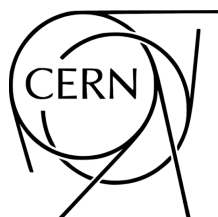


Low & High Energy Approach for Nuclear Structure Evolution and Fission Dynamics

IGFAE retreat 2026

The structure of the nuclear many-body systems and
its astrophysical and cosmological implications

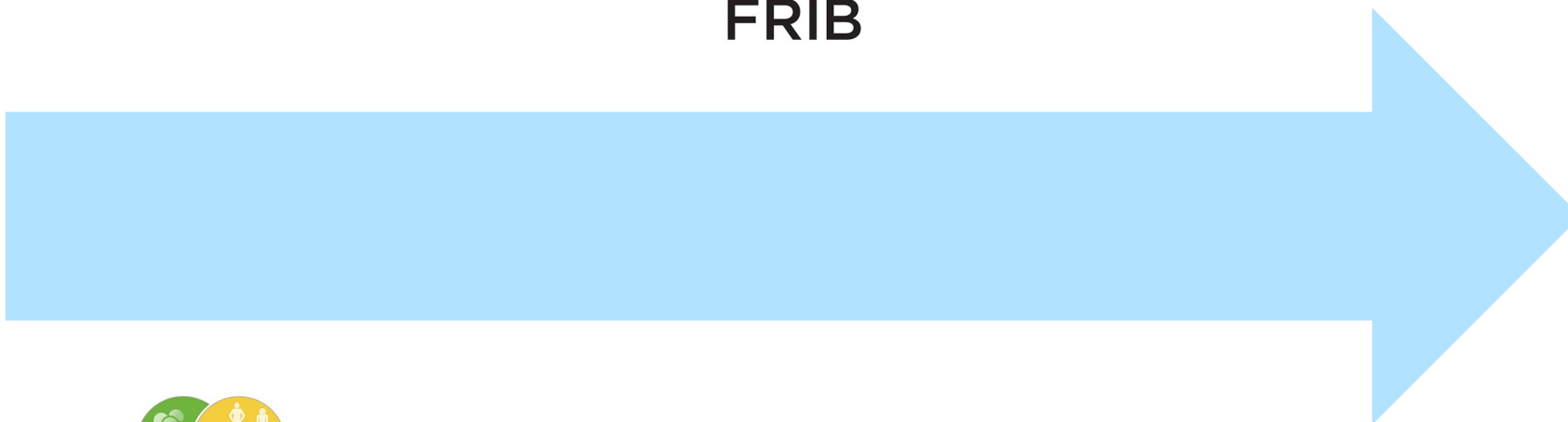




GANIL



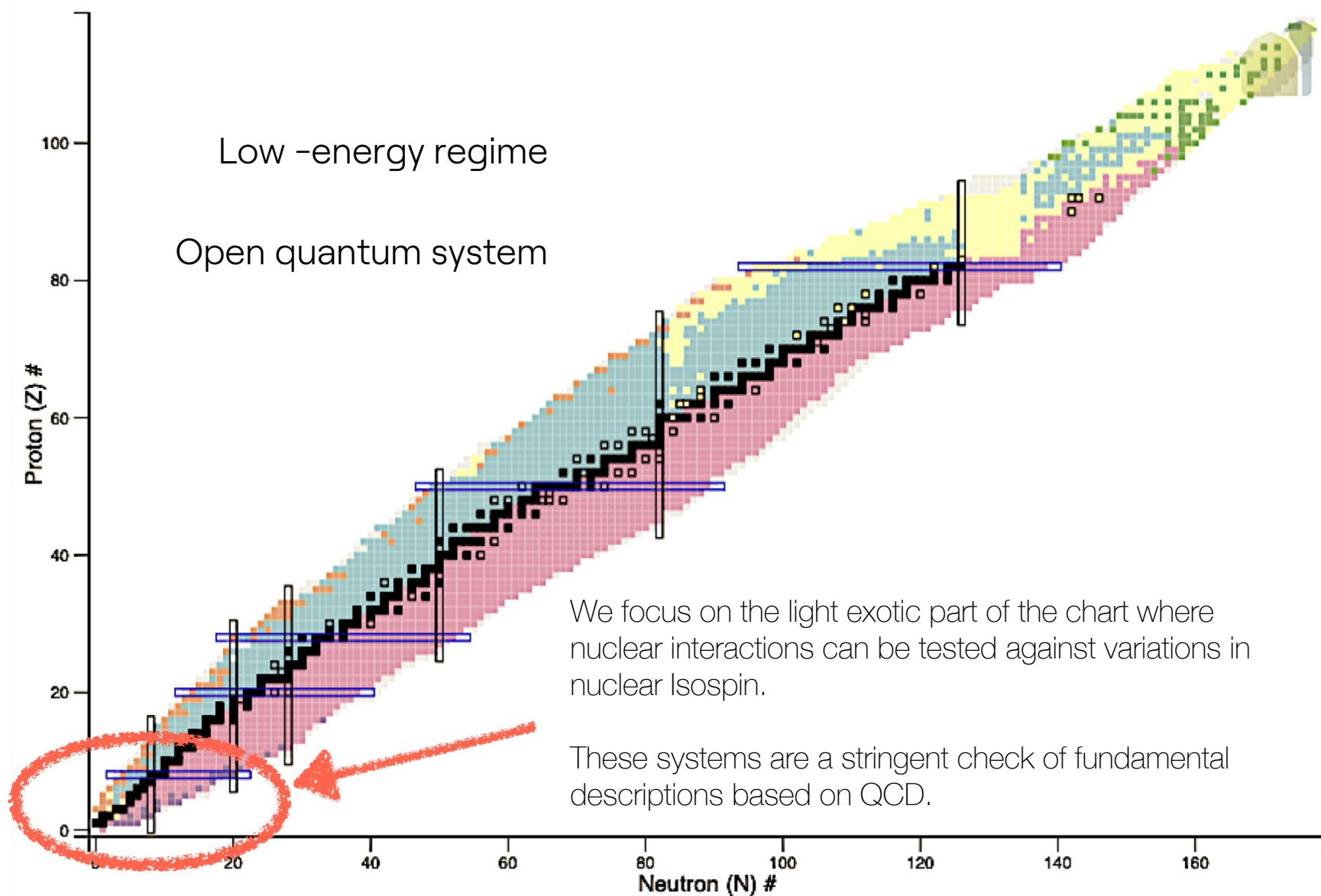
Low Energy (5–50 AMeV)

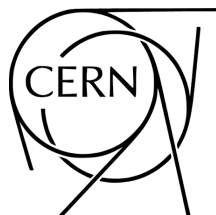


High Energy (50–1000 AMeV)



