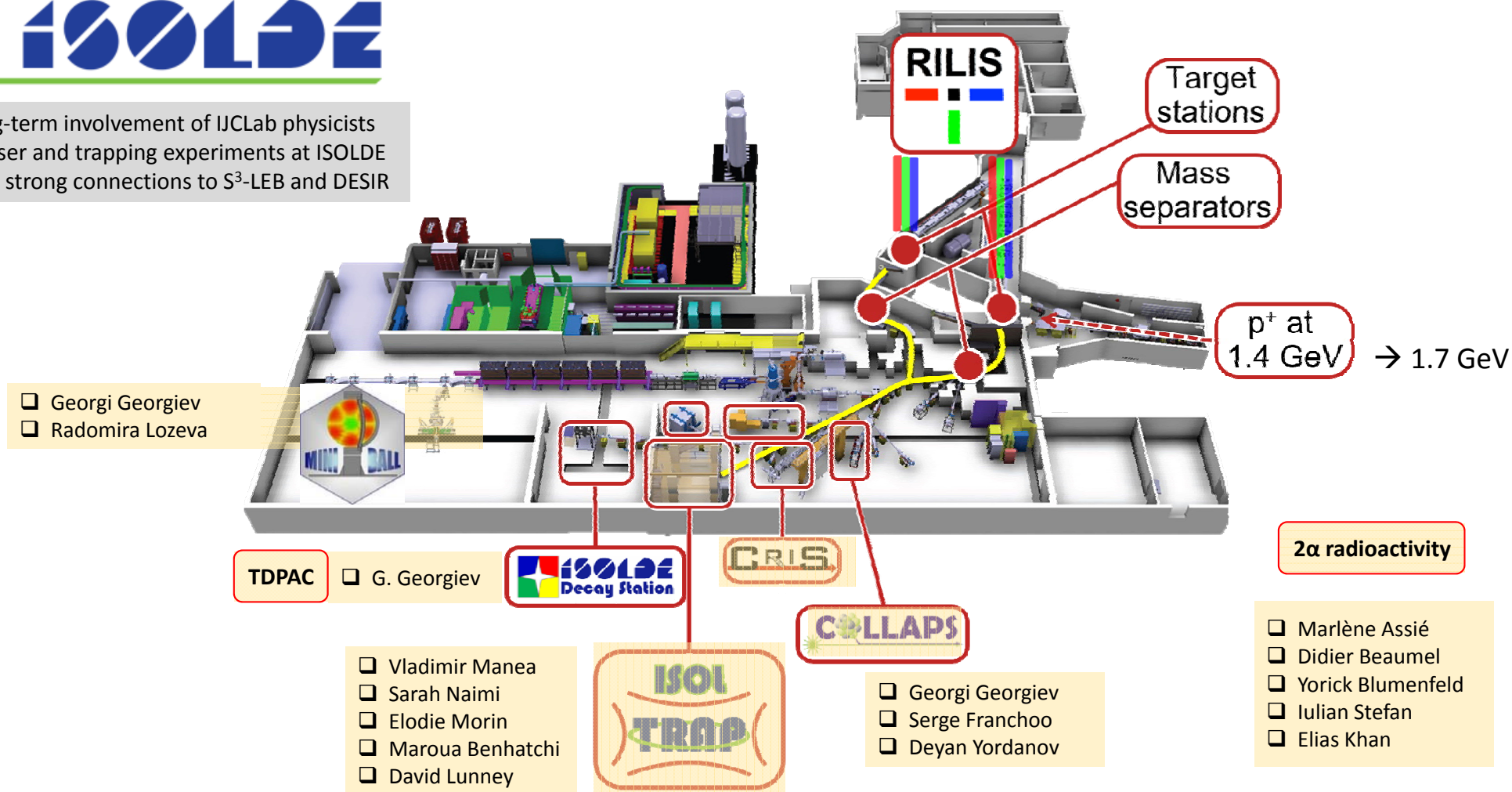


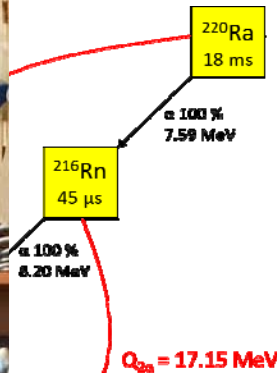
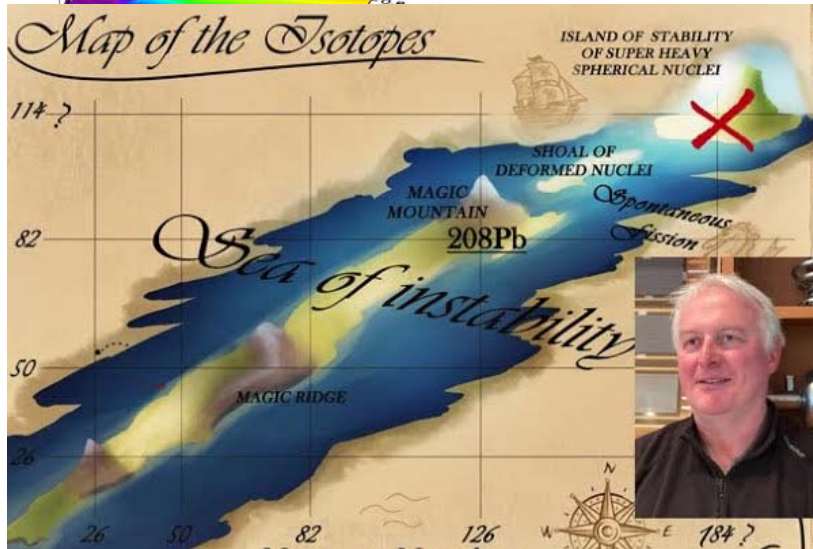
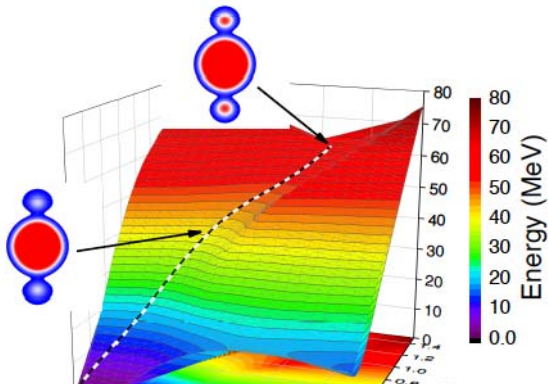


