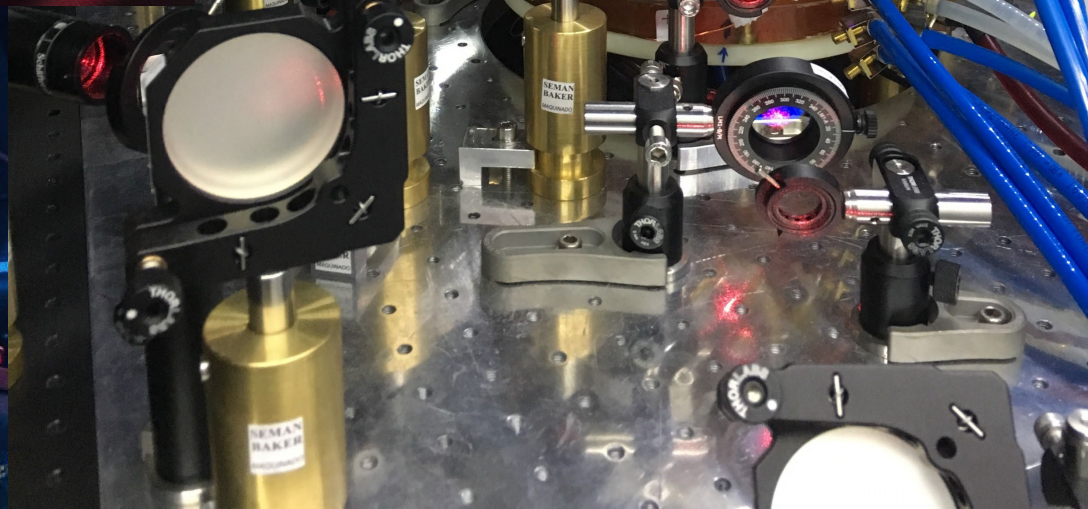
LABORATORIO NACIONAL
DE MATERIA CUÁNTICA

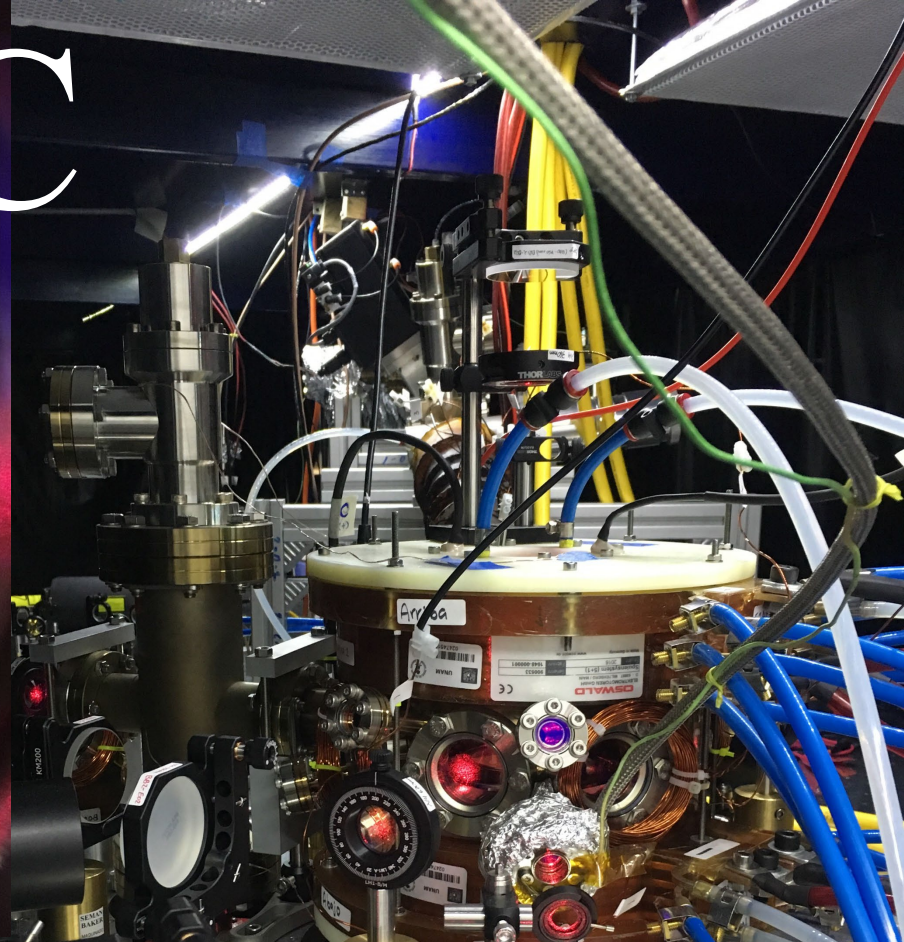
https://lanmac.org.mx/en

LANMAC

The National Laboratory for Quantum Matter: Ultracold Matter and Quantum Information (LANMAC) is distributed in 11 laboratories and a group of theoreticians with headquarters at the Physics Institute.

Magneto-optical trap of ^{6}Li atoms (brilliant spot at the center) at 200 microkelvin





National Laboratory of Sciences for Research and Conservation of Cultural Heritage (LANCIC)

1. Foster the use of specialized infrastructure and cutting-edge techniques for advanced research on the material study and conservation of Mexican cultural heritage.
2. Contribute to training of high-level specialized human resources.
3. Provide specialized services for cultural heritage assessment.

Main available techniques: In situ non-invasive spectroscopies XRF, Raman, FTIR, FORS, hiperespectral imaging and ion beam analysis (PIXE-RBS-PIGE-IBIL) in the laboratory, among others.

Effigy Maya censers, Museo de Palenque

Las Limas Lord, Olmec culture, MA Xalapa

San Lorenzo Olmec head, MA Xalapa

A sunday's afternoon dream at the Alameda park, Diego Rivera,


LEMA

https://www.fisica.unam.mx/laboratorios/lema/eng/index.html

LEMA
ACCELERATOR MASS SPECTROMETRY LABORATORY
Institute of Physics, UNAM, Mexico

PRESENTATION

The Accelerator Mass Spectrometry Laboratory (LEMA by its name in Spanish) of the Institute of Physics, is a National Laboratory where we carry out basic, applied and interdisciplinary research projects based on the determination of very low concentrations of radionuclides such as ^{14}C, ^{10}Be, ^{26}Al, ^{129}I and Pu.

LEMA provides radiocarbon analyses/dating services, and has been granted its **ISO 9001:2015** testing certification by the International Management and Evaluation Society (SIGE) in April 2018, for radiocarbon dating.

2014

Nuclear Instruments and Methods in Physics Research B 331 (2014) 233–237

Contents lists available at ScienceDirect

Nuclear Instruments and Methods in Physics Research B

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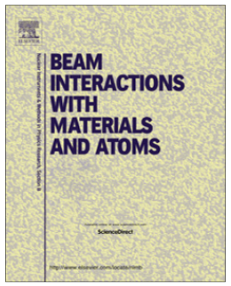


A new AMS facility in Mexico

C. Solís *, E. Chávez-Lomelí, M.E. Ortiz, A. Huerta, E. Andrade, E. Barrios

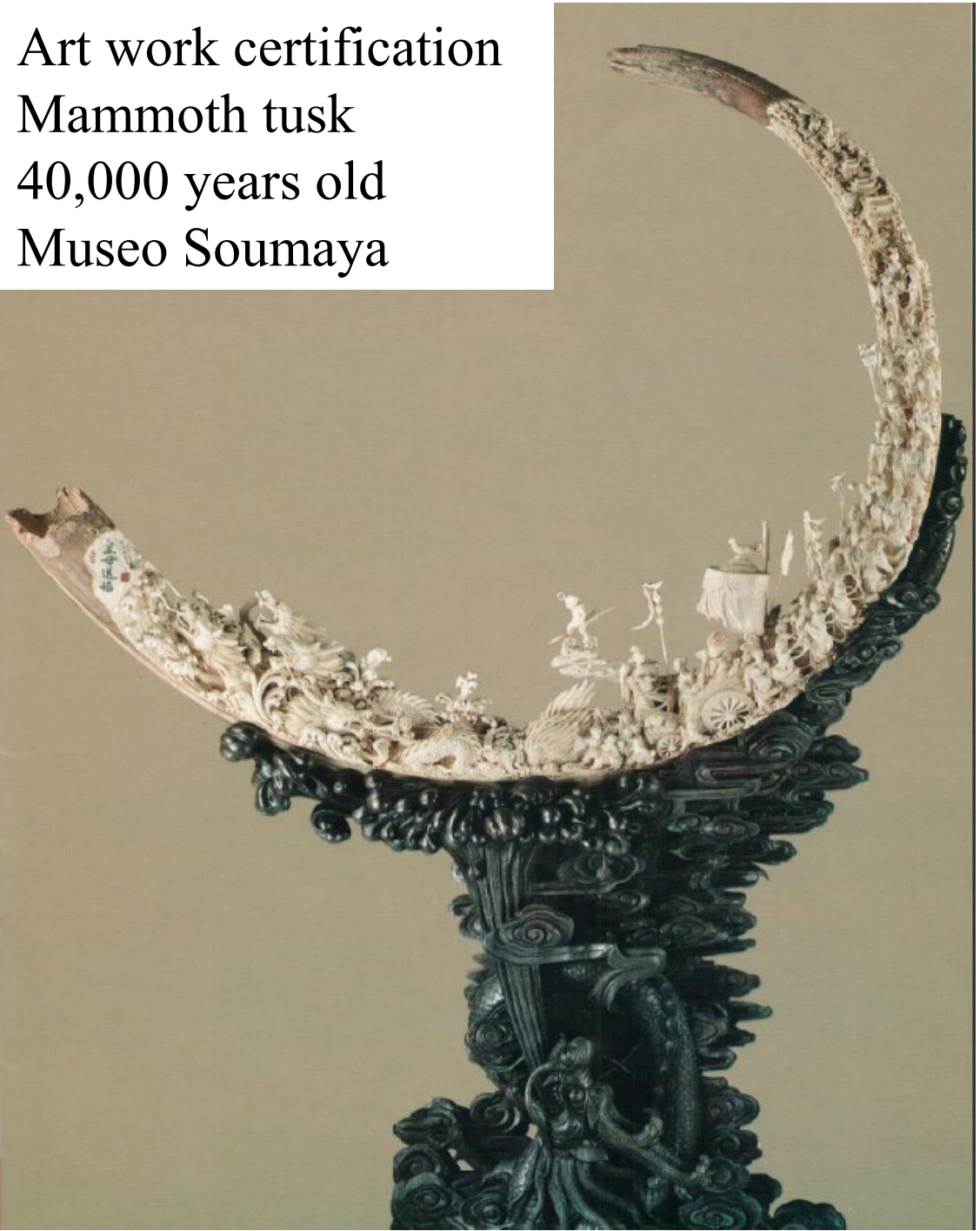
LEMA, Instituto de Física, Universidad Nacional Autónoma de México, Ap. Po. 20-364, Del. A. Obregón, Mexico, D.F., Mexico

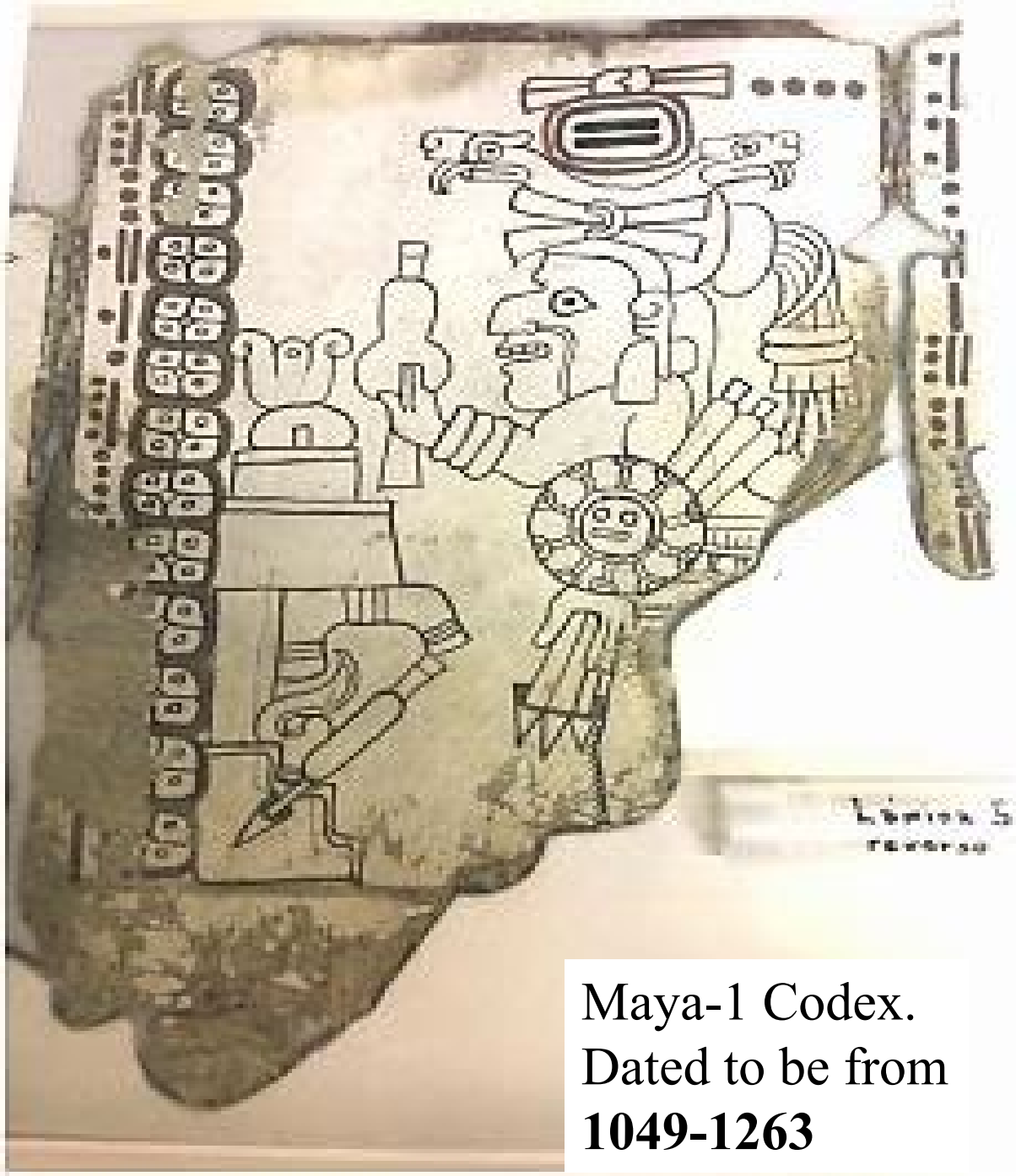
(geology) sciences

- Forensic sciences
- Mathematics (Statistics)
- **Nuclear Physics**

¡1000 samples a year!