Nuclear structure of light exotic nuclei

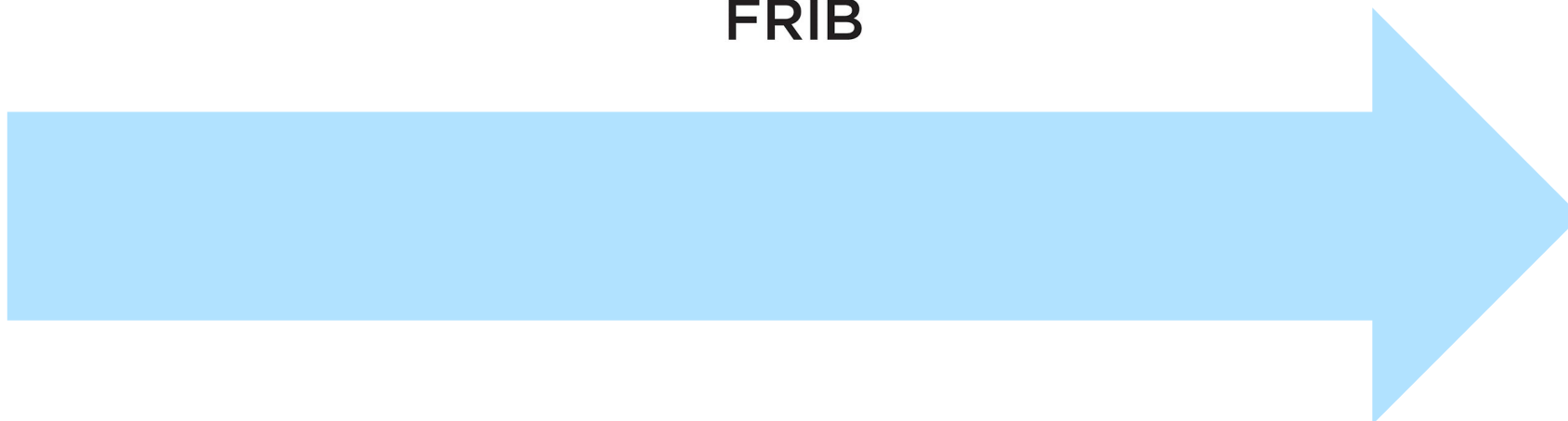




GANIL



Low Energy (5–50 AMeV)

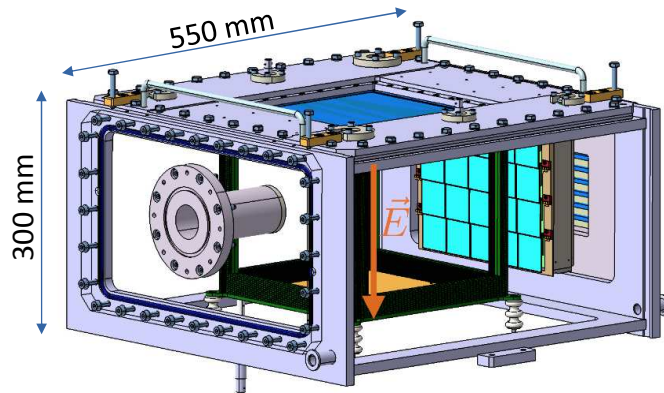


Nuclear structure of light exotic nuclei

Direct reactions
measured with
are specially well

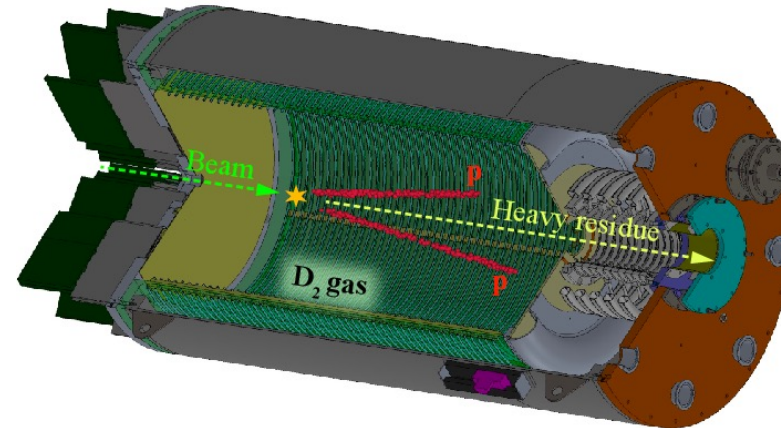
LOW ENERGY (5-50 AMeV) & ACTIVE TARGETS

Direct reactions (transfer, resonant elastic, etc)
measured with the new generation of **active targets**
are specially well suited for the study of these systems.



ACTAR TPC

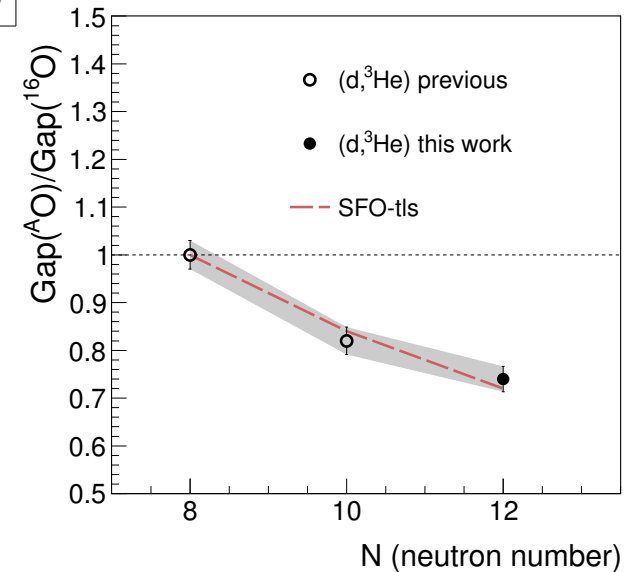
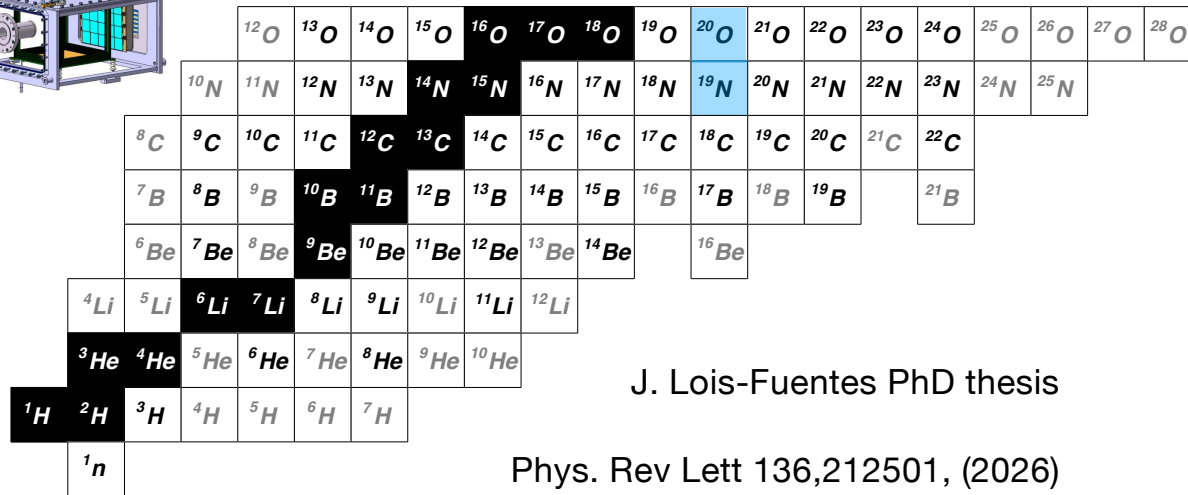
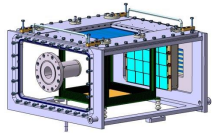
Cubic geometry, no magnetic field,
V=27 L, Amp: μ egas 128 mm
(France, Spain, Italy, Canada, Japan, Belgium)



AT TPC

Cylindrical geometry and magnetic field,
V= 250 L Amp: μ megas 128 mm,
multilayer thick GEM (1ML, 3 stages)
(USA, Spain, China)

Nuclear structure of light exotic nuclei



ACTAR TPC

First transfer campaign with ACTAR TPC. Successful results
Direct measurement of the **Z=6 shell gap** in neutron-rich isotopes

FEATURED IN PHYSICS

Quenching of the $\pi 0 p_{3/2} - \pi 0 p_{1/2}$ Spin-Orbit Splitting in ^{20}O and the Effect of the Tensor Force

J. Lois-Fuentes^{1,*}, B. Fernández-Domínguez^{1,†}, T. Roger², F. Delaunay³, M. Lozano-González¹, O. Sorlin², T. Otsuka⁴, T. Suzuki^{5,‡}, N. L. Achouri³ et al.