Long-term involvement of IJCLab physicists in laser and trapping experiments at ISOLDE with strong connections to S³-LEB and DESIR

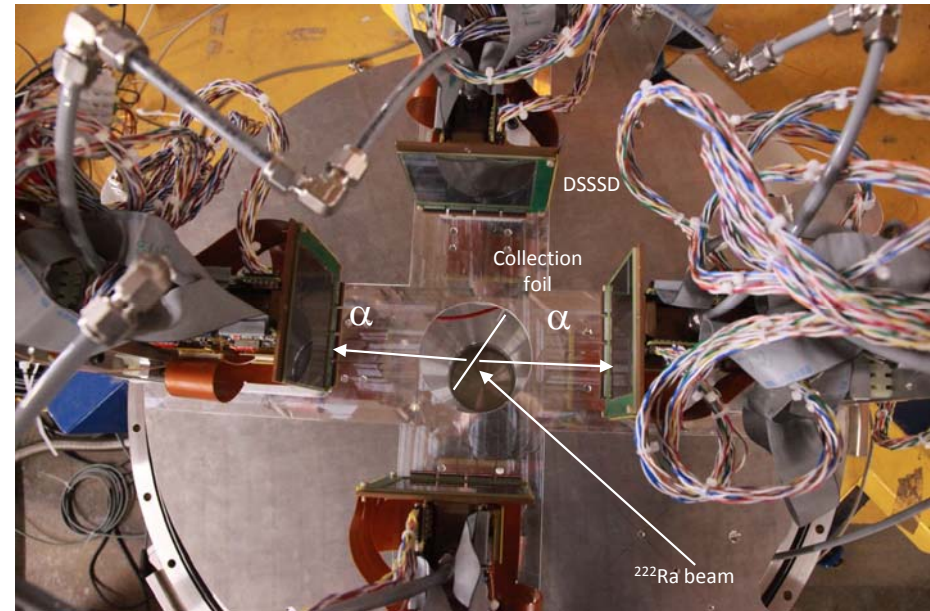


Double alpha experiment (IS-712)

IS712



MUSETT sur LA1 @ ISOLDE



Expérience en cours (fini demain)!

- Prediction of simultaneous 2-alpha radioactivity: F. Mercier, E. Khan et al. *Phys. Rev. Lett.* (2021)
- The two alphas emitted back to back with identical energies (but weak branching ratio...)
- Experimental proposal at CERN-ISOLDE to discover this effect : INTC-P-616; spokespersons E. Khan & Ch. Theisen



Laser spectroscopy – spins, moments, charge radii



Contents lists available at ScienceDirect

Physics Letters B

Phys. Lett. B 847 (2023) 138278

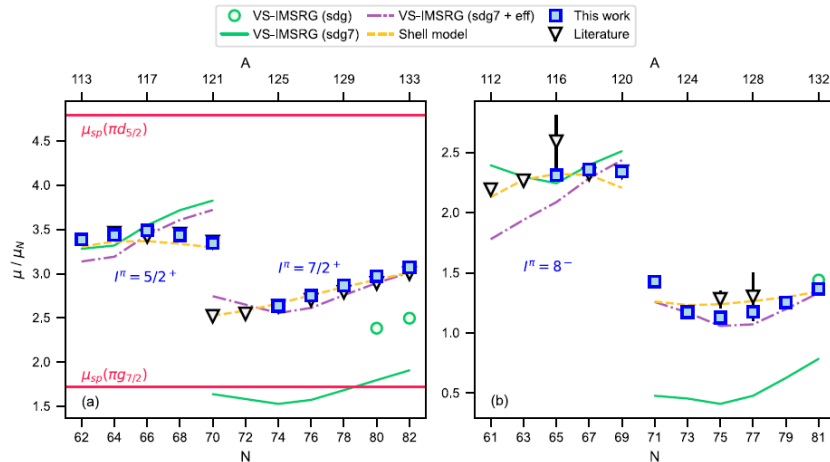
journal homepage: www.elsevier.com/locate/physletb