Art work certification
Mammoth tusk
40,000 years old
Museo Soumaya





Maya-1 Codex.
Dated to be from
1049-1263

Descubren en México vest
pobladores más antiguos

Arturo Barba Navarrete 22 julio, 2020

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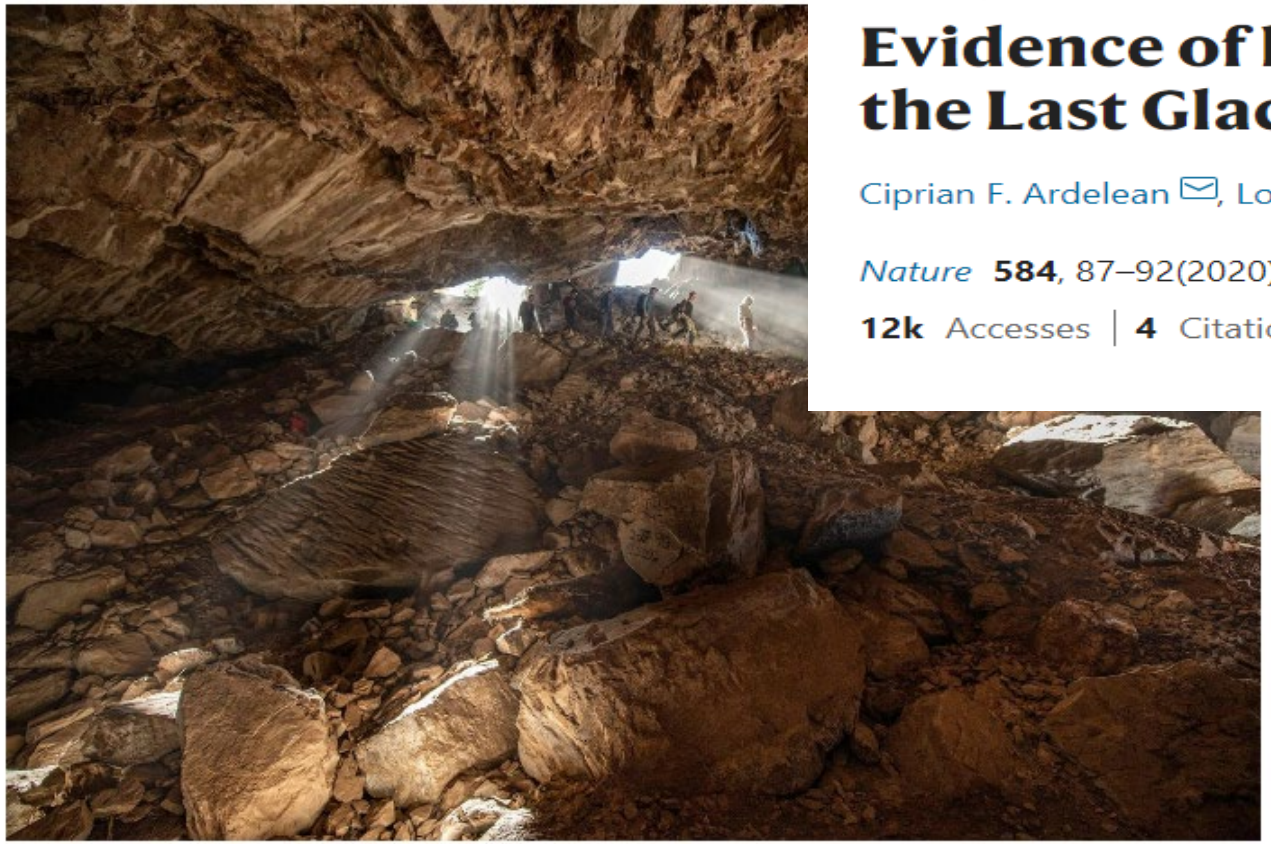

En plena Edad del Hielo en lo que hoy es el norte del estado mexicano de Zacatecas, **hace 30 mil años,** un grupo humano ocupó una cueva ubicada casi en la punta de un cerro desde donde podía observar la panorámica del frío

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Article | Published: 22 July 2020

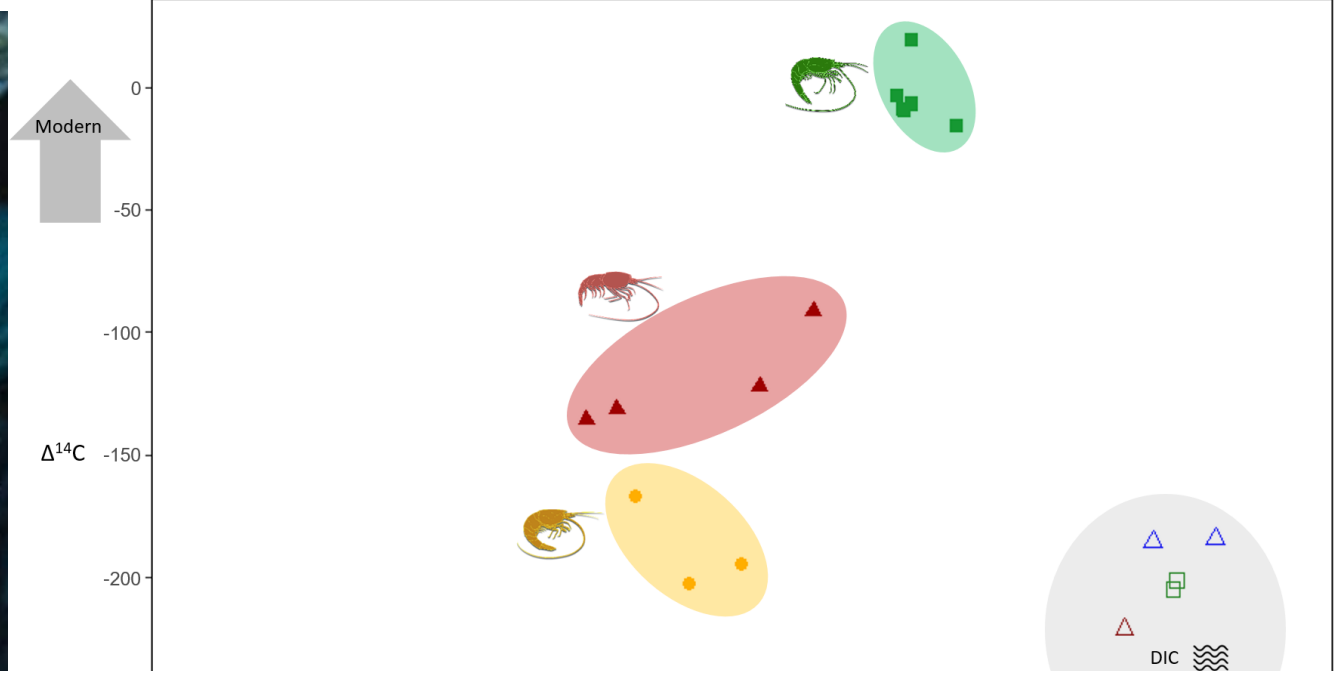
Evidence of human occupation in Mexico around the Last Glacial Maximum

Ciprian F. Ardelean, Lorena Becerra-Valdivia, [...] Eske Willerslev

Nature **584**, 87–92(2020) | Cite this article

12k Accesses | **4** Citations | **1987** Altmetric | Metrics

^{14}C



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nature research

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Distribution patterns, carbon sources and niche partitioning in cave shrimps (Atyidae: *Typhlatya*)

E. M. Chávez-Solís[1,2], C. Solís[3], N. Simões[2,4,5] & M. Mascaró[2,4]✉

ELSEVIER

Physics Procedia 90 (2017) 2 – 9

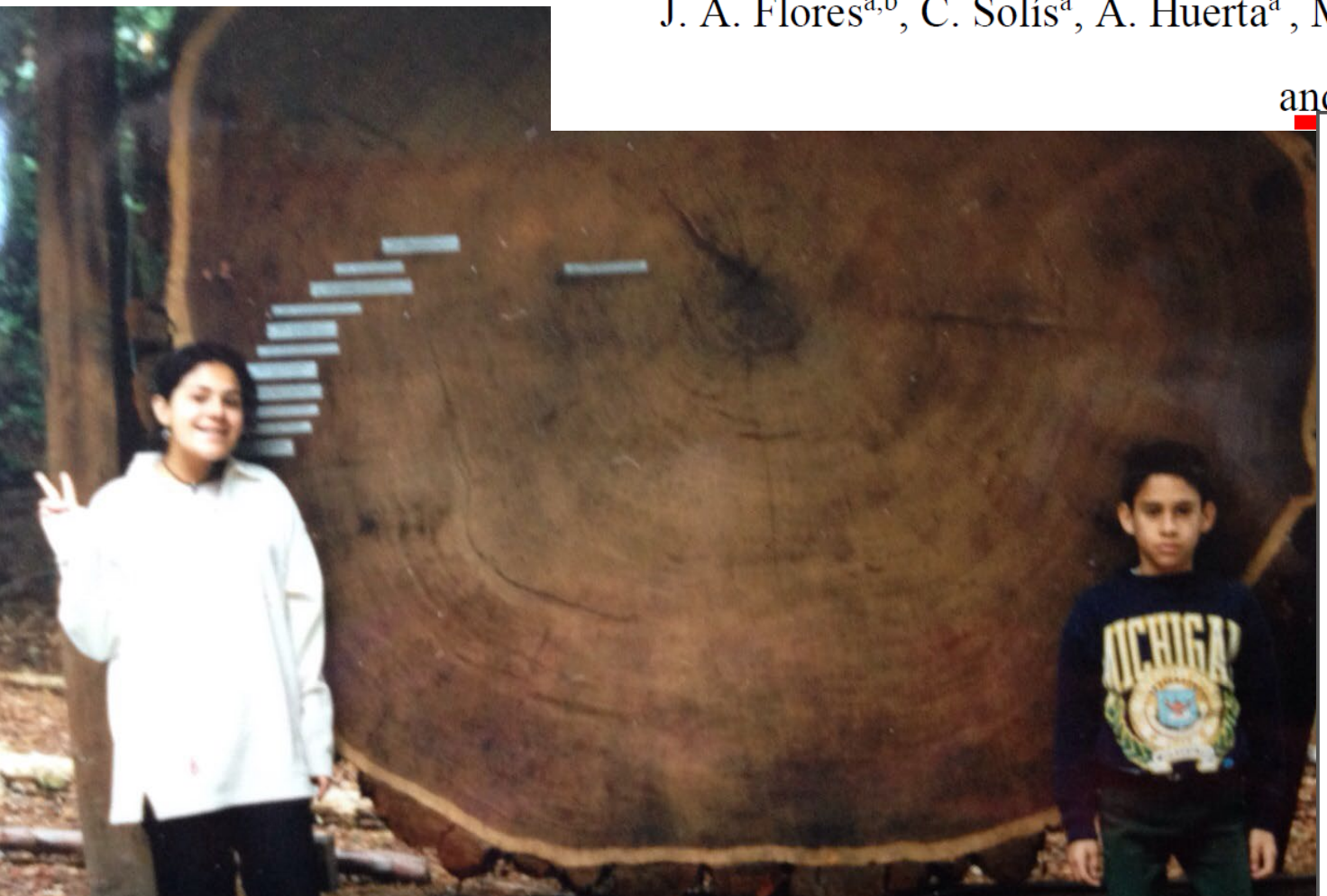
Dendro-chronology

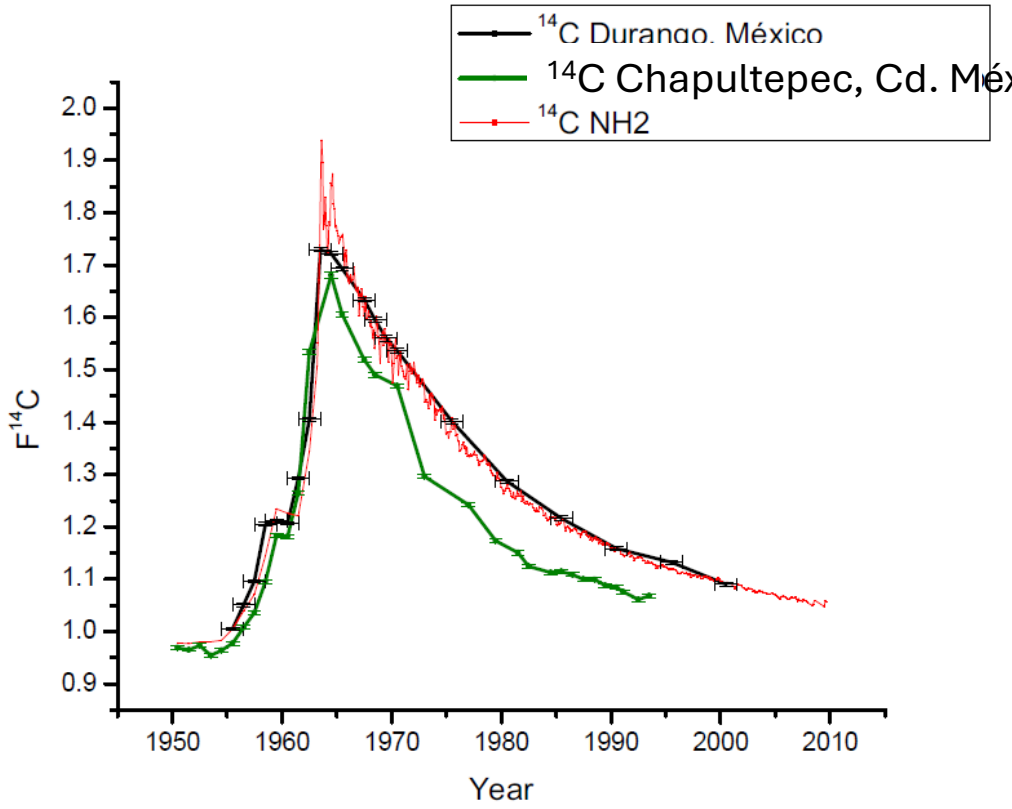
Conference on the Application of Accelerators in Research and Industry, CAARI 2016,
30 October – 4 November 2016, Ft. Worth, TX, USA

Historic binnacle of $^{14}C/^{12}C$ concentration in Mexico City.