Show more

Phys. Rev. Lett. **136**, 212501 – Published 27 May, 2026

DOI: <https://doi.org/10.1103/PhysRevLett.136.212501>

PDF

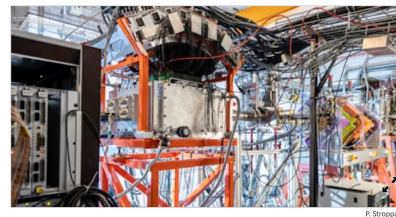
Share

Export Citation

The Shell Model's Shell Game

May 27, 2026 • Physics 19, s76

A new experiment settles a controversy over proton and neutron energies in light nuclei.



P. Stroppe/CERN

The shell model describes how protons and neutrons (nucleons) fill up their respective energy levels, or orbitals, as they increase in number. Once a nucleus contains six or more protons, a gap opens between the sixth and the

SYNOPSIS

PDF Version

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Quenching of the $\pi 0 p_{3/2} - \pi 0 p_{1/2}$ Spin-Orbit Splitting in ^{20}O and the Effect of the Tensor Force

J. Lois-Fuentes et al.

Phys. Rev. Lett. **136**, 212501 (2026)

Published May 27, 2026

Recent Articles

Helium Spectroscopy Hits Record Precision

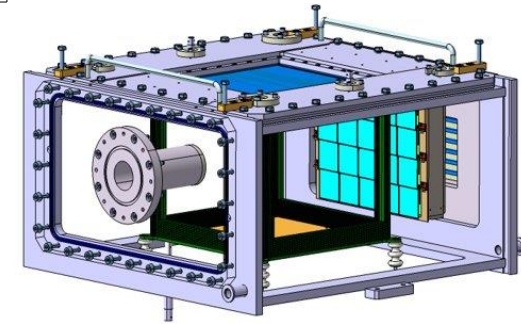
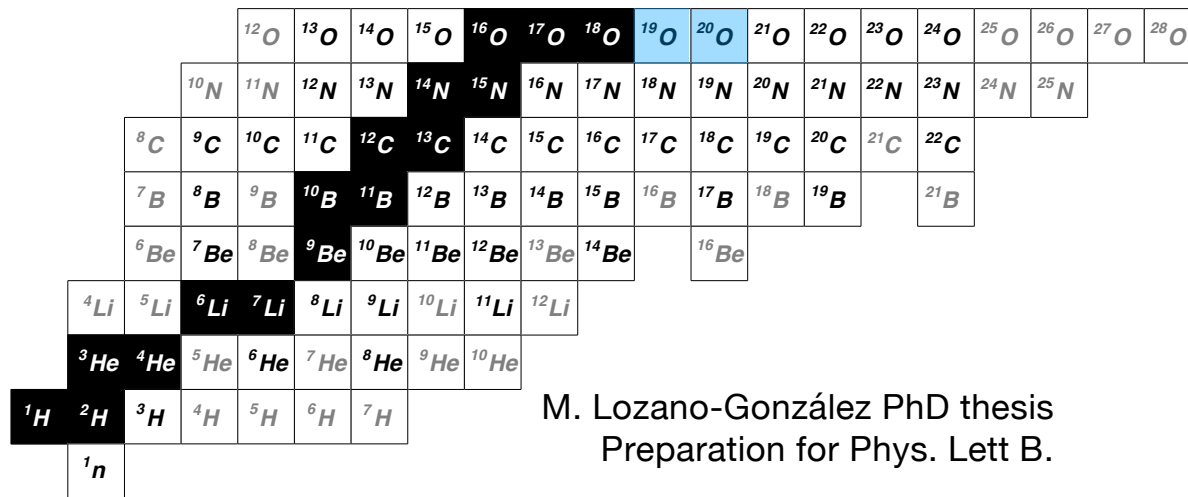
Improved measurements of an electronic transition in helium-4 atoms constrain the size difference between helium-4 and helium-3 nuclei.

A More Stable Photon Emitter

A new device that generates single photons with more consistent wavelengths than existing methods could improve quantum

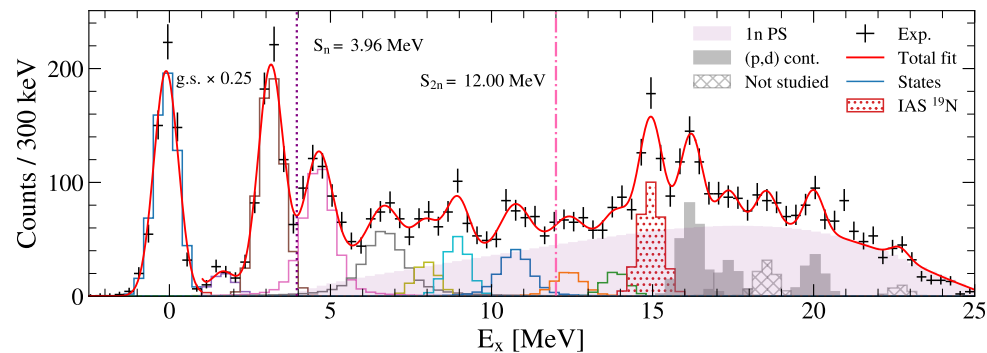
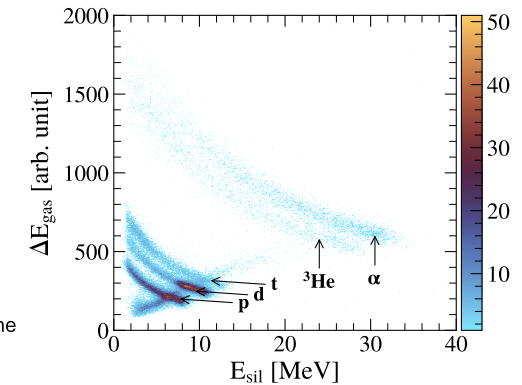
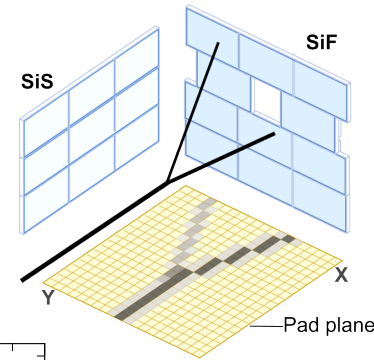
Tensor part of nn-interaction responsible