Letter

Electromagnetic moments of the antimony isotopes $^{112-133}\text{Sb}$

S. Lechner^{a,b,c,d,e,f,g}, T. Miyagi^{c,d,e,f,g}, Z.Y. Xu^{g,h}, M.L. Bissell^{i,j,k,l}, K. Blaum^{e,i}, B. Cheal^j, C.S. Devlin^k, R.F. Garcia Ruiz^{a,m,n,1}, J.S.M. Ginges^k, H. Heylen^{a,e}, J.D. Holt^f, P. Ingram^{c,g}, A. Kanellakopoulos^g, Á. Koszorús^{a,g}, S. Malbrunot-Ennenauer^{a,f,j,k}, R. Neugart^{e,m}, G. Neyens^{a,g}, W. Nörtershäuser^c, P. Plattner^{a,n,e}, L.V. Rodríguez^{e,o}, G. Sanamyan^k, S.R. Stroberg^{p,q,r,3}, Y. Utsuno^{q,r}, X.F. Yang^s, D.T. Yordanov^o

^a Université Paris-Saclay, CNRS-INS2P3, IJCLab, 91405 Orsay, France



12/06/2024

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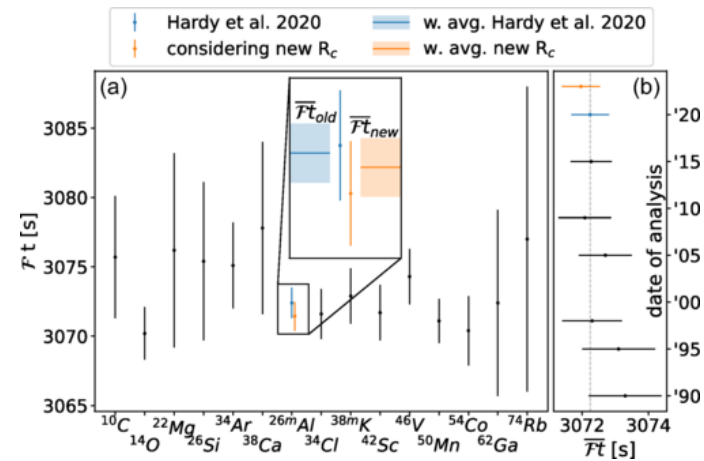
Featured in Physics Editors' Suggestion Open Access

Nuclear Charge Radius of ^{26m}Al and Its Implication for V_{ud} in the Quark Mixing Matrix

P. Plattner et al.

Phys. Rev. Lett. **131**, 222502 – Published 27 November 2023

Physics See Viewpoint: Quark Picture Put to the Test



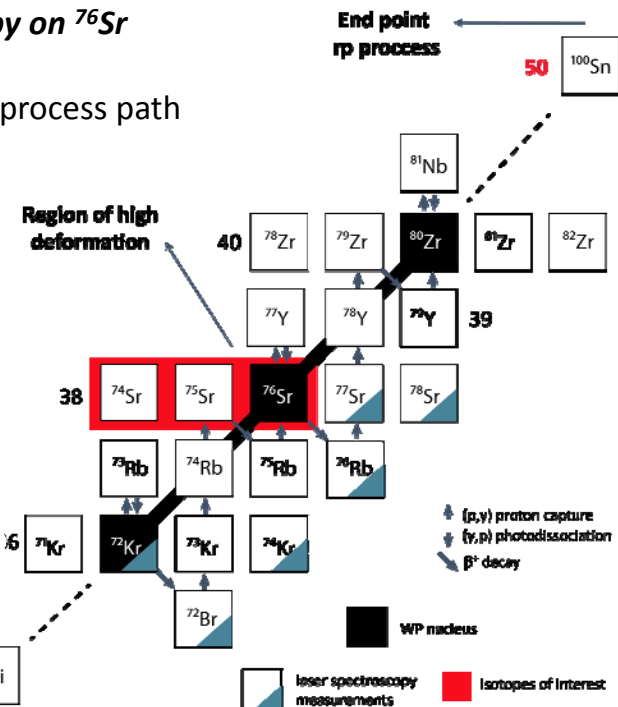
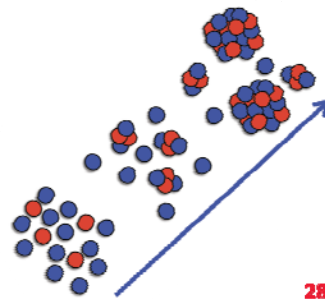
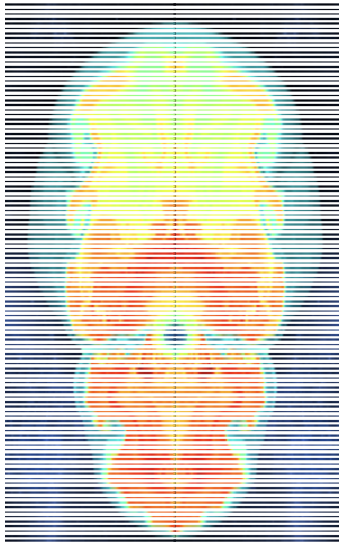
IJCLab AP day – ISOLDE Physics – D. Lunney

"Employing ROC to explore astrophysics milestones: nuclear structure of the $N = Z$ nucleus ^{76}Sr "
INTC – P - 706