J. A. Flores[a,b], C. Solís[a], A. Huerta[a] , M. E. Ortiz[a], M. G. Rodríguez-Ceja[a], J. Villanueva[c]

and E. Chávez [a], *

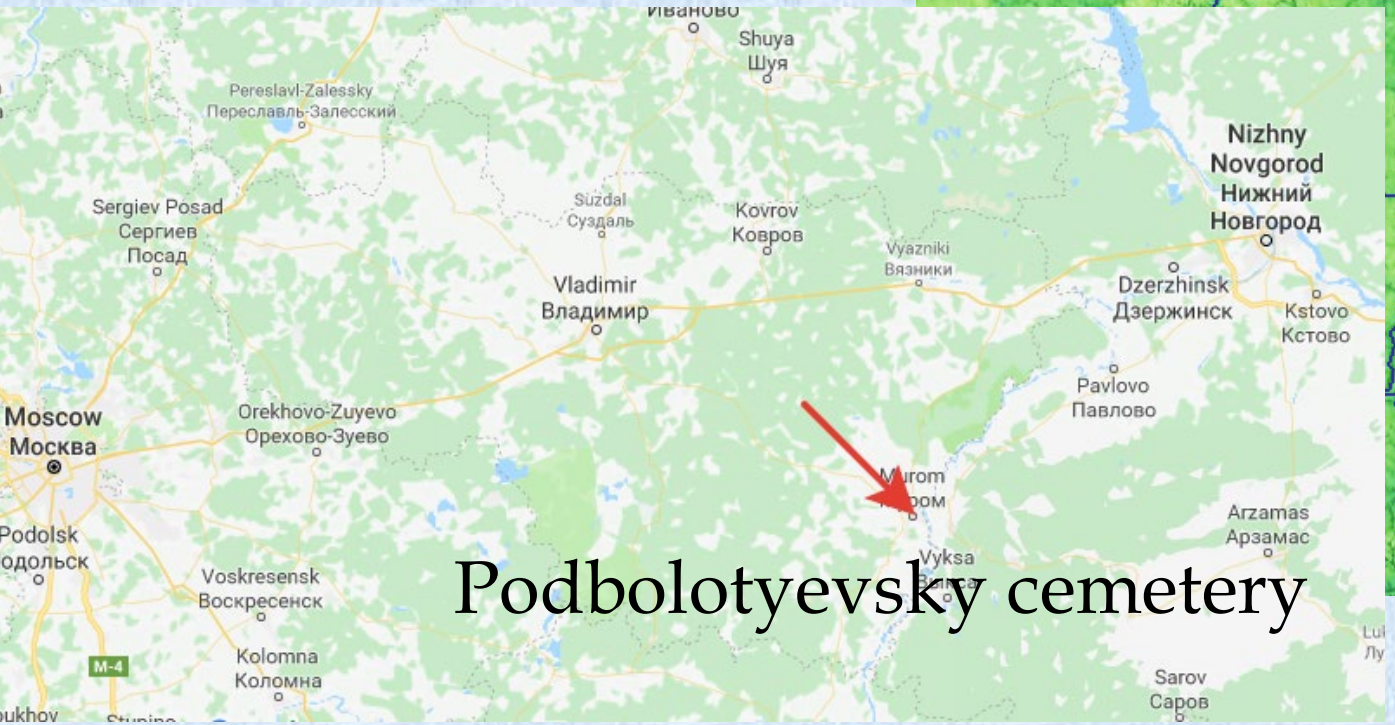




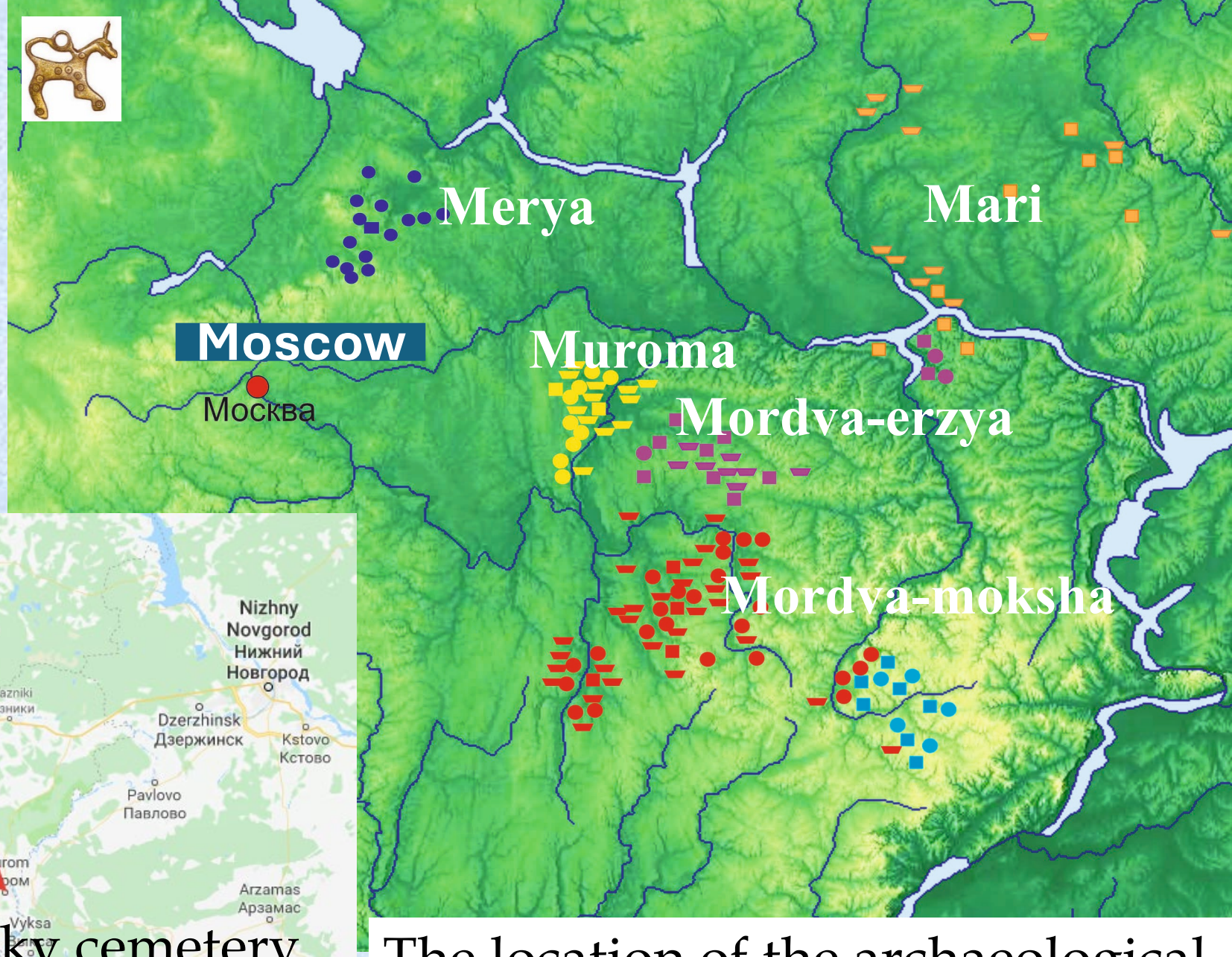
Detailed characterization of MexicanCoffee grains

Inga Zinicovscaia, Dimitri Grozdov, Javier Mas, Alejandro Martínez, Corina Solís, María Rodríguez, Efraín Chávez.

Roman Mimokhod
Olga Zelentsova
Irina Saprykina
Inga Zinicovskaia
Dimitry Grozdov
Dulce Martínez
Corina Solís
María Rodríguez Ceja
Arcadio Huerta
Efraín Chávez.

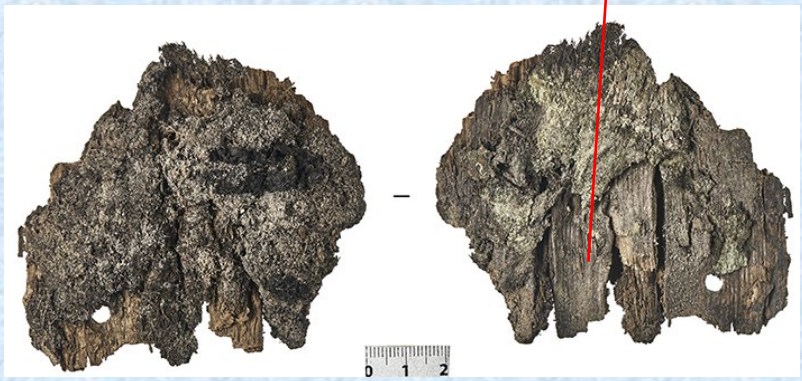


Podbolotyevsky cemetery



The location of the archaeological sites of the Finno-Ugric peoples

Burial 57 (f.)



The board is under the belt

wooden container

Burial 154

- UNAM
- IFUNAM
- **The 5.5 MV single ended Van de Graaff Accelerator Laboratory**
- Material Sciences
  - Ion beam análisis of surfaces and films
  - Material modification by ion implantation
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  - Small angle proton scattering
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  - Dynamics: Nucleus-Nucleus interaction potential. Stellar Nucleosynthesis
- Present and future: the ECRIS Project.

70th anniversary CN-Van de Graaff accelerator WORKSHOP

Instituto de Física, UNAM
Angel Dacal Seminar Room
Friday January the 12th, 2024

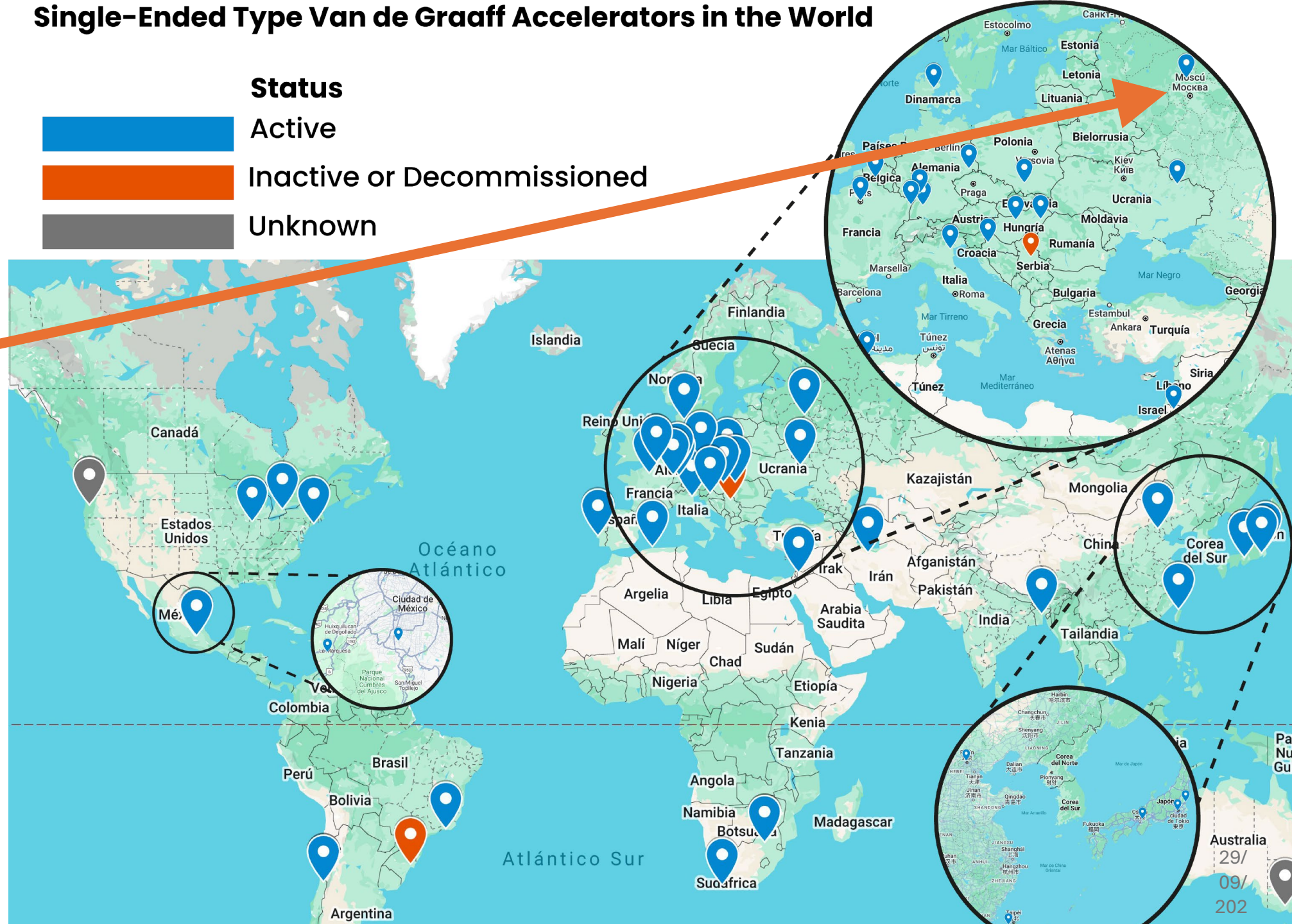
Preliminary list of speakers:

Mercedes Rodriguez	México
Efraín Chávez	México
Eduardo Andrade	México
Steven Muhl	México/UK
Libertad Barrón Palos	México
Bernard Clément	France
Osvaldo Civitarese	Argentina
Jorge Piekarewicz	USA
Smail Damache	Argelia
Dimitri Kamanin	Russia
Sotirios Charisopoulos	Greece/IAEA
Andrew M. Rogers	USA

Organizing committee: D.J. Marín-Lámbarri ◦ E. Chávez ◦ J. Mas-Ruiz ◦ G. Reza ◦ A. O. Valdez-Guerrero

E-mail : dmarin@fisica.unam.mx

There are hundreds of laboratories operating electrostatic accelerators around the world.



Beams (2024): p, d, ^{3,4}He, ^{20,22}Ne, ^{40}Ar, ^{134}Xe

Imax < 10 μA

The Van de Graaff accelerator, a great facility to prepare specialists in nuclear instrumentation and techniques.

https://baspa.fisica.unam.mx/#header-section

BASPA

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Basic and Applied Science with the Particle Accelerators (BASPA) at DFNAR-IFUNAM

BASPA user group includes all academics (scientific researchers, professors, students) that take part in experiments carried out at one of the two particle accelerators of the “Departamento de Física Nuclear y Aplicaciones de la Radiación" (DFNAR) in the Instituto de Física de la UNAM.

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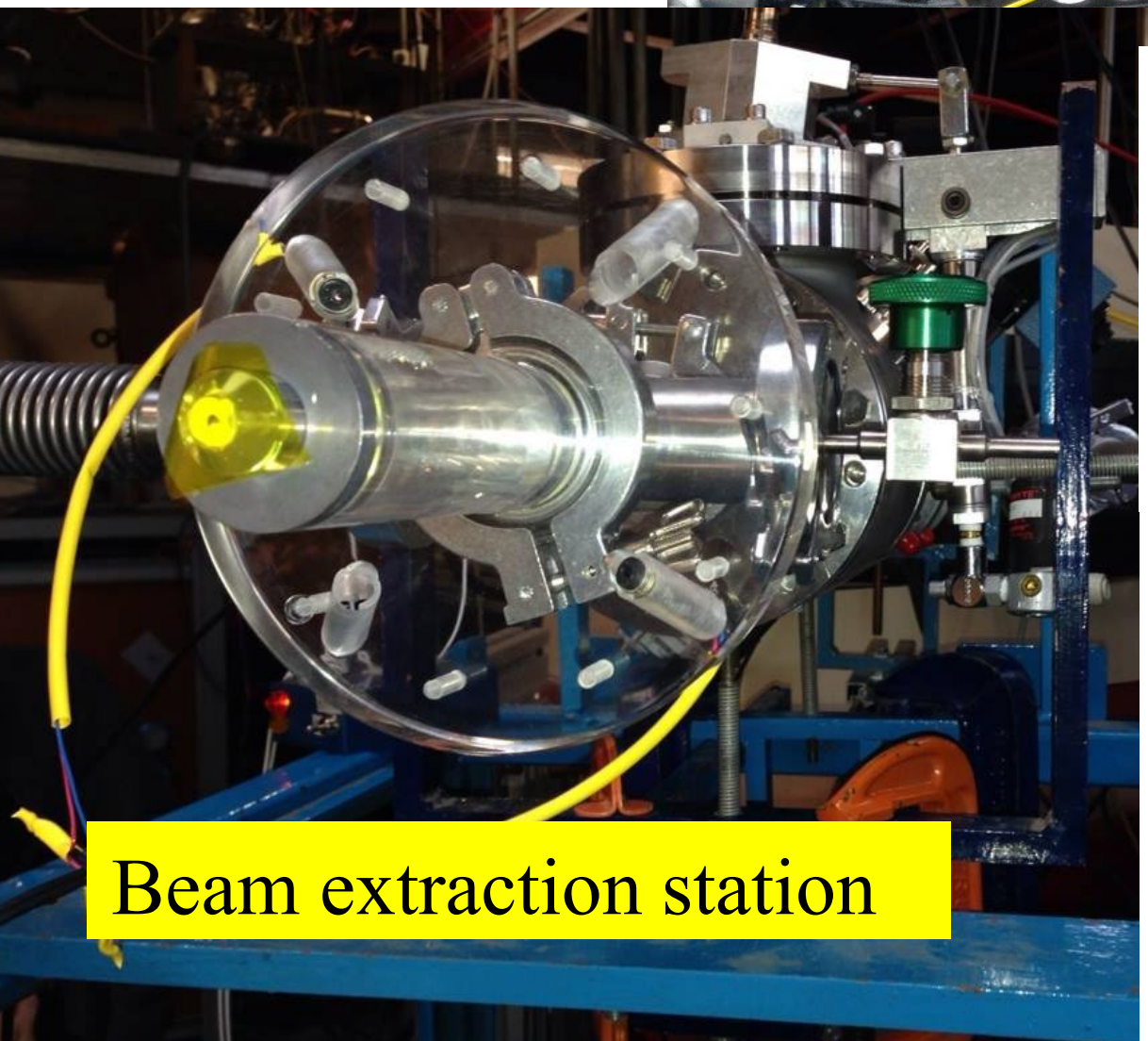
Over 100 publications in analysis of surfaces and thin films using IBA: RBS, PIXE, NRA, ERDA



Beam extraction station

Contents lists available at ScienceDirect

Nuclear Instruments and Methods in Physics Research B

journal homepage: www.elsevier.com/locate/nimb

Adhesive and tribocorrosive behavior of TiAlPtN/TiAlN/TiAl multilayers sputtered coatings over CoCrMo

C.E. Canto [a,*]. E. Andrade [a]. M.F. Rocha [b]. B. Alemón [c]. M. Flores [c]

Contents lists available at ScienceDirect

Nuclear Instruments and Methods in Physics Research B

journal homepage: www.elsevier.com/locate/nimb

Ion beam analysis and co-sputtering simulation (CO-SS) of bi-metal films produced by magnetron co-sputtering