Nuclear structure of light exotic nuclei



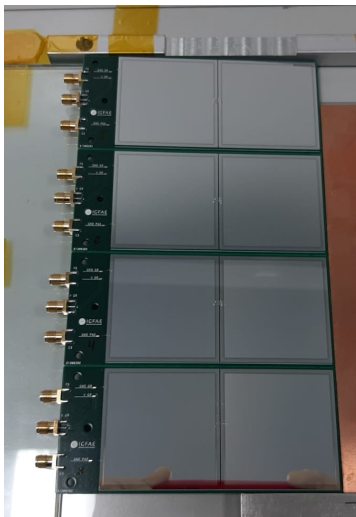
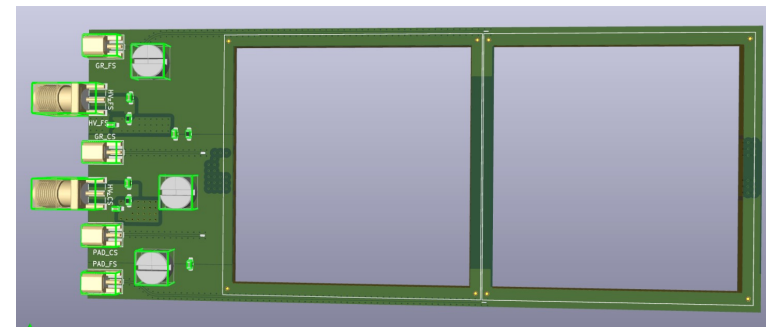
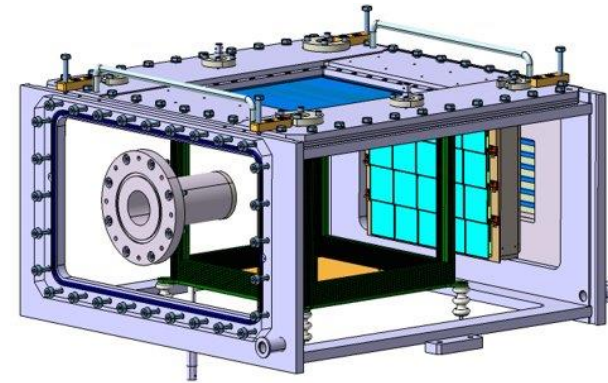
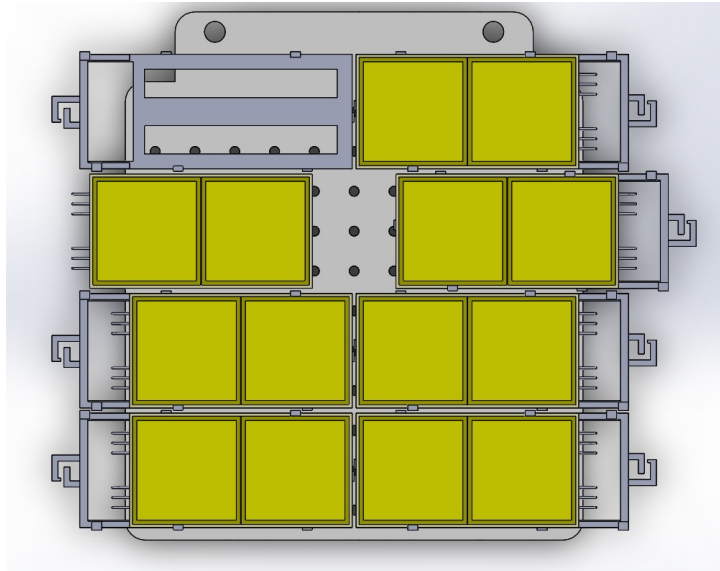
ACTAR TPC

First transfer campaign with ACTAR TPC. Successful results
Direct measurement of the **N=8,14 shell gap** in neutron-rich ^{19}O isotopes



Nuclear structure of light exotic nuclei

ACTAR TPC - Upgrade

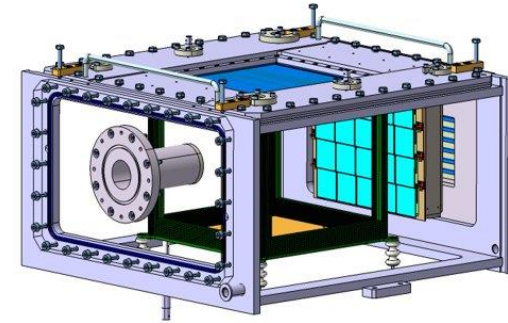


- 1.5 mm thick Silicon sensors
- Holder design → Cristina Cabo (IGFAE)
- PCB design & Bounding → IGFAE (LHCb engineers). Eliseo Pérez, Antonio Pazos, Antonio Fernández Prieti

Exotic nuclei with ACTAR TPC

[illegible]

ACTAR TPC



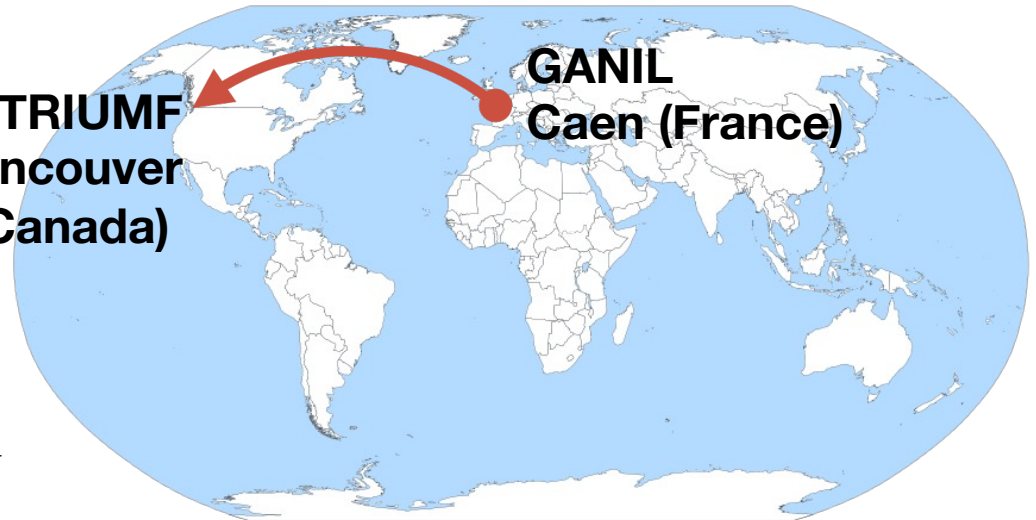
TRIUMF (Canada) : 2025

- S2008 "Probing single-particle states in ^{21}Al "
Spokespersons: B. Fernández-Domínguez, T. Roger
Approved in 2022
- S2384 "Detailed study of ^{12}Li "
Spokespersons: B. Fernández-Domínguez, T. Roger
Approved in 2023

TRIUMF
Vancouver
(Canada)



GANIL
Caen (France)