Aim: Laser spectroscopy on ^{76}Sr

^{76}Sr – Waiting point for rp -process path

Supernovae simulations: proton-rich ejecta



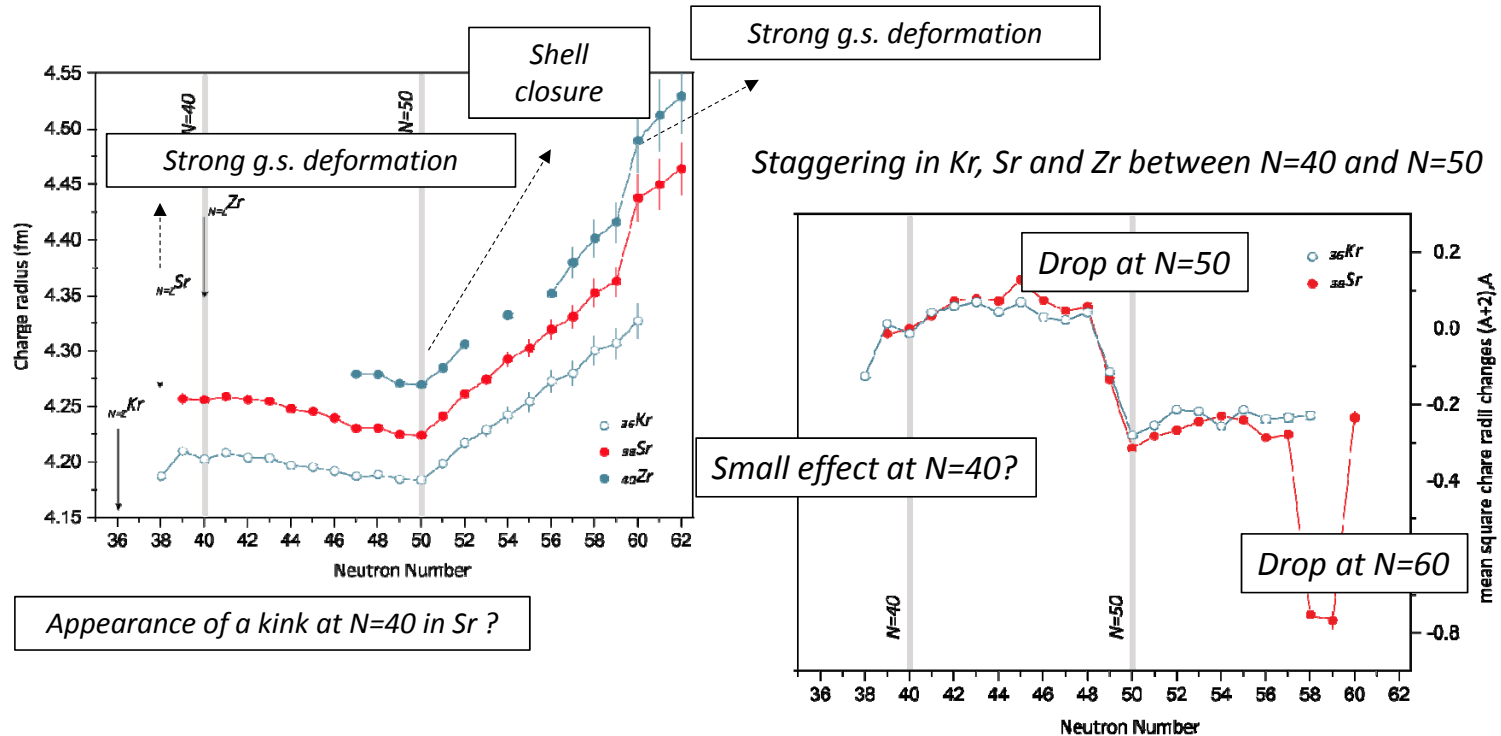
Constraining nuclear physics: abundance observations determine astrophysical conditions, Psaltis et al. ApJ (2024)

"Employing ROC to explore astrophysics milestones: nuclear structure of the $N = Z$ nucleus ^{76}Sr "