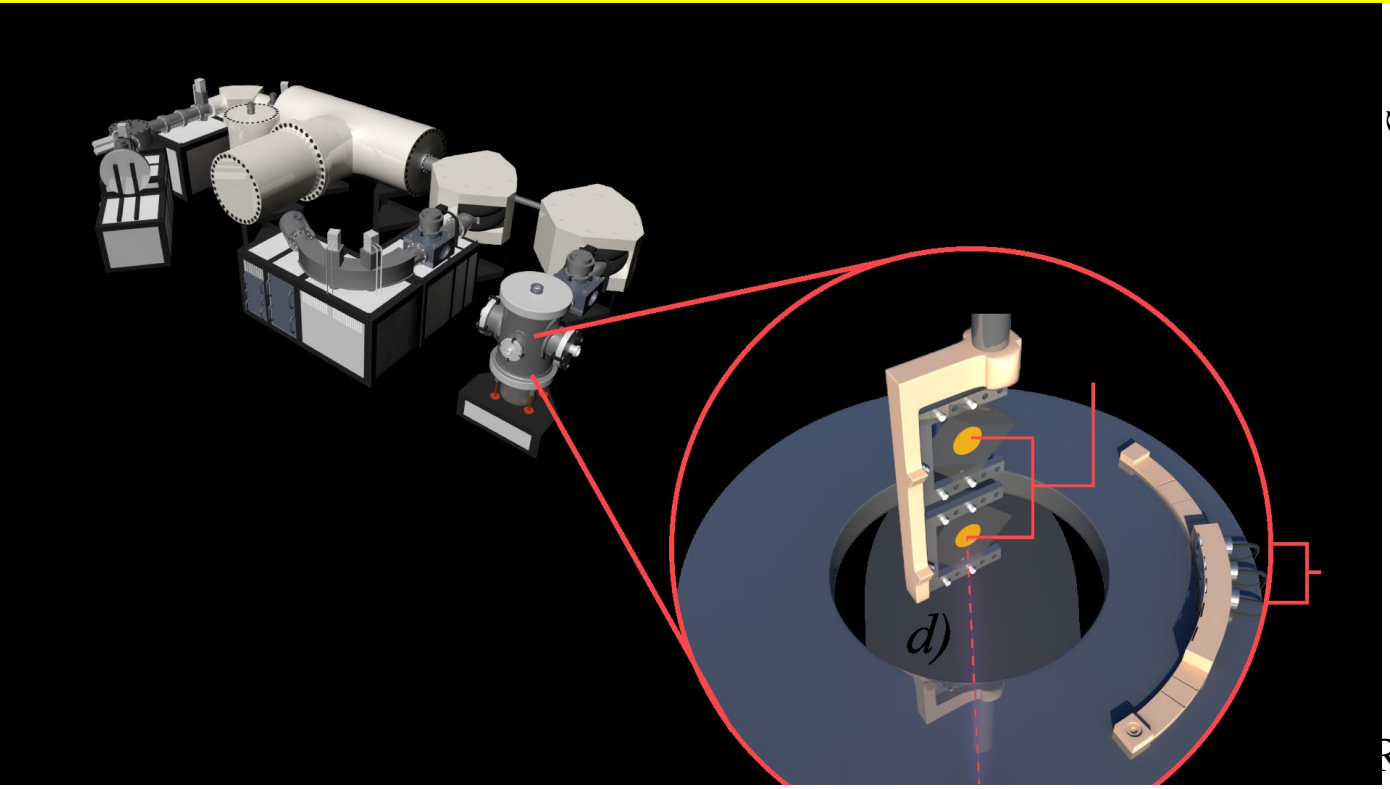
J. Cruz [a,b], E. Andrade [a,*], S. Muhl [b], C. Canto [a], O. de Lucio [a], E. Chávez [a], M.F. Rocha [c], E. Garcés-Medina [d]

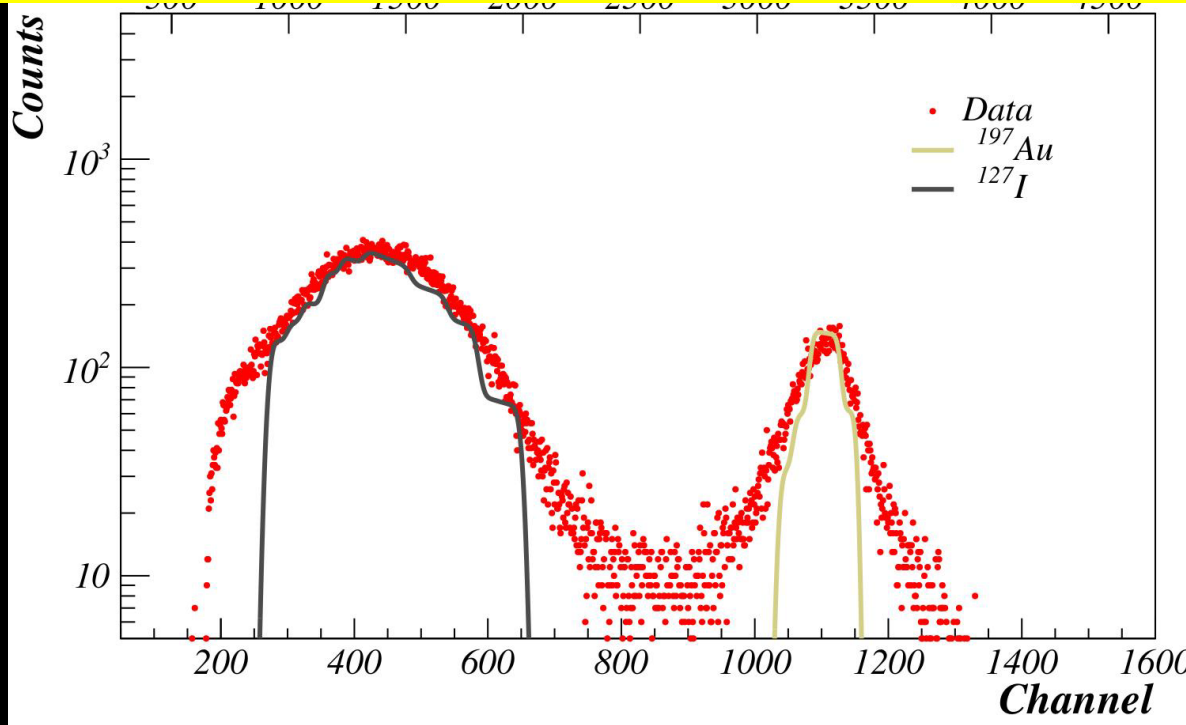
Contents lists available at ScienceDirect

Microchemical Journal

journal homepage: www.elsevier.com/locate/microc

Ion implantation





RBS analysis of the ^{127}I implanted target. when bombarding with 5035 keV ^{28}Si. Data is represented by dots, and the solid line the SIMNRA simulation.

Nuclear Instruments and Methods B (2024)

Isotopically selected implanted targets for nuclear reaction studies

S. Sandoval-Hipólito[a], E. Andrade[a], C. Esquivel-Carrillo[a], A. Huerta[a], L.A. Acosta[a], D. J. Marín-Lámbarri[a], J. Mas-Ruiz[b,*], G. Reza[a], M. Rodríguez-Ceja[a], C. Solís[a], A. O. Valdéz-Guerrero[a], E. Chávez[a]

[a]*Instituto de Física, Universidad Nacional Autónoma de México, Av. Universidad 3000, Mexico city, 04510, México*

[b]*Instituto de Ciencias Nucleares, Universidad Nacional Autónoma de México, Cto. Exterior S/N, Mexico city, 04510, México*

44th Symposium on Nuclear Physics Cocoyoc — IOP Publishing

Journal of Physics: Conference Series **2619** (2023) 012010 doi:10.1088/1742-6596/2619/1/012010

Monoisotopic targets production from atomic and molecular positive ion implantation in a tandem accelerator at low energies

J. Mas-Ruiz, D. J. Marín-Lámbarri, S. Sandoval-Hipólito, E. Monroy-Díaz, G. Reza, A. O. Valdéz-Guerrero, L. Acosta, E. Andrade, D. Belmont, A. Huerta, C. Solís and E. Chávez

Largest single-ended Van de Graaff accelerators of the world collaboration opportunities.

- Monochromatic tagged fast neutrons in Nuclear Physics Research
- Prompt gamma spectroscopy with fast neutrons
- IBA-techniques intercomparison.
- Surface modification by ion impact
- Radiation effect in semiconductors.
- Ion-Beam and Nanotechnology
- Mechanisms of action and power increase of Nano powder oxide ionistor.
- Mechanisms of action and power increase of a new renewable-energy source.
- Functional transition for homogeneous electronics technologies.
- The effect of high-energy particles in the structural, phase state and physical properties of composite ceramic materials
- Structural study of a mimetic system in the presence of an indole arylhydrazone derivative
- Study of zeolites for agriculture, health and environment protection applications

Study of zeolites for agriculture, health and environment protection applications Cuba-JINR-Mexico collaboration

Edwin Pedrero, Aleksandr Doroshkevich, Efrain Chávez
Mario S. Pomares, Gerardo Rodríguez, Oscar Díaz, Maikel Díaz.

Instituto de Ciencia y Tecnología de Materiales, Universidad de La Habana (IMRE-UH)
Frank Laboratory of Neutron Physics, Joint Institute for Nuclear Research (JINR)
Instituto de Física, Universidad Nacional Autónoma de México (IFUNAM)
Natural Zeolite Engineering Laboratory (NatZEng®-IMRE-UH)
I. Superior de Tecnologías y Ciencias Aplicadas, Universidad de La Habana (InSTEC-UH)

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PHYSICS LETTERS B

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^{208}Pb(n,n) E_n = 1-2 MeV

Probing additional dimensions in the universe with neutron experiments

Alejandro Frank [a,b], Piet Van Isacker [c], Joaquín Gómez-Camacho [d]

ncias Nucleares, Universidad Nacional Autónoma de México, Apartado Postal 70-543, 04510 México, D.F., Mexico
as Físicas, Universidad Nacional Autónoma de México, Apartado Postal 139-B, 62251 Cuernavaca, Morelos, Mexico
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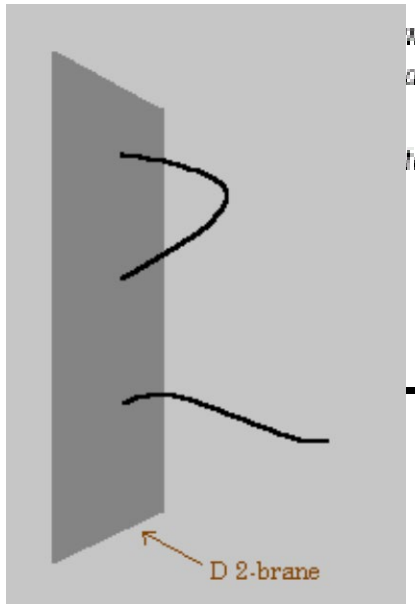
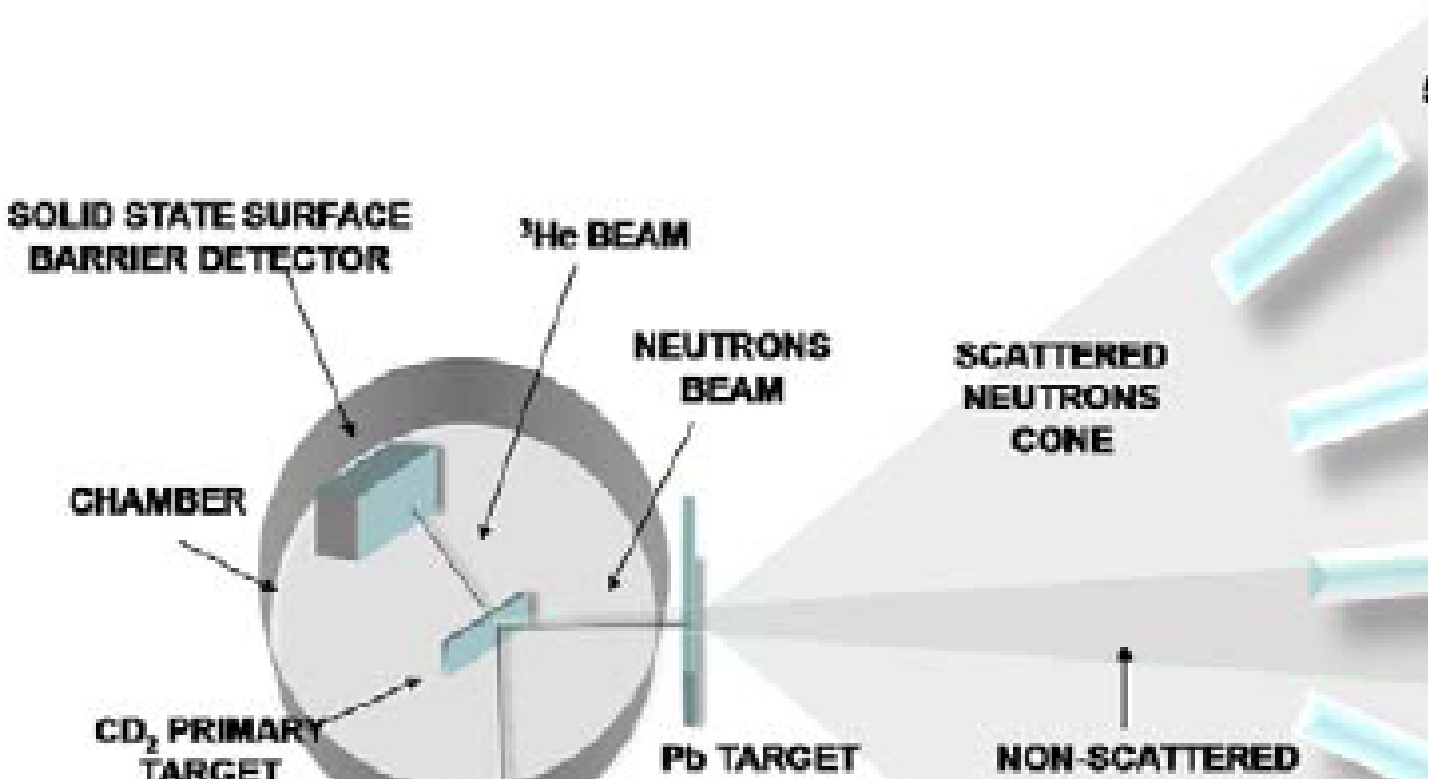
tamento de Física Atómica, Nuclear y Molecular, Facultad de Física, Universidad de Sevilla, Sevilla, Spain

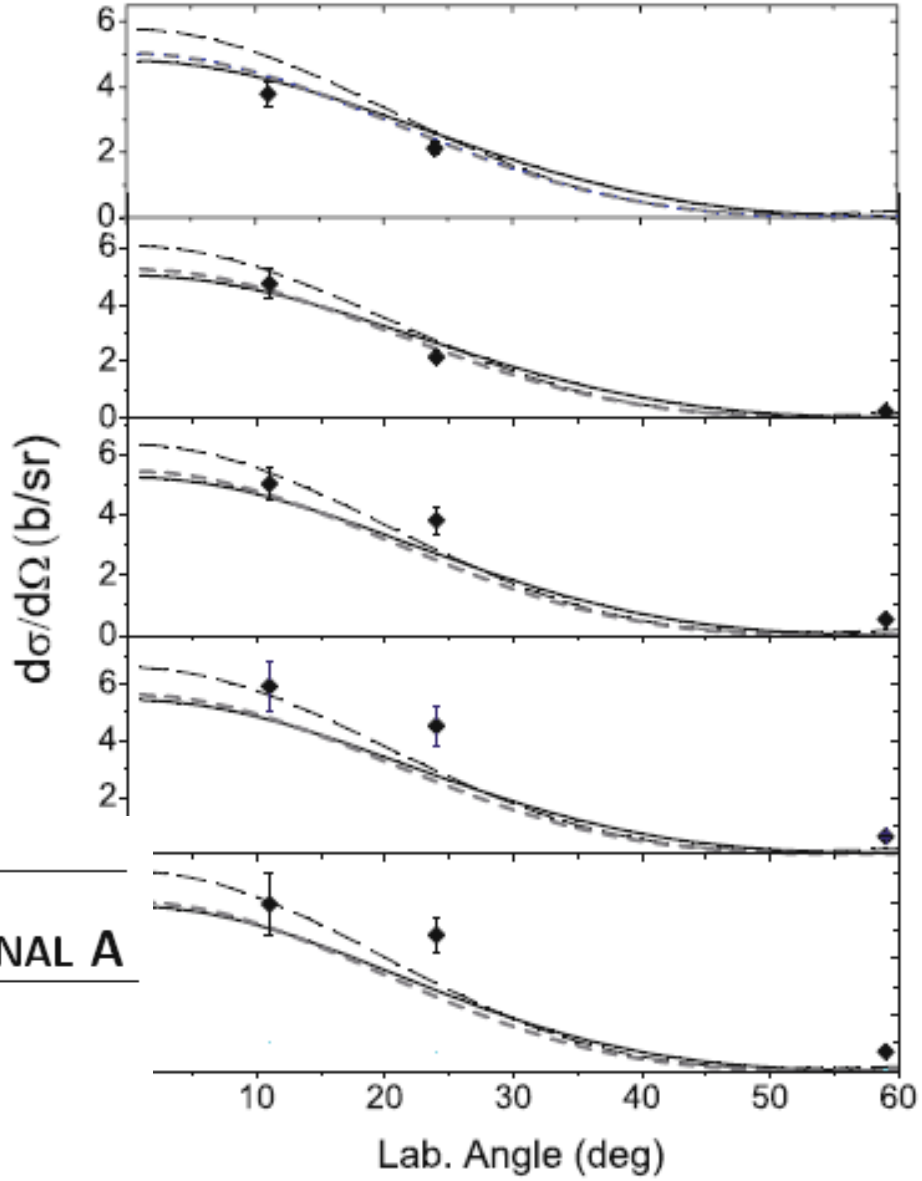
Received 12 May 2003; received in revised form 17 November 2003; accepted 9 December 2003