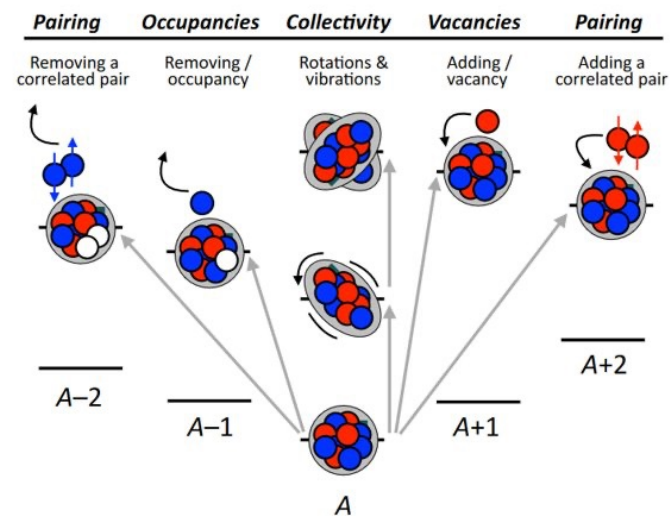
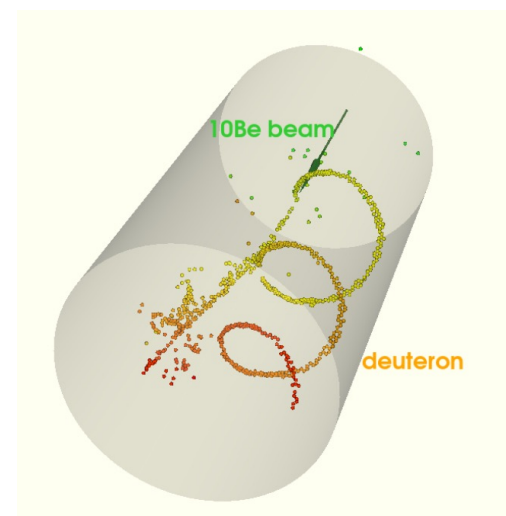
- Very succesful results → analysed by I. Blanco-Calviño

A Solenoid Spectrometer Apparatus for Reaction Studies

SOLARIS



Facility for Rare Isotope Beams
at Michigan State University



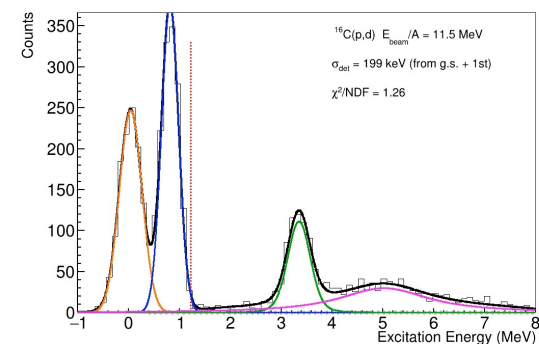
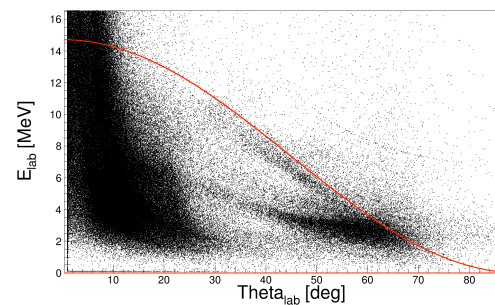
(A. Muñoz-Ramos PhD thesis)

A Solenoid Spectrometer Apparatus for Reaction Studies

SOLARIS

Facility for Rare Isotope Beams
at Michigan State University

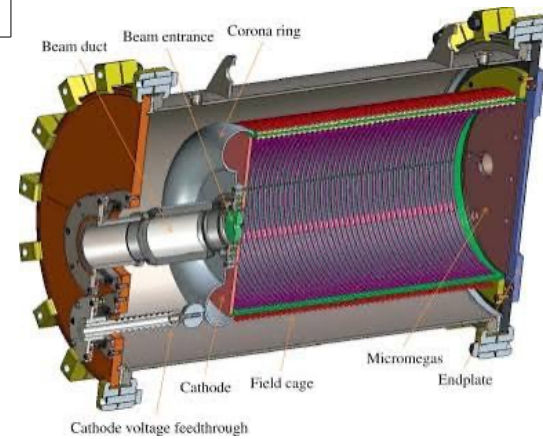
- A. Muñoz-Ramos (PhD thesis)
- Georgina Xifra (PhD thesis)
- David Palacios Suárez-Bustamante (Ph.D Thesis)



Preliminary Results → ongoing

Exotic nuclei with AT TPC

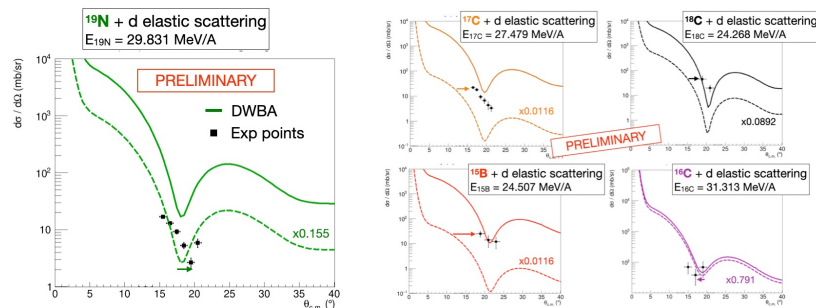
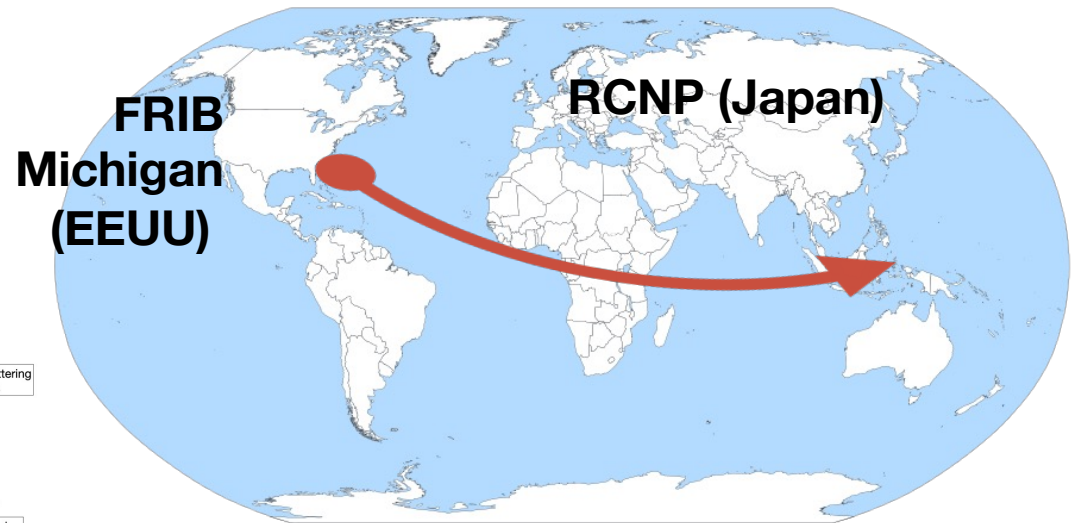
AT-TPC



AT- TPC

RCNP (Japan) : 2026

- S2008 “Detailed structure of ^{18}C ”
Spokespersons: B. Fernández-Domínguez,
Y. Ayyad Approved in 2019 → run 2026