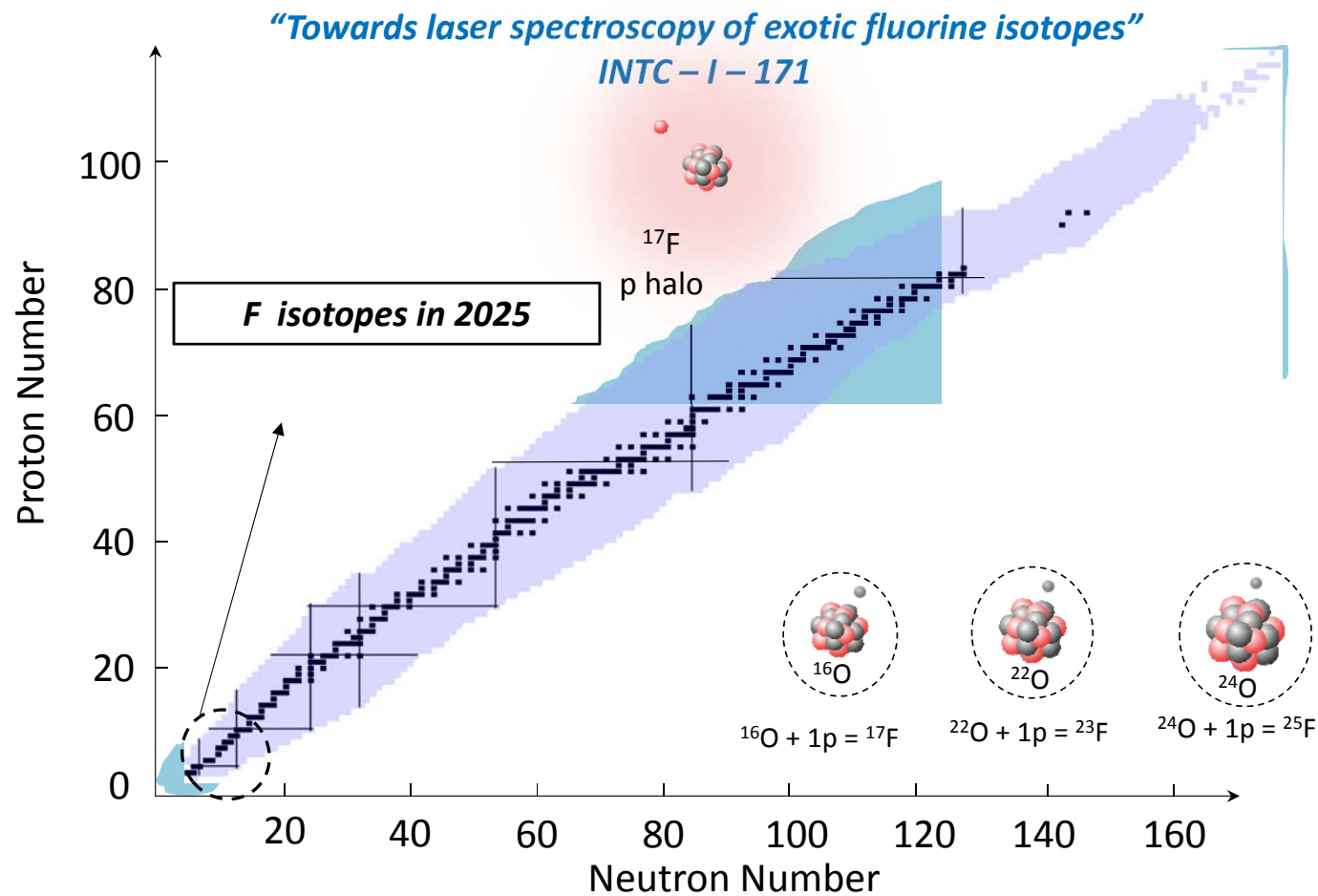
INTC – P - 706

Investigating the $N=40$ neutron subshell closure

Charge radii of Kr, Sr and Zr between $N=40$ and $N=50$



neutron – neutron (nn) and proton – proton (pp) pairing correlations
expected to be magnified in $N = Z$ nuclei



**2025 Request (D. Yordanov):
2 kE missions; 4 kE fonctionnement**

Rotational and Hyperfine Structure of RaF and AcF Molecules: route to higher sensitivity for EDM



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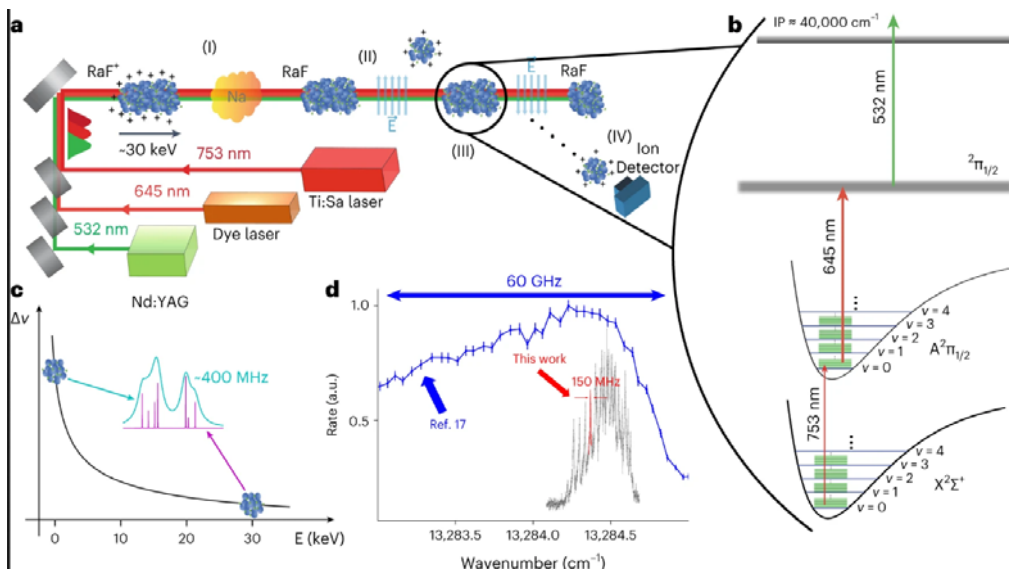
Article | Published: 09 January 2024

Precision spectroscopy and laser-cooling scheme of a radium-containing molecule

[S. M. Udrescu](#) , [S. G. Wilkins](#) , [A. A. Breier](#), [M. Athanasakis-Kaklamanakis](#), [R. F. Garcia Ruiz](#) , [M. Au](#), [I. Belošević](#), [R. Berger](#), [M. L. Bissell](#), [C. L. Binnersley](#), [A. J. Brinson](#), [K. Chrysalidis](#), [T. E. Cocolios](#), [R. P. de Groote](#), [A. Dorne](#), [K. T. Flanagan](#), [S. Franchoo](#), [K. Gaul](#), [S. Geldhof](#), [T. F. Giesen](#), [D. Hanstorp](#), [R. Heinke](#), [Á. Koszorús](#), [S. Kujanpää](#), [L. Lalanne](#), [G. Neyens](#), [M. Nichols](#), [H. A. Perrett](#), [J. R. Reilly](#), [S. Rothe](#), [B. van den Borne](#), [A. R. Vernon](#), [Q. Wang](#), [J. Wessolek](#), [X. F. Yang](#) & [C. Zülch](#)