Editor: W. Haxton



0° <θ< 10°





Eur. Phys. J. A (2009)
DOI 10.1140/epja/i2009-10873-7

THE EUROPEAN PHYSICAL JOURNAL A

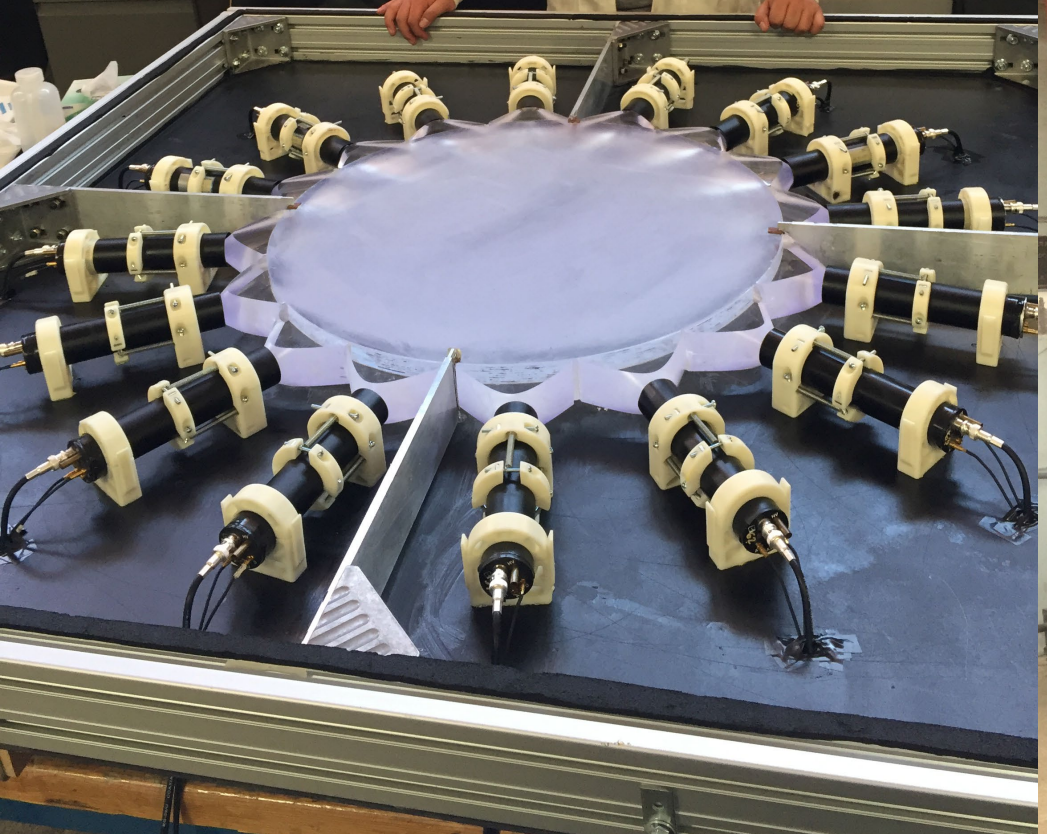
Regular Article – Experimental Physics

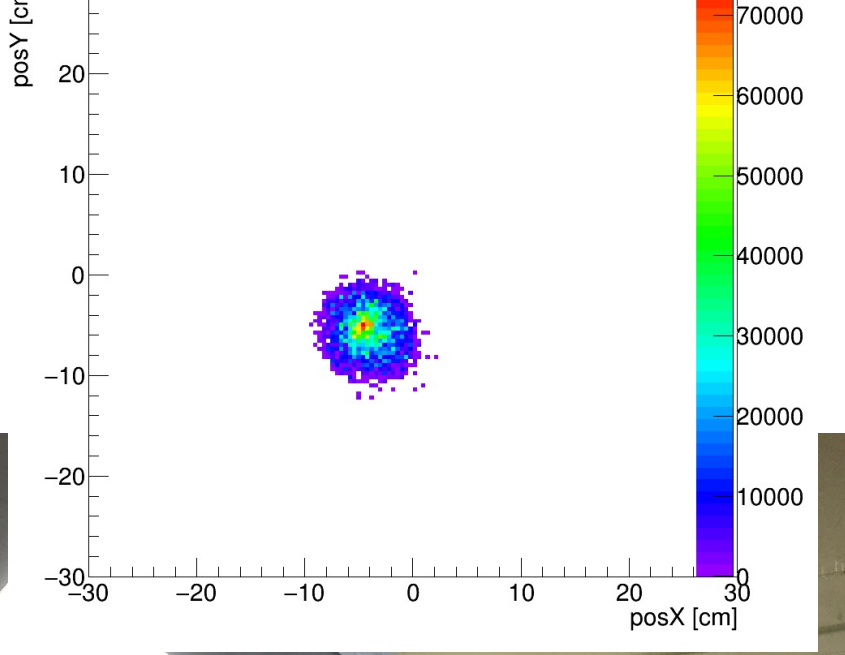
Elastic scattering of neutrons on ^{nat}Pb at forward angles

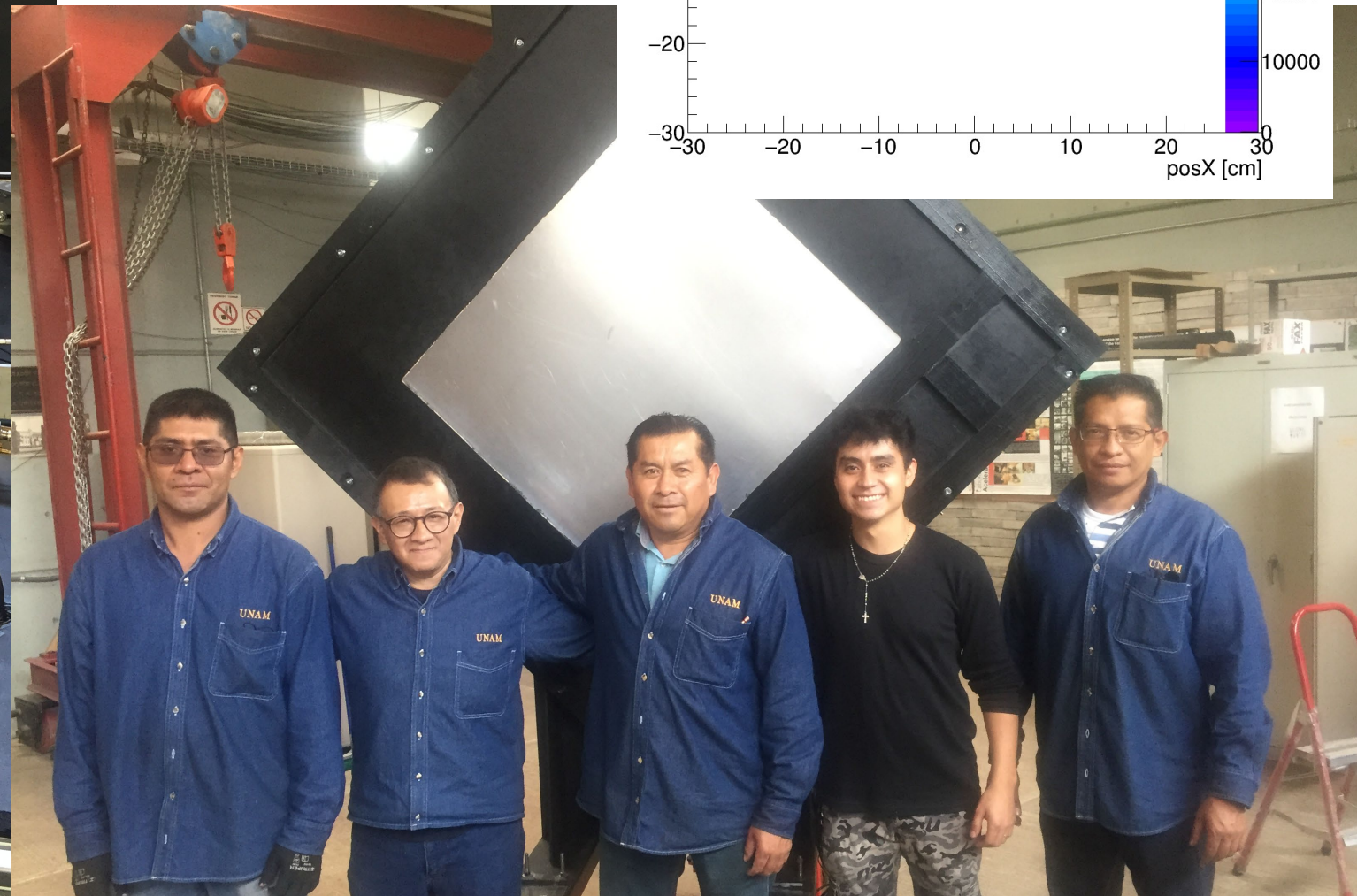
E. Chávez[1,a], P. Rodríguez[1], A. Huerta[1], M.E. Ortiz[1], L. Barrón-Palos[1], F. Favela[1], D. Marín[1], E. Moreno[2], G. Murillo[2], R. Policroniades[2], and A. Varela[2]

erimental data and optical model calculations
al cross-sections (angular distribution) of the el
g of ^{nat}Pb(n, n) at neutron energies of 2.9 Me
MeV, 3.2 MeV and 3.4 MeV (from top to botto
The dashed line corresponds to the KD parameterization, t

MONDE: Momentum Neutron DEtector







A joint IU/UNAM effort to search for dark matter and exotic interactions using protons and nuclei.

M. Snow
A. Szczepaniak
C. Horowitz
L. Barrón
L. Acosta
E. Chávez
C. Fernández
T. Yepez
…

- UNAM
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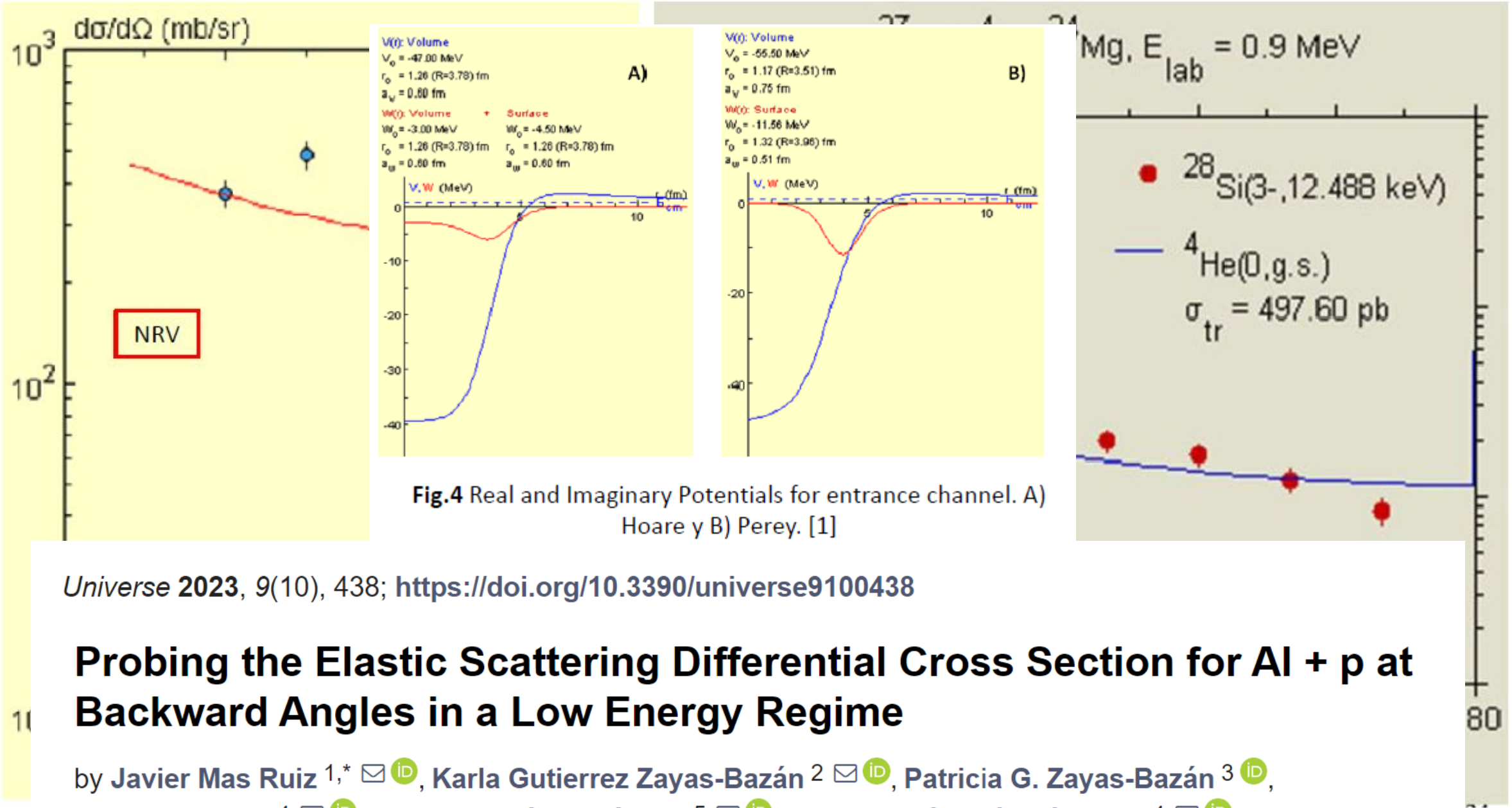


Fig.4 Real and Imaginary Potentials for entrance channel. A) Hoare y B) Perey. [1]

Universe **2023**, *9*(10), 438; **https://doi.org/10.3390/universe9100438**

Probing the Elastic Scattering Differential Cross Section for Al + p at Backward Angles in a Low Energy Regime

by **Javier Mas Ruiz** [1,*], **Karla Gutierrez Zayas-Bazán** [2], **Patricia G. Zayas-Bazán** [3], **Arcadio Huerta** [4], **Jorge Sastré-Hernández** [5], **Daniel José Marín-Lámbarri** [4], **Luis Acosta** [4], **Eduardo Andrade** [4], **Corina Solís** [4] and **Efrain R. Chávez Lomelí** [4]

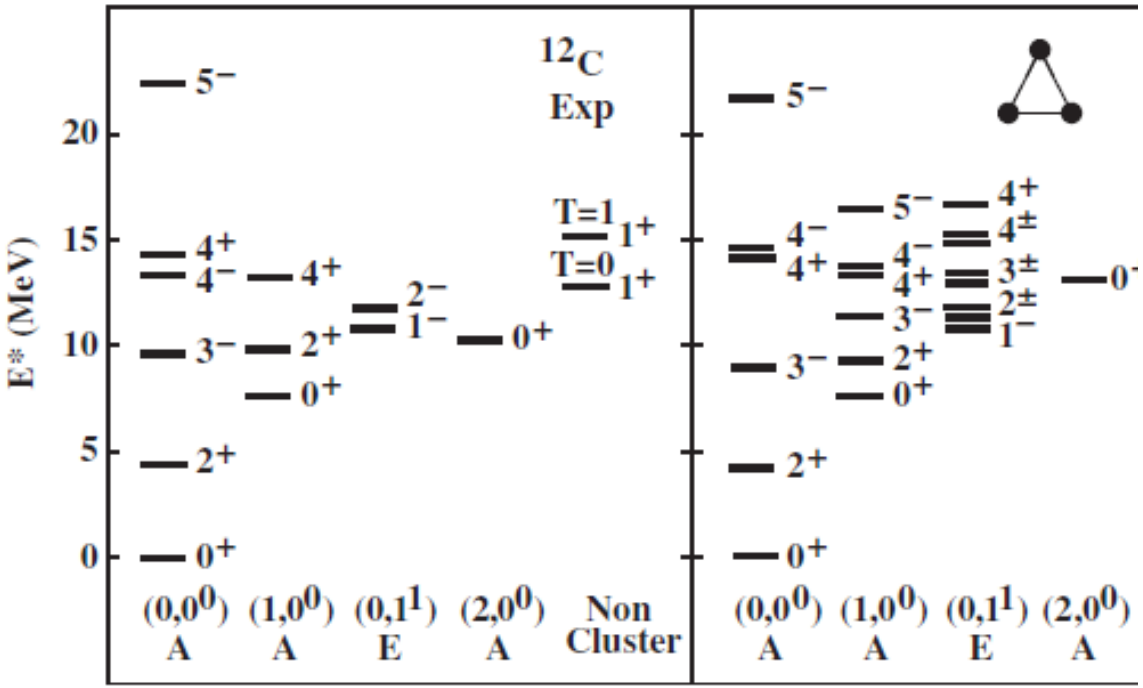


FIG. 5. Comparison between the low-lying experimental spe
trum of ^{12}C and the energies of the oblate symmetric t
calculated using Eq. (2) with parameters that are discussed
the text. The levels are organized in columns corresponding to t
ground state band and the vibrational bands with A and E