P. Miriot-Jaubert Post-Doct (IGFAE)

Organisation of activities AT TPC



**SOLENOIDAL
SPECTROMETER
WORKSHOP**

*PHYSICS HIGHLIGHTS AND
INSTRUMENTATION DEVELOPMENTS*

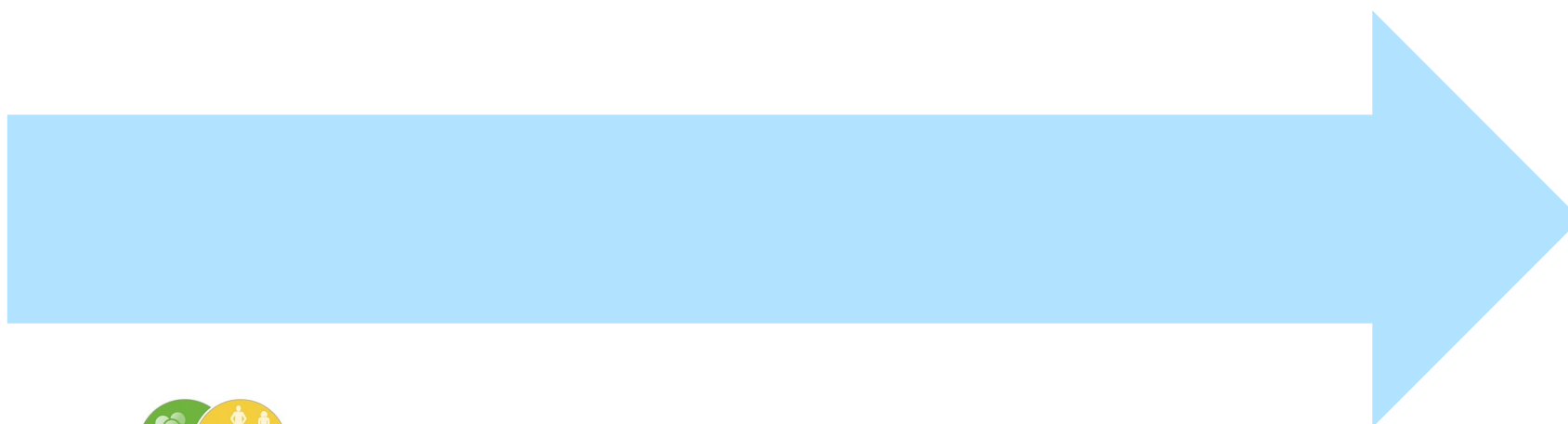
9 - 12 December 2025
IGFAE Santiago de Compostela (Spain)

Scientific advisory committee:
Dr. A. Machiavelli (ORNL, US)
Prof. O. Tengblad (CSIC, Spain)
Prof. S. Freeman (University of Manchester, UK)
Dr. C. Hoffman (ANL, US)
Prof. R. Kanungo (Triumf, Canada)
Dr. T. Roger (GANIL, France)
Dr. M. Cavallaro (INFN-LNS, Italy)

Local organising committee:
Y. Ayyad, C. Cabo, H. Álvarez Pol,
B. Fernández Domínguez, M. Caamaño
(IGFAE Universidade de Santiago de Compostela)
S. Beceiro (Universidade da Coruña)

Logos and text at the bottom:
ATI, USC, IGFAE INSTITUTO GALEGO DE FÍSICA DE ALTAS ENERXÍAS 25 1999 2024, XUNTA DE GALICIA, qur, Confirmando por la Unión Europea, Fondos Europeos

Y. Ayyad & C. Cabo 2025

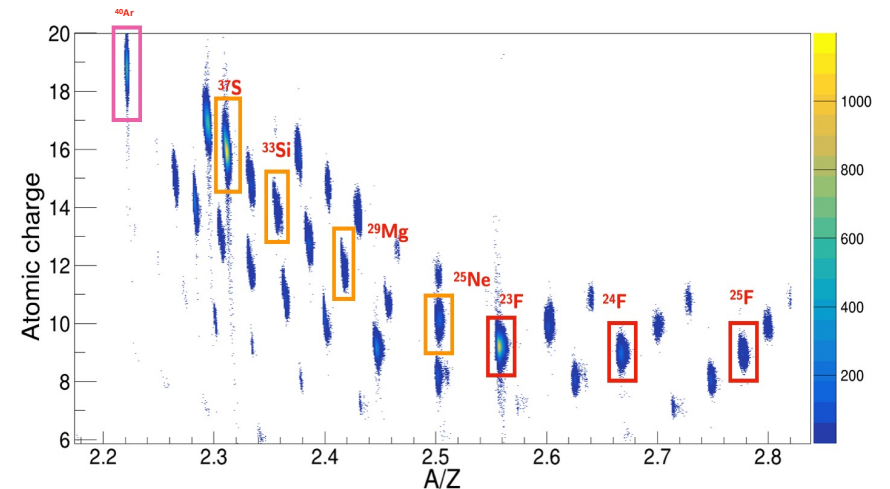
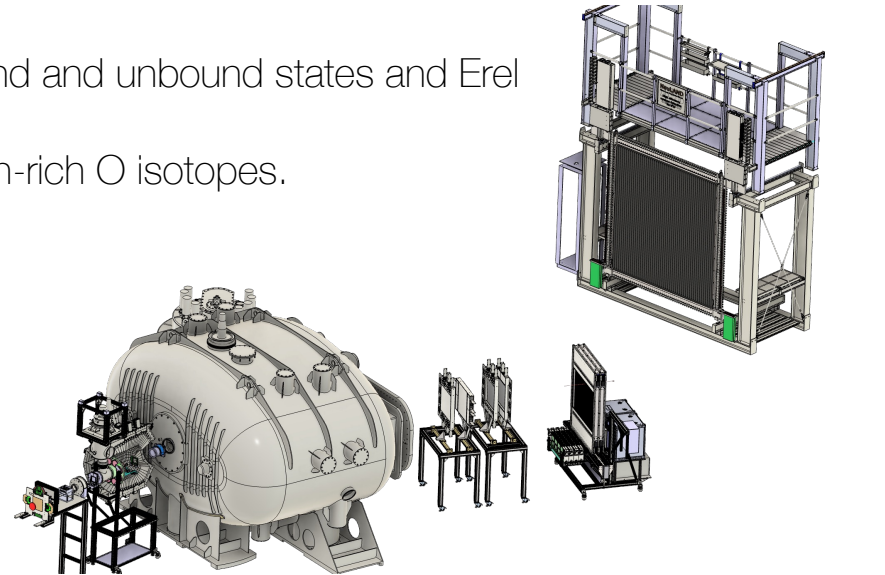


High Energy (50–1000 AMeV)



R3B @ FAIR - CALIFA

- Ongoing analysis “**Unveiling the structure of neutron-rich $Z=9$ isotopes: the case of ^{25}F** ”:
 1. First R3B experiment to investigate the **nuclear structure of $^{23,24,25}\text{F}$ using quasi-free (p,2p) and (p,pn) reactions.**
 2. Measurement of momentum distributions for bound and unbound states and Erel spectra with high accuracy.
 3. Study of $p_{1/2}$ and $p_{3/2}$ spin-orbit splitting in neutron-rich O isotopes.
- **Successful tests of ALPIDE** (Monolithic Active Pixel Sensor) detector concept for R3B, with part of the sensors + electronics funded by IGFAE-USC.
- **CALIFA completion** programme: 400 detection units (crystal + APD) to be mounted and characterized at IGFAE-USC (June-December 2026).
- **Fire at UNILAC** -> Postposed beam till 2027. HYDRA experiment (sched. Sep 2026), with strong IGFAE-USC participation, cancelled.
- FAIR high-energy cave installation scheduled for late 2026 and 2027 (**not delayed** by fire). **Starting new physics programme in 2028 at FAIR (^{12}C).**



Grupo FICA - IGFAE retreat 2026

R3B Data analysis

Conference papers based on USC PhD Thesis:

- **Feijoo-Fontan, M. et al.** : “Populating bound and unbound states of ^{18}C via quasi-free $(p,2p)$ reactions”, Proceedings of Science 475, 011 (2026).
- **Benlliure, J. et al.**: “Fission studies using quasi-free NN scattering reactions in inverse kinematics”, Nucl. Phys. A 1063, 123173 (2025).
- **Feijoo-Fontan, M. et al.** : “Development of a PID algorithm for the CALIFA detector to study multinucleon knockout reactions in exotic nuclei”, Nucl. Phys. A 1059, 123103 (2025).