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[Nature Physics](#) **20**, 202–207 (2024) | [Cite this article](#)



- Observation of the distribution of nuclear magnetization in a molecule - Wilkins, Science, submitted
- Pinning down electron correlations in RaF via spectroscopy of excited states - Athanasakis, Nat Comm, submitted
- Ionization potential and dissociation energy of radium monofluoride - Wilkins, PRL, submitted
- Radiative lifetime of the $A^2\Pi_{1/2}$ state in RaF with relevance to laser cooling - Athanasakis, PRA, accepted

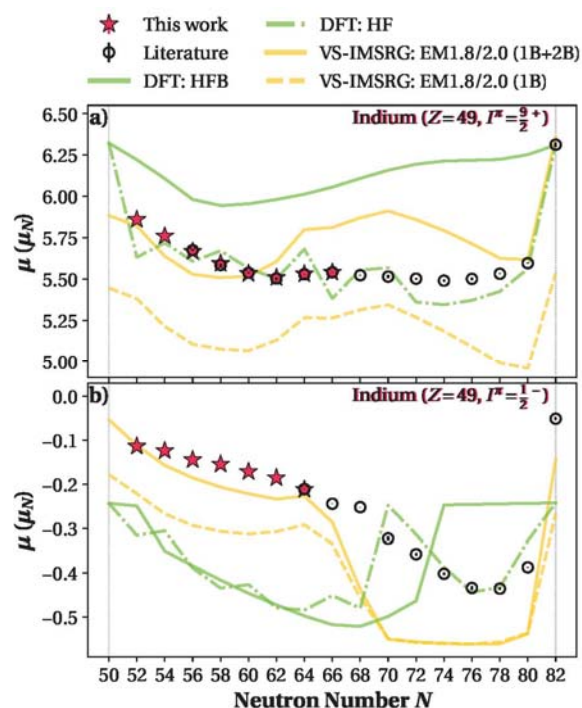
NEXT: winter physics (AcF)

(More) Laser spectroscopy of the indium chain

Electromagnetic Properties of Indium Isotopes Elucidate the Doubly Magic Character of ^{100}Sn

nature
physics

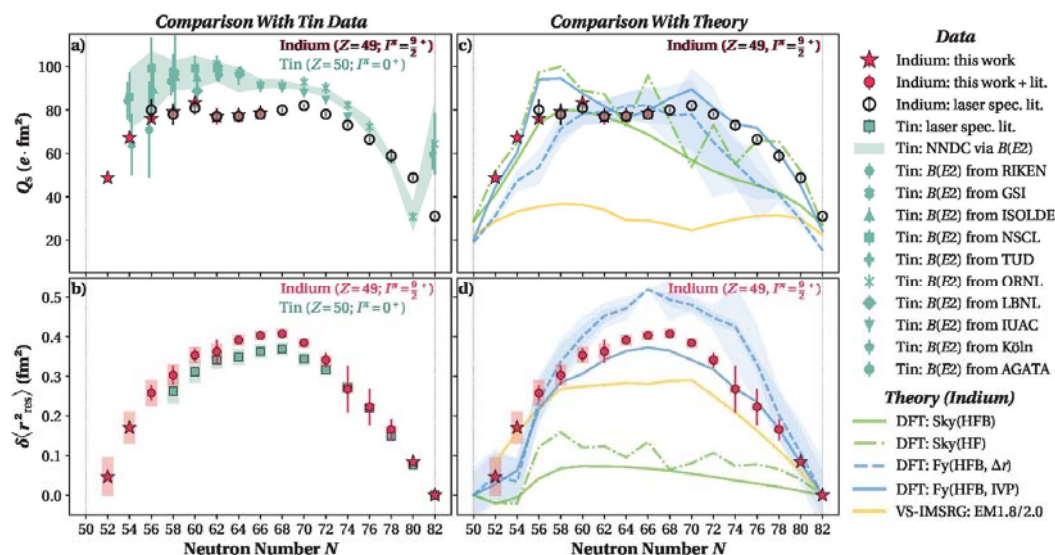
in print
J. Karthein et al.



Nature
(2022) !

Both $\delta\langle r^2 \rangle$ and Q_s indicate:

- dominant quadrupole deformation at mid-shell
- clear reduction of collective properties towards $N=50$
→ doubly magic character of ^{100}Sn



- Both the ab initio and the DFT reproduce well the magnetic moments

Marked jump predicted by the DFT for ^{99}In

Request (S. Franchoo):
2 kE missions; 4 kE fonctionnement

ISOLTRAP Mass spectrometry of the indium chain

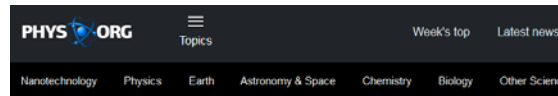
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Isomeric Excitation Energy for $^{99}\text{In}^m$ from Mass Spectrometry Reveals Constant Trend Next to Doubly Magic ^{100}Sn