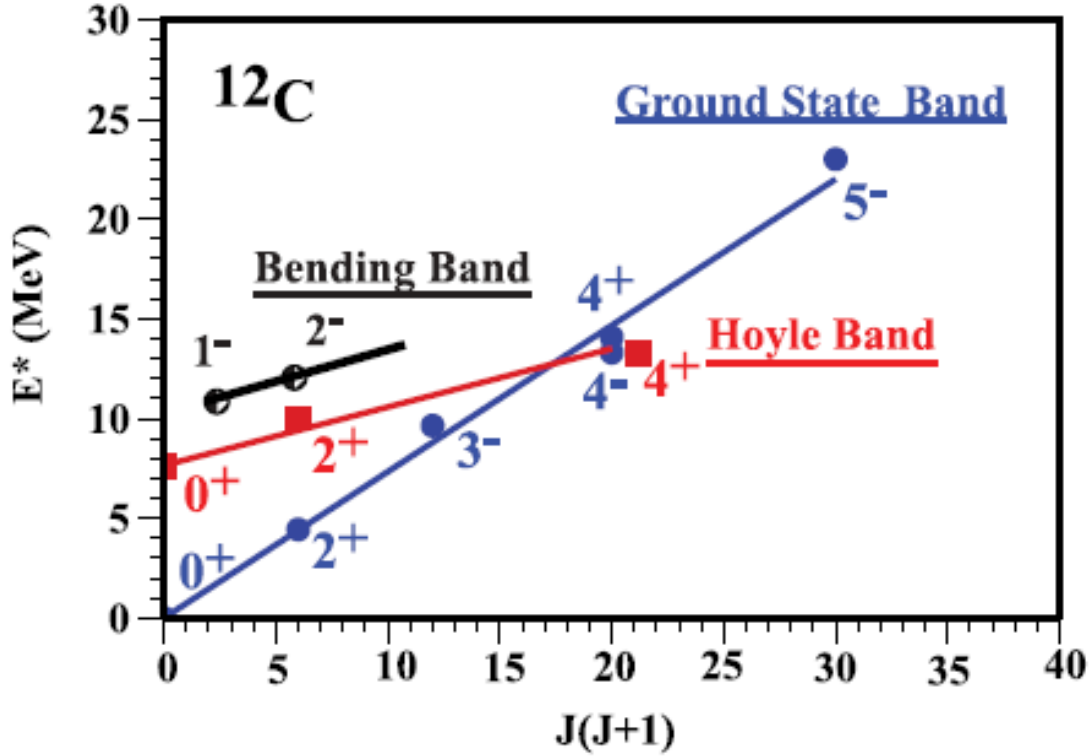
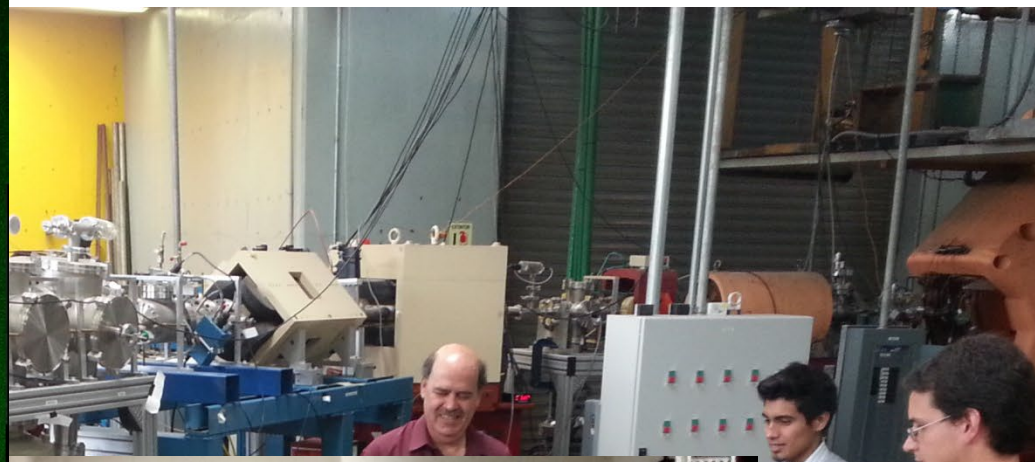


FIG. 4 (color online). Rotational band structure of the ground-state band, the Hoyle band, and the bending vibration in ^{12}C.

Evidence for Triangular $\mathcal{D}_{3h}$ Symmetry in ^{12}C

D. J. Marín-Lámbarri,[1] R. Bijker,[2] M. Freer,[1] M. Gai,[3,4] Tz. Kokalova,[1] D. J. Parker,[1] and C. Wheldon[1]

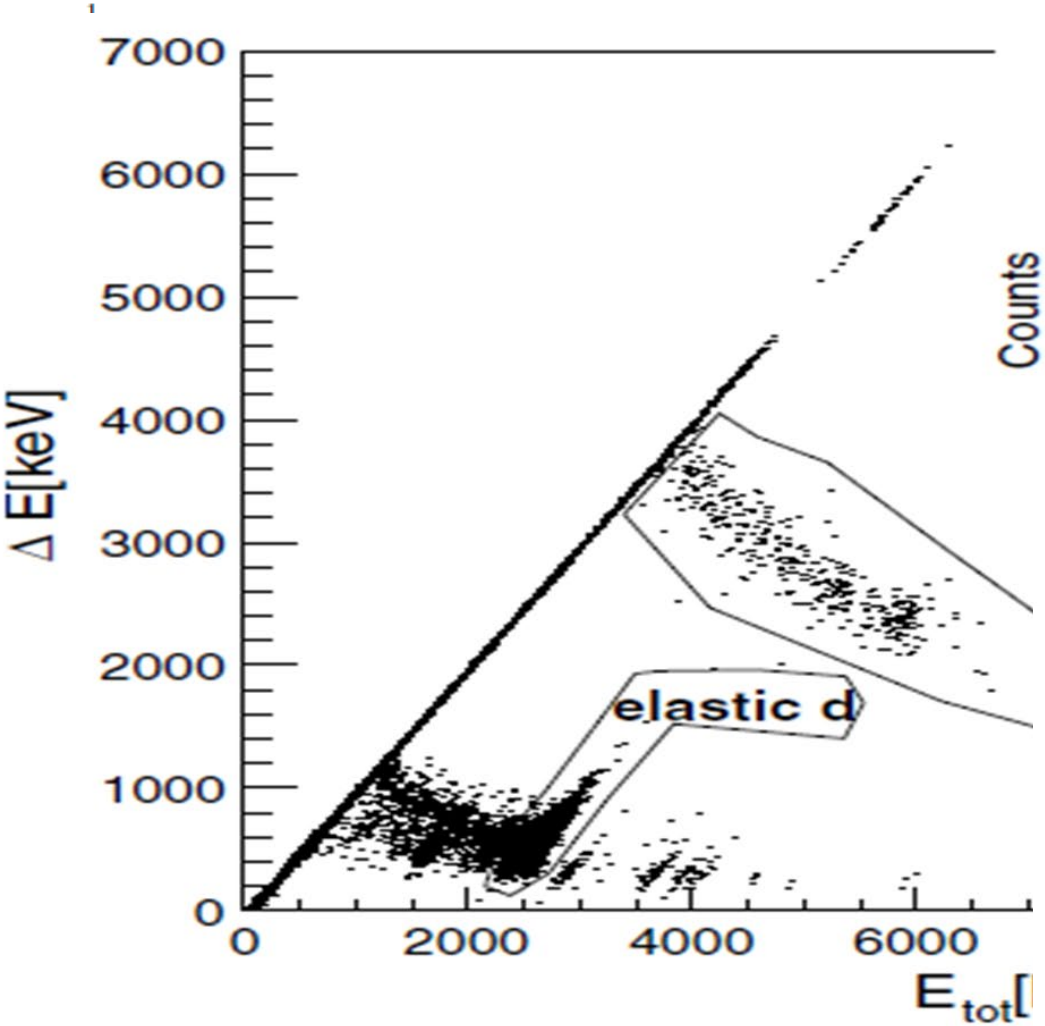


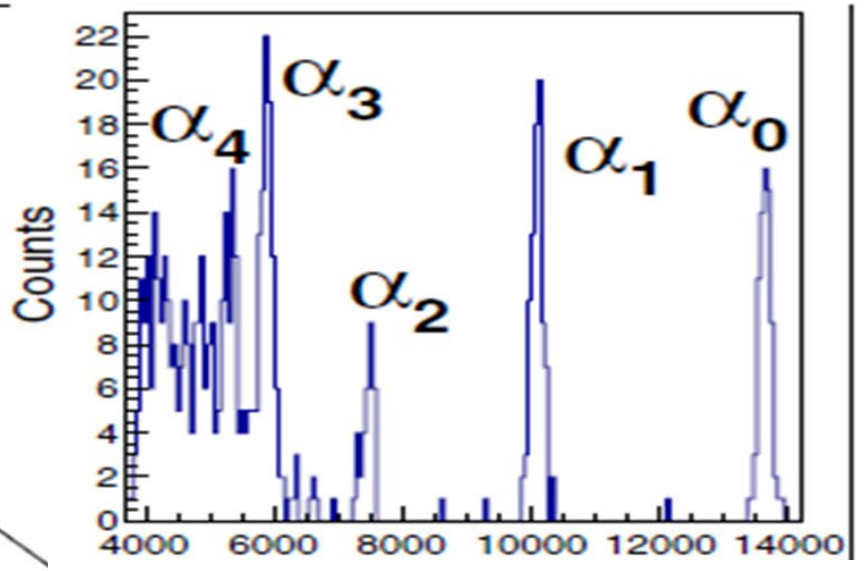
PHYSICAL REVIEW SPECIAL TOPICS—ACCELERATORS AND BEAMS **18,** 123502 (2015)

SUGAR
10^{17}-10^{19} at/cm^2

New supersonic gas jet target for low energy nuclear reaction studies

F. Favela,[1] L. Acosta,[1,2] E. Andrade,[1] V. Araujo,[1] A. Huerta,[1] O. G. de Lucio,[1] G. Murillo,[3] M. E. Ortiz,[1] R. Policroniades,[3] P. Santa Rita,[1] A. Varela,[4] and E. Chávez[1]

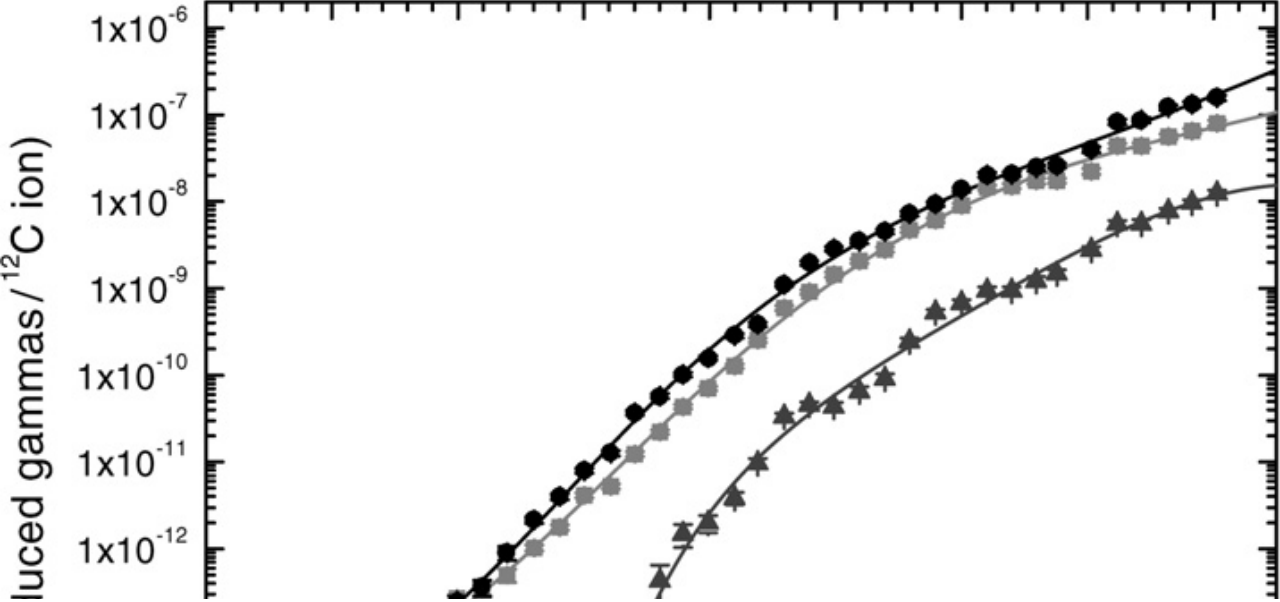




XL Symposium on Nuclear Physics 2017 (Cocoyoc2017) IOP Publishing
IOP Conf. Series: Journal of Physics: Conf. Series **876** (2017) 012015 doi:10.1088/1742-6596/876/1/012015

Study of the 12C excited states above the Hoyle State.

E. López-Saavedra[1], L. Acosta[1], V. Araujo[1], F. Favela[1], A. Huerta[1], J. Aspiazu[2], G. Murillo[2], R. Policroniades[2], P. Santa Rita[1], A. Varela[2] and E. Chávez[1]



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NUCLEAR PHYSICS A
Nuclear Physics A 779 (2006) 318–332

Absolute cross sections measurement for the $^{12}C + ^{12}C$ system at astrophysically relevant energies

L. Barrón-Palos [a,*], E.F. Aguilera [b], J. Aspiazu [b], A. Huerta [a], E. Martínez-Quiroz [b], R. Monroy [a], E. Moreno [b], G. Murillo [b], M.E. Ortiz [a], R. Policroniades [b], A. Varela [b], E. Chávez [a]