Publications:

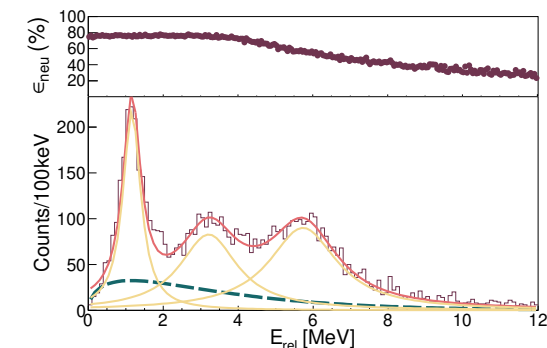
- **Panin, V. et al. (with H. Alvarez-Pol)**: “Probing QFS mechanism with the $^{12}\text{C}(p, 2p)^{11}\text{B}$ reaction in inverse kinematics”, Phys. Lett. B 879, 140595 (2026).
- **Rodriguez-Sanchez, J.L. et al. (with H. Alvarez-Pol, M. Feijoo-Fontán)**: “Neural network-based prediction of particle-induced fission cross sections for r -process nucleosynthesis trained with dynamical reaction models”, Nucl. Phys. A 1060, 123104 (2025).

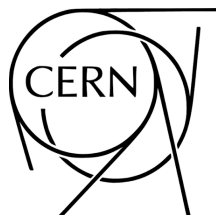
USC PhD Thesis:

- **Feijoo-Fontan, M.**: “Exploring the structure of light neutron-rich nuclei through quasi-free scattering reactions in inverse kinematics with the R3B setup at GSI/FAIR”. Sup: J.L. Rodríguez-Sanchez. Tit: H. Alvarez-Pol. Defended: 27/01/2026. Sobresaliente Cum laude.

Ongoing PhD Thesis:

- **González-Rusell, P.**: “Study of the structure of nucleon-rich isotopes 22, 23, 24O.” Sup: H. Alvarez-Pol; J.L. Rodríguez-Sanchez.

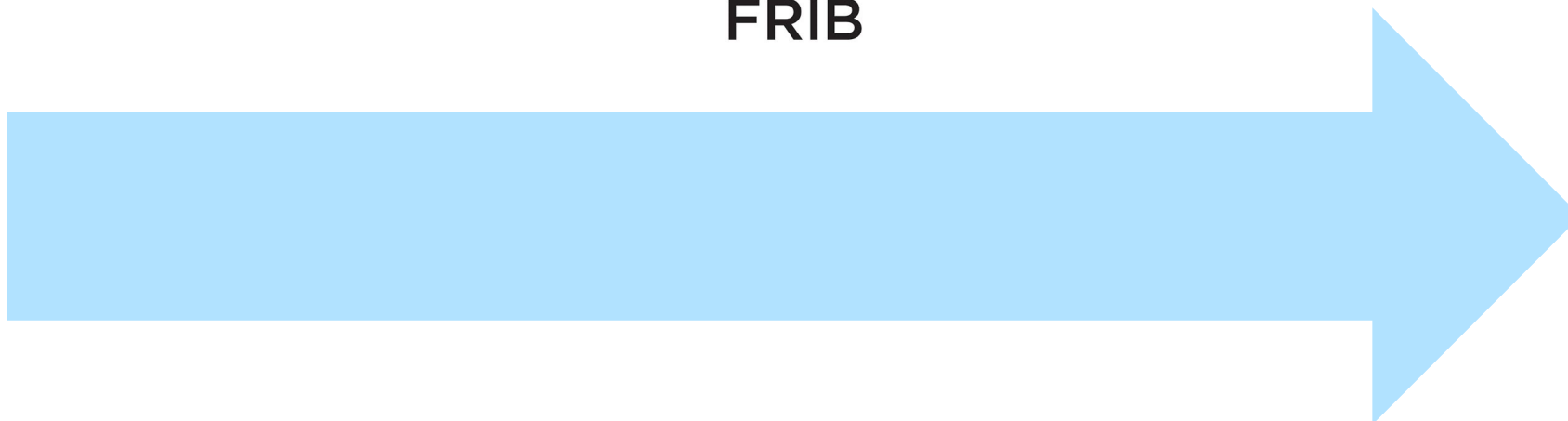




GANIL



Low Energy (5–50 AMeV)