L. Nies, D. Atanasov, M. Athanasakis-Kaklamanakis, M. Au, K. Blaum, J. Dobaczewski, B. S. Hu, J. D. Holt, J. Kartheim, I. Kulikov, Yu. A. Litvinov, D. Lunney, V. Manea, T. Miyagi, M. Mougeot, L. Schweikhard, A. Schwenk, K. Sieja, and F. Wienholtz
Phys. Rev. Lett. **131**, 022502 – Published 14 July 2023



Home / Physics / General Physics
JULY 20, 2023
Editors' notes

An even closer look at the 'doubly magic' tin-100 nucleus

by CERN

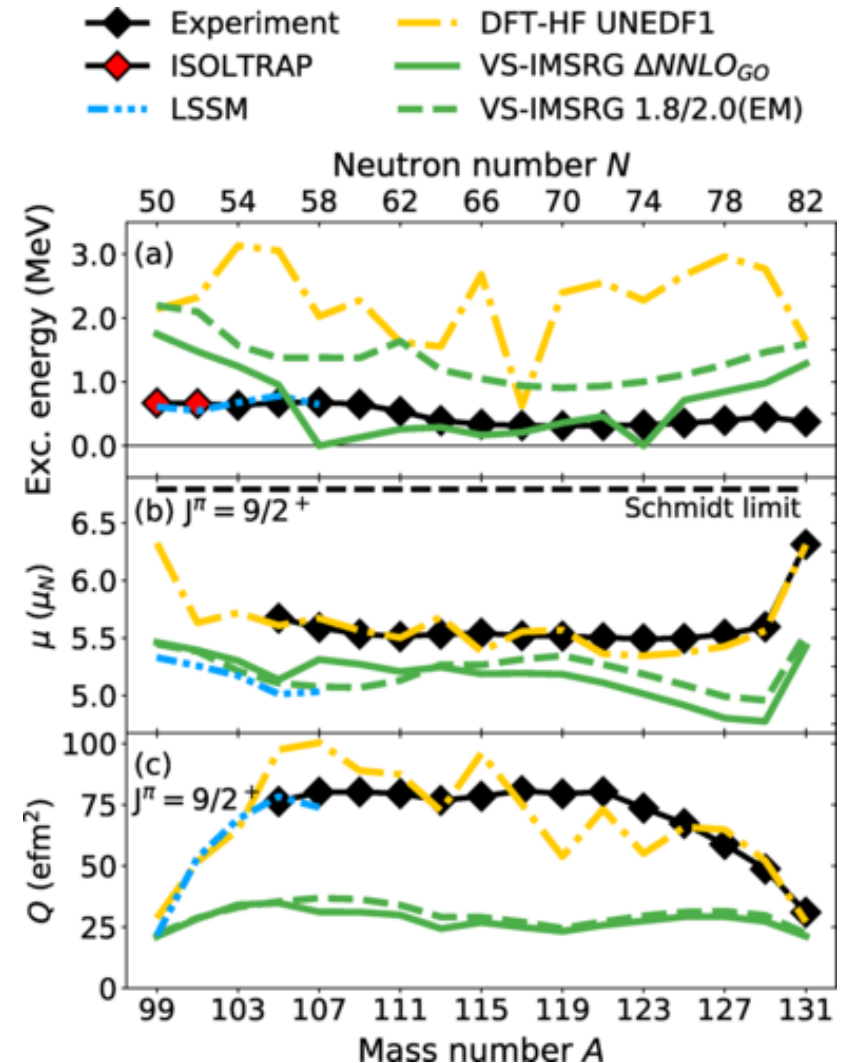


ISOLTRAPers Lukas Nies (right) and Maxime Mougeot (left) setting up the ISOL...

In a new paper published in *Physical Review Letters*, researchers working at CERN's ISOLDE facility describe how an upgrade to the ISOLTRAP experiment has allowed them to

Mass spectrometry of the light indium isotopes (including $N=50$) tests the same theory as well as large-scale shell model calculations (from IPHC/Strasbourg) (magnetic moments from CRIS).

Article also picked up by CERN Courier and other news outlets.





More mass spectrometry on isomers

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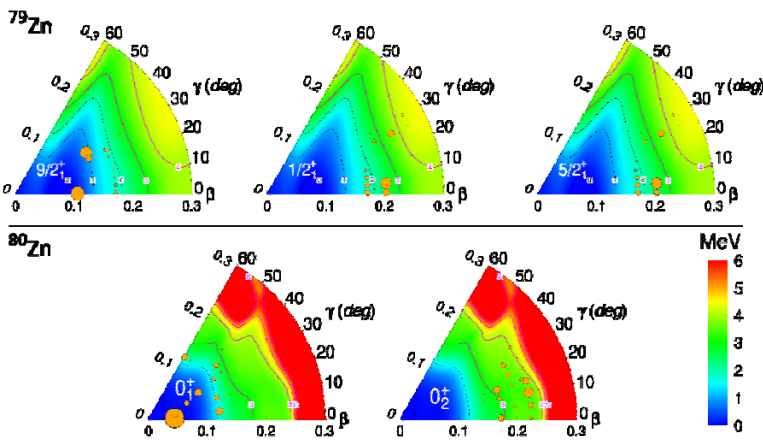
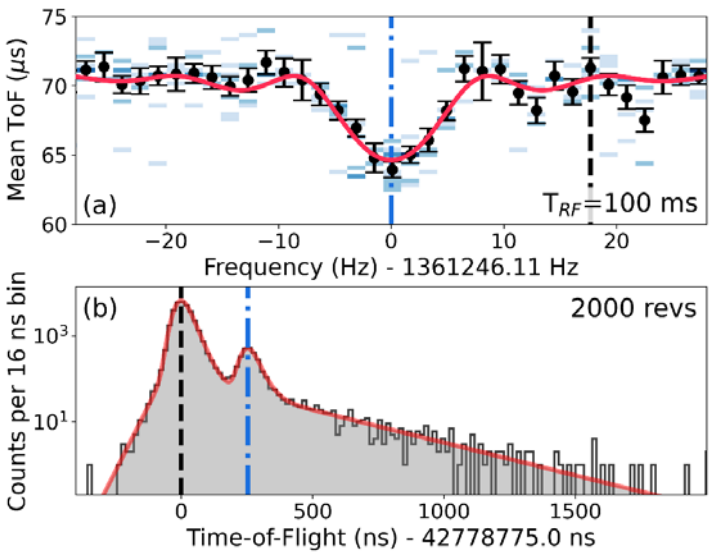
Further Evidence for Shape Coexistence in $^{79}\text{Zn}^m$ near Doubly Magic ^{78}Ni