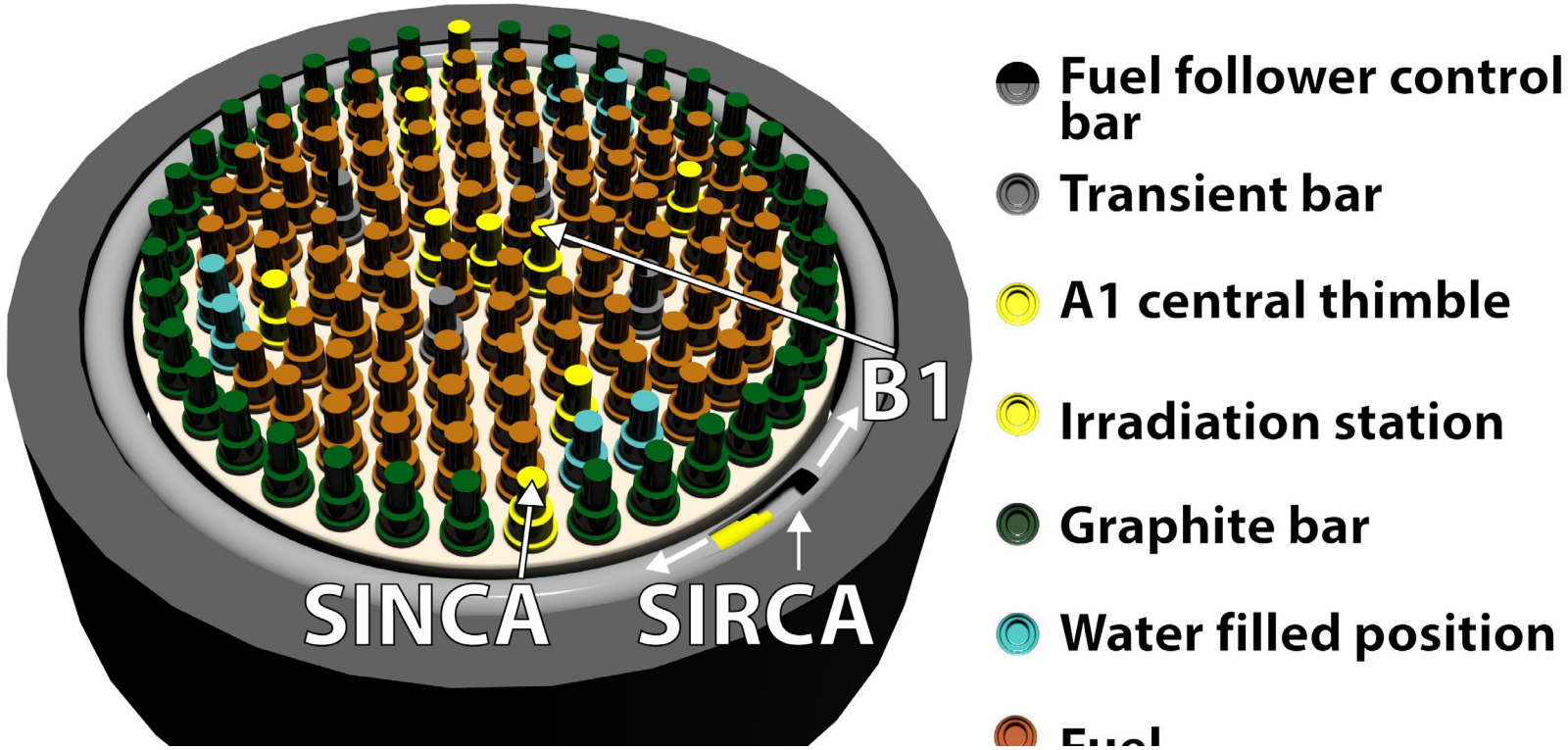
Eur. Phys. J. Plus (2020) 135:899
https://doi.org/10.1140/epjp/s13360-020-00906-7

THE EUROPEAN PHYSICAL JOURNAL PLUS

Regular Article

AMS cross-section measurement for the $^{28}Si(d,\alpha)^{26}Al$ reaction near the Coulomb barrier

G. Reza[1,a], A. B. Zunun-Torres[1], S. Padilla[1], J. Mas-Ruiz[1], D. J. Marín-Lámbarri[1], L. Acosta[1], P. Amador-Valenzuela[2], E. Andrade[1], D. Belmont[1], L. E. Charón[1], A. Huerta[1], D. Godos-Valencia[1], J. N. Martínez[3], C. G. Méndez[1], E. Moreno[2], G. Murillo[2], R. Policroniades[2], M. Rodríguez-Ceja[1], S. Sandoval-Hipólito[1], V. R. Sharma[2], C. Solís[1], A. Varela[2], P. Villaseñor[2], E. Chávez[1]



PHYSICAL REVIEW C **102**, 044601 (2020)

Measurement of the thermal neutron capture cross section by ^{9}Be using the neutron flux from a nuclear research reactor and the AMS technique

D. J. Marín-Lámbarri,[1,*] J. García-Ramírez,[1] E. Sánchez-Zúñiga,[1] S. Padilla,[1] L. Acosta,[1] E. Chávez,[1] H. S. Cruz-Galindo,[2] A. Huerta,[1] G. Méndez,[1,3] R. Raya-Arredondo,[2] M. Rodríguez-Ceja,[1,4] C. Solís,[1] and L. Barrón-Palos[1]

Contents lists available at ScienceDirect

Nuclear Inst. and Methods in Physics Research, B

journal homepage: www.elsevier.com/locate/nimb

Accelerator Mass Spectrometry, an ultrasensitive tool to measure cross sections for stellar nucleosynthesis

E. Chávez [a], V. Araujo-Escalona [a], J. Mas-Ruiz [a,*], L. Acosta [a], E. Andrade [a], L. Barrón-Palos [a], R.J.R. Gleason [a], A. Huerta [a], M. Rodríguez-Ceja [a], D.J. Marín-Lámbarri [a,b], C.G. Méndez [a], S. Padilla [a], C. Solís [a], A.O. Valdez-Guerrero [a]

[a] *Instituto de Física, Universidad Nacional Autónoma de México, Av. Universidad 3000, Mexico city, 04510, Mexico*
[b] *Instituto de Ciencias Nucleares, Universidad Nacional Autónoma de México, Cto. Exterior S/N, Mexico city, 04510, Mexico*

ARTICLE INFO

Keywords:
Accelerator mass spectrometry (AMS)
Activation method
Nuclear astrophysics
Nucleosynthesis
Long-lived radioisotopes
Cross sections measurements
^{28}Si$(d,\alpha)^{26}$Al
^{26}Al
^{10}B
^{14}C

ABSTRACT

The combination of the activation method and accelerator mass spectrometry (AMS) has grown to be an important resource to measure nuclear reaction cross sections, especially when these are very small. The activation method refers to the production of long-lived radioisotopes by nuclear reactions induced by charged particles, neutrons, or γ-rays. The ultrasensitivity achieved by AMS allows the detection of even a very small number of such long-lived radioactive products. Several reviews of this topic have been published recently and our goal in this work is to continue with the review effort by including some of our own publications, as well as a few more.

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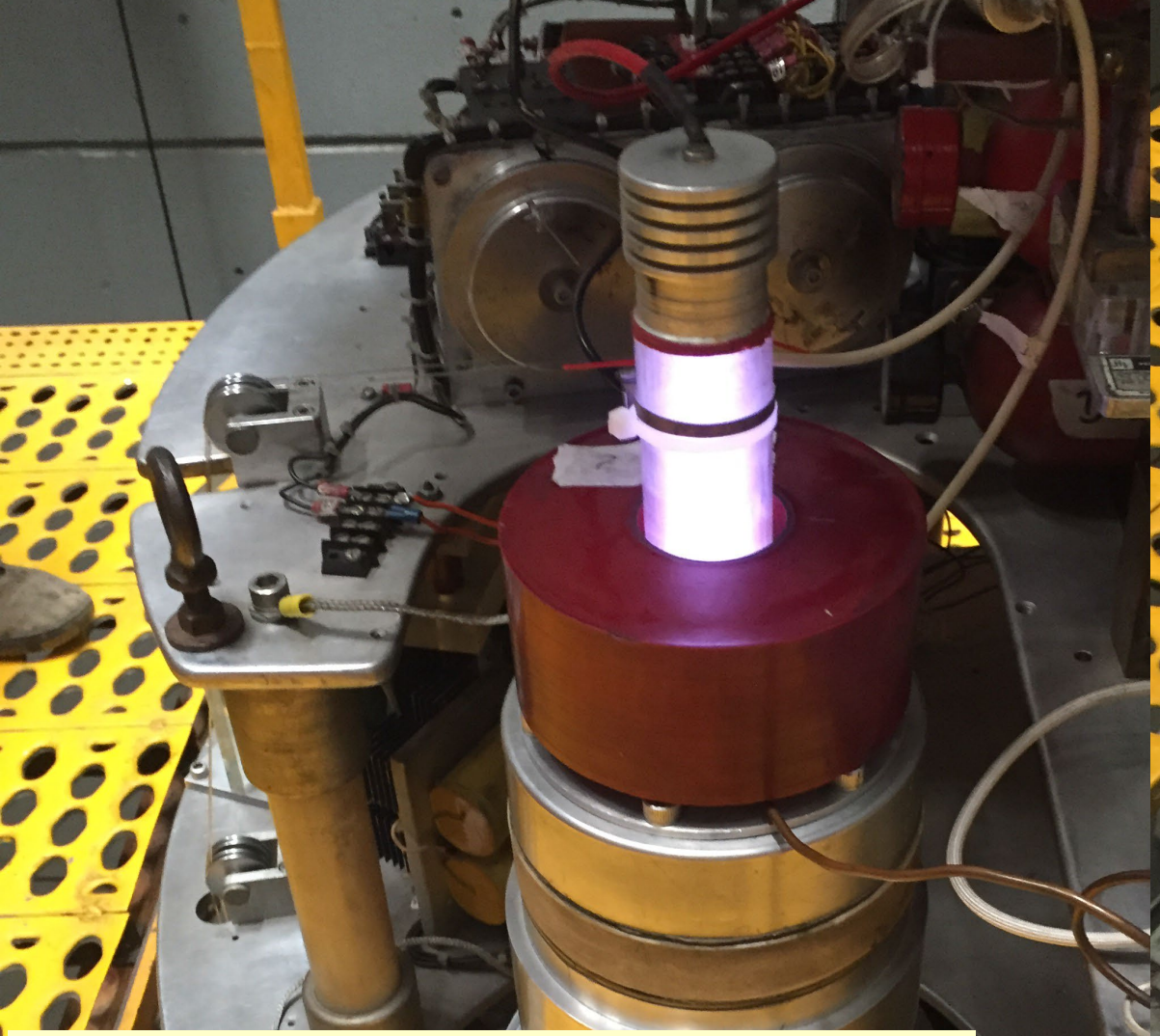
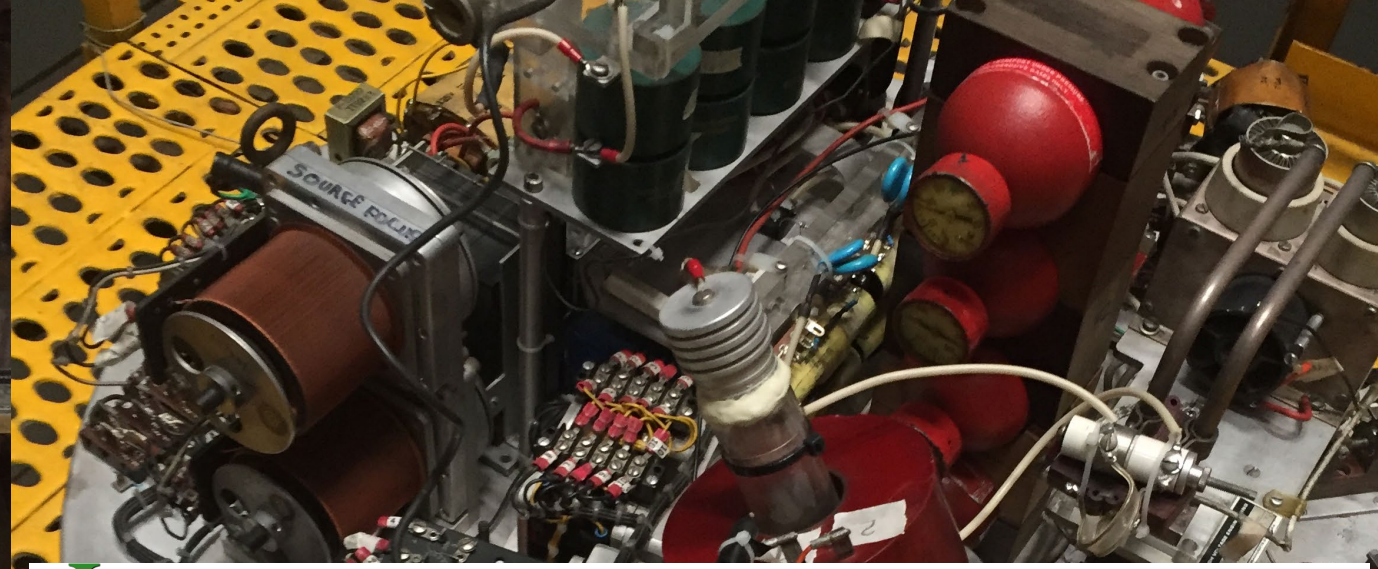
  - Dynamics: Nucleus-Nucleus interaction potential. Stellar Nucleosynthesis
- **Present and future: the ECRIS Project.**

Short term future: ECRIS for the 5.5 MV Van de Graaff Accelerator





2018: HV discharge destroys RF-IS
2020: Restaured
2020: covid
2022: modification for heavy ions

J inst

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REVISED: *March 18, 2021*
ACCEPTED: *July 19, 2021*
PUBLISHED: *August 11, 2021*

TECHNICAL REPORT

Restoration of the radio frequency ion source of the 5.5 MV CN-Van de Graaff accelerator at IFUNAM

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PIG Ion Source: 2+, 3+ charge states for Ar, Kr and Xe.

Positive Ion Sources for the Single-ended 5.5 MV Van de Graaff Accelerator at IFUNAM

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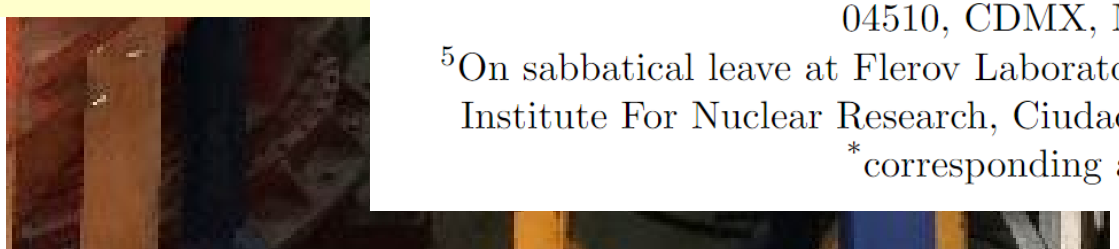
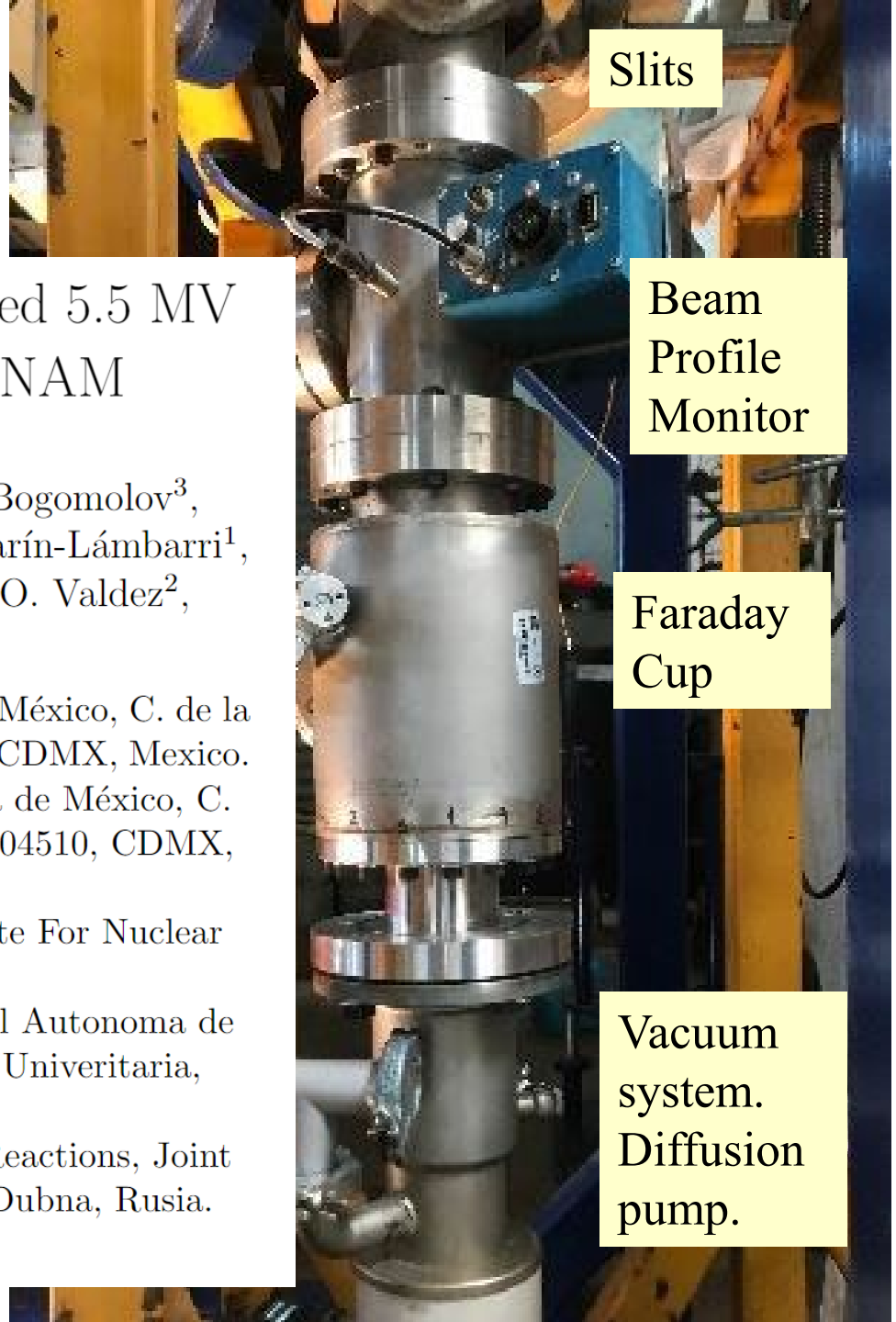
Ion Source Test Bench





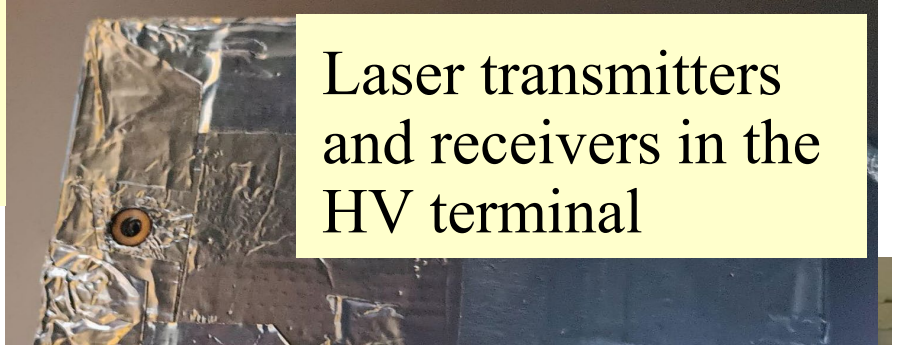
Slits

Beam Profile Monitor

Faraday Cup

Vacuum system. Diffusion pump.