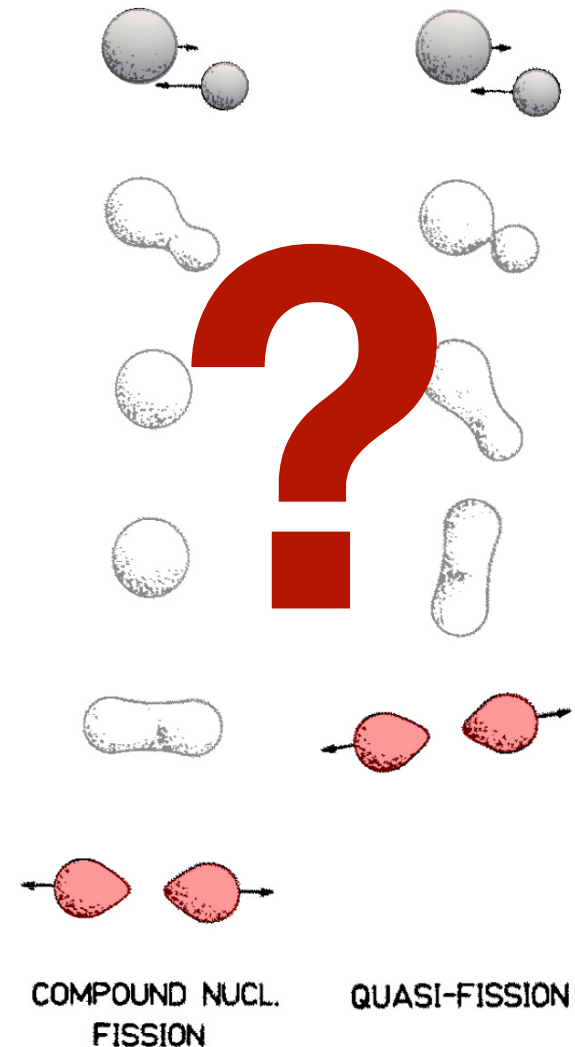


High deformation



Fission and quasifission: between microscopic and macroscopic worlds

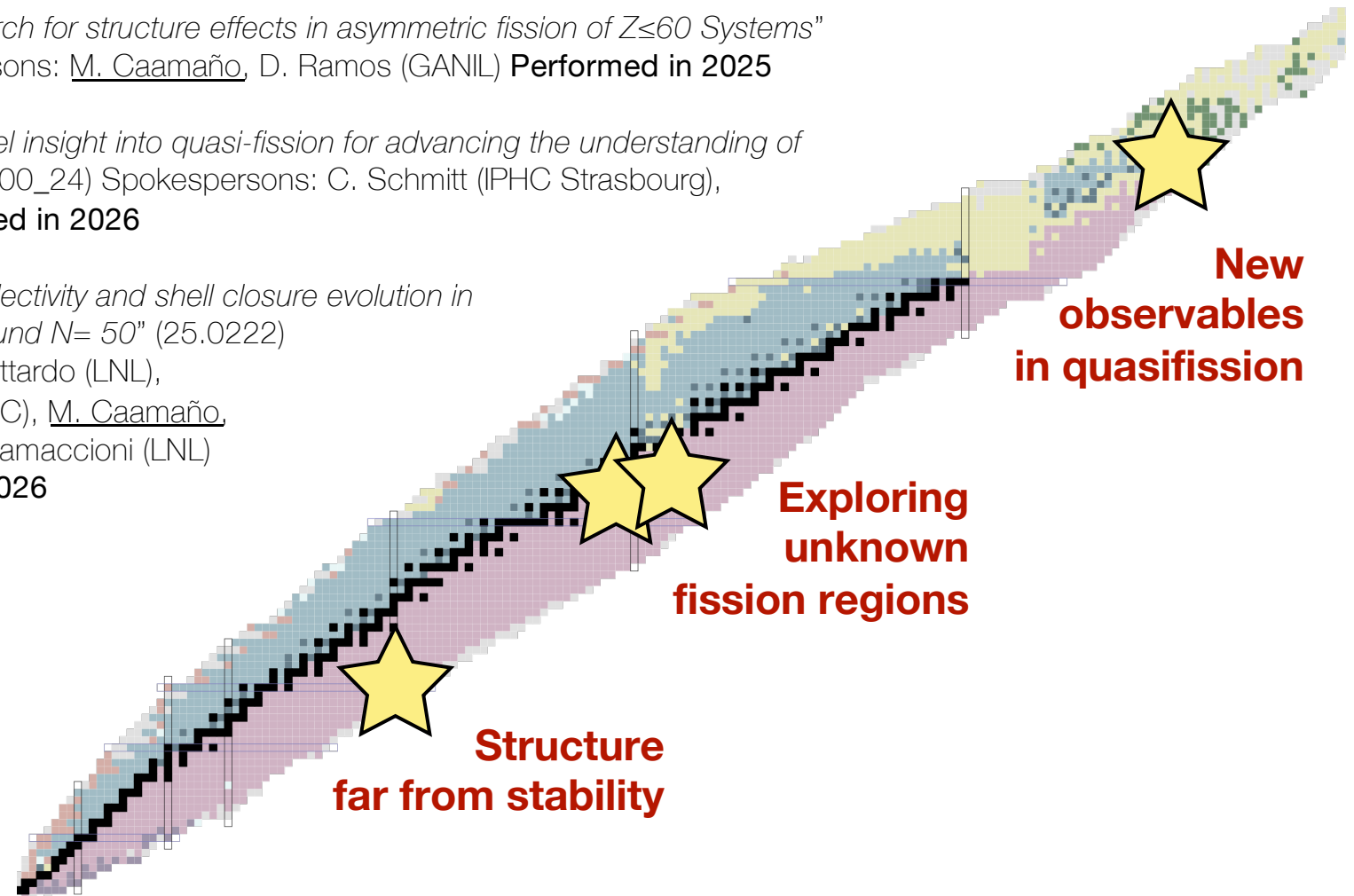
- Fission and quasifission are **unique processes** where the competition between microscopic and macroscopic properties of nuclear matter decide the outcome.
- Despite its widespread use for energy applications, **fundamental properties** of fission **are still to be understood**.
- The major challenge is the large number of particles involved: **it is not enough** to describe it macroscopically, but it is **computationally impossible** to treat all particles and their interactions.
- The main properties are obtained through the **combination of as many observables as possible**.



Some data taking

This past year we run **experiments led by our group**:

- **GANIL (France)**: “Search for structure effects in asymmetric fission of $Z \leq 60$ Systems” (E866_22) Spokespersons: M. Caamaño, D. Ramos (GANIL) **Performed in 2025**
- **GANIL (France)**: “Novel insight into quasi-fission for advancing the understanding of reaction dynamics” (E900_24) Spokespersons: C. Schmitt (IPHC Strasbourg), M. Caamaño **Performed in 2026**
- **LNL-INFN (Italy)**: “Collectivity and shell closure evolution in neutron-rich nuclei around $N = 50$ ” (25.0222) Spokespersons: A. Gottardo (LNL), J.J. Valiente-Dobón (IFIC), M. Caamaño, F. Angelini (GSI), D. Stramaccioni (LNL) **To be performed in 2026**



And data analysis

The bulk of the analysis is being carried out by our students:

- **B. Errandonea:** “Study of the evolution of nuclear structure and fission dynamics with low-energy reactions” FPI (supervisors: M. Caamaño, D. Ramos (GANIL)) PhD USC.
- **N. Sánchez:** “New fission modes in light systems around $Z=60$ ” (supervisors: M. Caamaño, H. Álvarez) PhD USC.
- **F. Angelini:** “Spectroscopic study of nuclei in the region of ^{78}Ni ” (supervisors: J.J. Valiente (IFIC, Valencia), A. Gottardo (LNL-INFN, Padova), M. Caamaño) PhD U. de Padova (Italy) (2025)

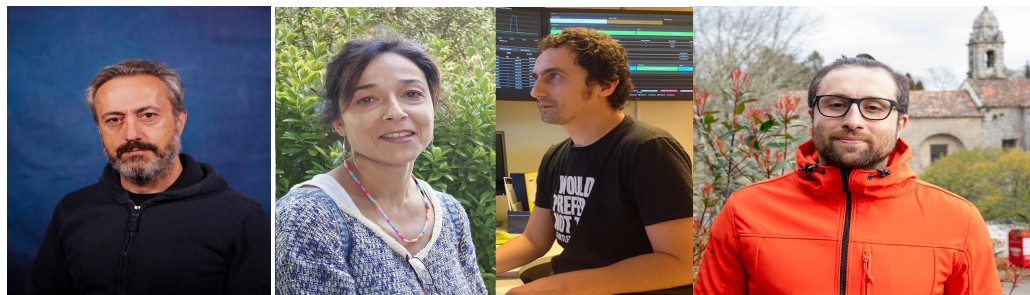
Some publications:

- **D. Ramos, M. Caamaño, et al.:** “Isotopic fission yields of ^{240}Pu as a function of the excitation energy” Phys. Rev. C 113, 054611 (2026).
- **N. Kumar, with M. Caamaño, et al.:** “First experimental isotopic mapping of the fission “ γ -bump” and its connection to the Pygmy dipole resonance” Phys. Lett. B 878 (2026) 140506.
- More in preparation...

And collaborations, long-standing and beginning new ones:

- **n_TOF/CERN:** Neutron-induced reactions at CERN
- **VAMOS/GANIL:** Fission and quasifission study campaign at GANIL/Spiral2
- **QF at ANU:** We are planning experiments at ANU (Australia) with the world-leading group in quasifission.

SA3-The structure of the nuclear many-body systems and its astrophysical and cosmological implications



Staff



Post-doc



Technical
contrat

Ph.D.
Students



Nico