Laser remote control system



Laser transmitters and receivers in the HV terminal

An internal laser communication system for large single-ended electrostatic accelerators.

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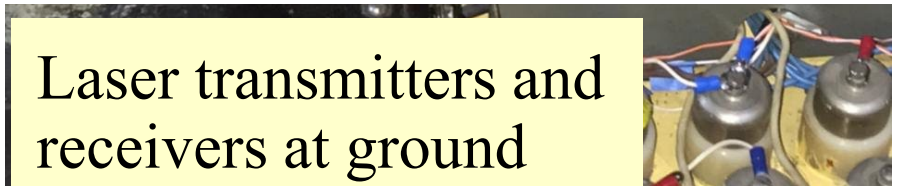
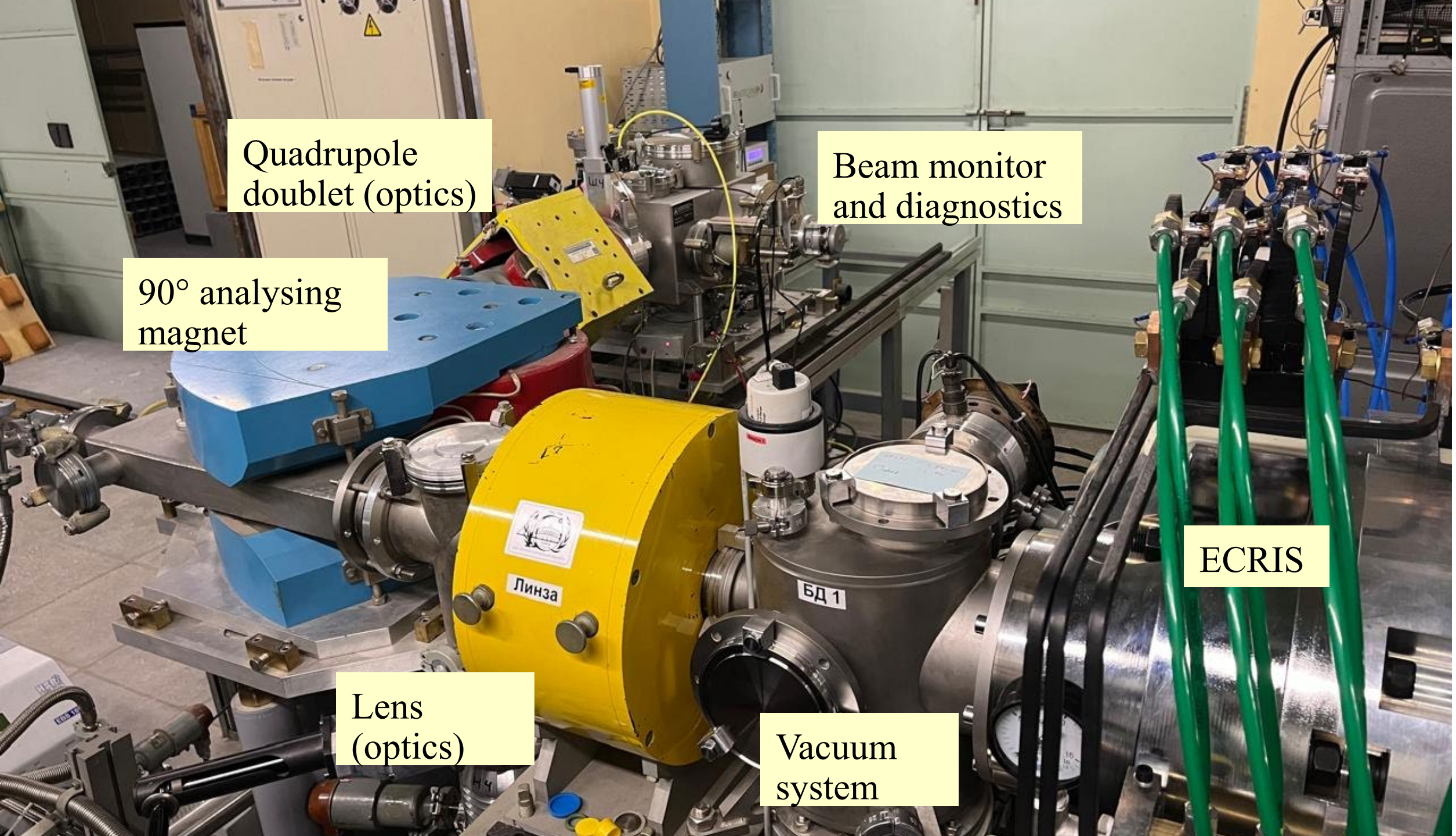
Arduino circuits and sensors



Laser transmitters and receivers at ground


Quadrupole doublet (optics)
Beam monitor and diagnostics
90° analysing magnet
ECRIS
Линза
БД 1
Lens (optics)
Vacuum system

¿ $^{16}O^{8+}$ @ 40 MeV ?

¿ $^{40}Ar^{10+}$ @ 50 MeV?

¿ $^{84}Kr^{20+}$ @ 100 MeV?

¿ $^{132}Xe^{28+}$ @ 140 MeV?

Simulation of the Permanent Magnet System For Compact 14 GHz ECR Ion Source

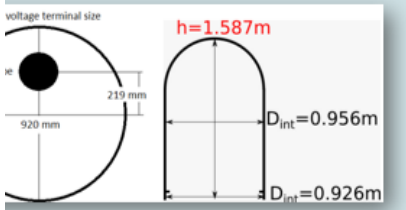
Kirill Berestov, Sergey Bogomolov, Dmitry Pugachev, Vladimir Mironov

Relevance

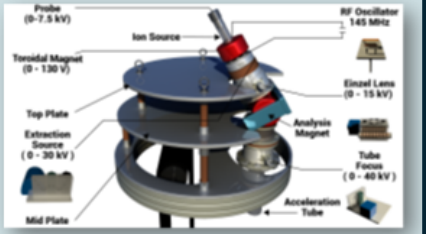
Multiple charge state ion beams are of special interest in the fields of nuclear terial physics and other applications. Electron ion source can produce high intensity ion beams or pulse mode. For high-voltage accelerators, the mption of devices. As a room available in a high-

Requirements to the ECR i located at HV termi

- ✓ **Low power consumption:** up to 1 kW is available;
- ✓ **Low maintenance:** this ECRIS should be able to ru without any maintenance for no less than 2000 hours;
- ✓ **Compact size.**



ce available for the ion source in the tank



The high voltage terminal inside the tank

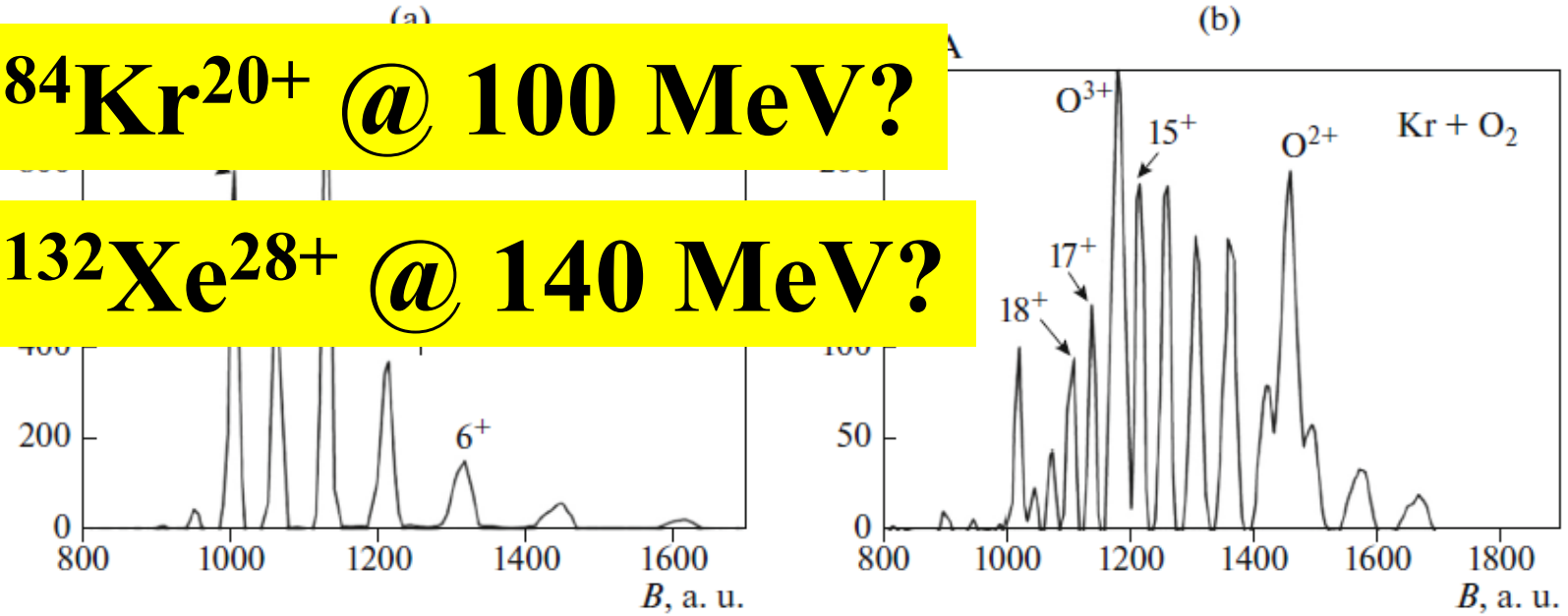
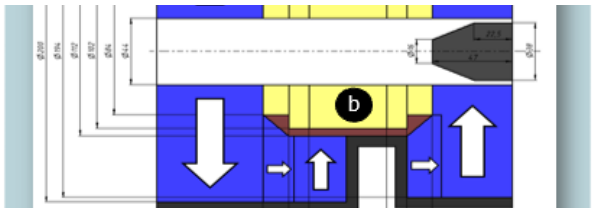
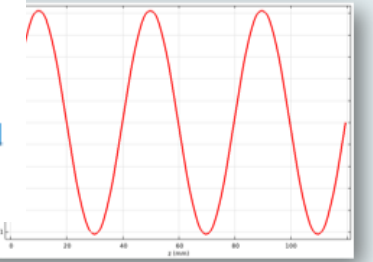


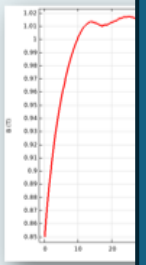
Fig. 3. Argon ion spectra upon optimization of the source operation mode for the maximum current of (a) Ar^{8+} and (b) Kr^{17+} ions.



Hexapole magnetization configuration (24 sectors): 1 – pole (0°), 2 – middle sector (45°), 3 – interpole sector (90°) [1]



Azimuthal distribution of the radial magnetic field in the central region of the plasma chamber on the wall

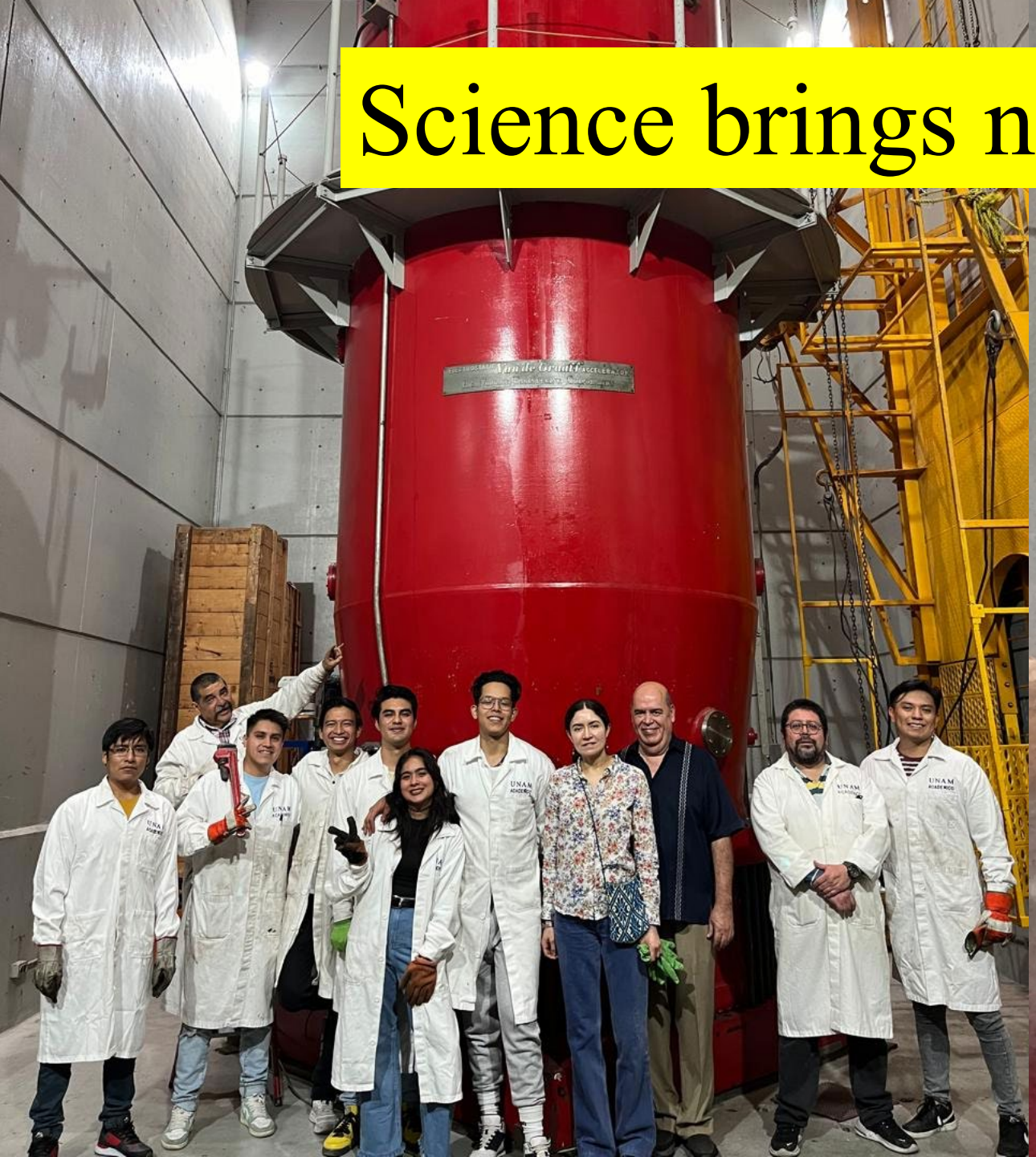


Axial distribu field of t

10	**Ne**	neon	20.180
18	**Ar**	argon	39.948
36	**Kr**	krypton	83.798(2)
54	**Xe**	xenon	131.29
86	**Rn**	radon	


Van de Graaff

Science brings nations together:



Большое спасибо за внимание