L. Nies *et al.*
Phys. Rev. Lett. **131**, 222503 – Published 30 November 2023

Collaboration with JYFLTRAP

Improved MR-TOF resolving power

new DNO (Discrete Non-Orthogonal)
large-scale shell model calculations
(from IPHC/Strasbourg)



Laser spectroscopy... with ISOLTRAP!

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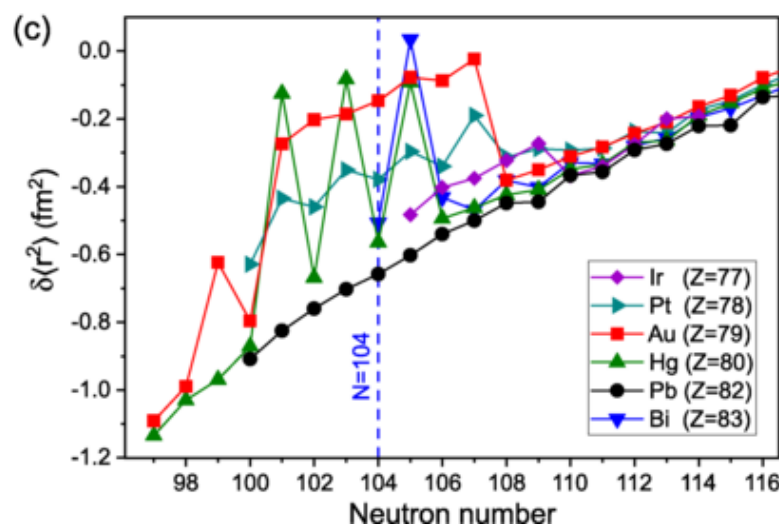
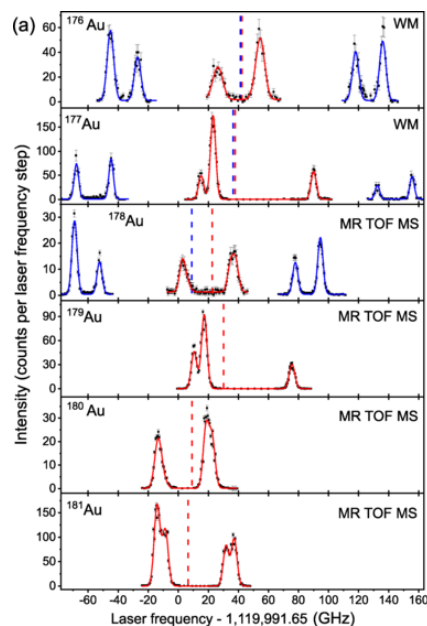
Editors' Suggestion

Open Access

Deformation versus Sphericity in the Ground States of the Lightest Gold Isotopes

J. G. Cubiss *et al.*

Phys. Rev. Lett. **131**, 202501 – Published 14 November 2023



IJCLab AP day

News News Topic: Physics

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ISOLDE observe des transitions de forme dans des noyaux d'or

Une observation qui intervient un peu plus de 50 ans après que le phénomène a été observé pour la première fois à ISOLDE dans des noyaux de mercure

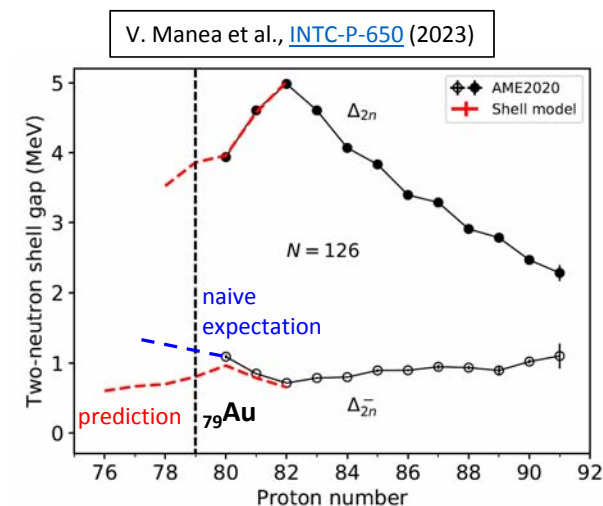
15 NOVEMBRE, 2023

Activité 2023-2024:

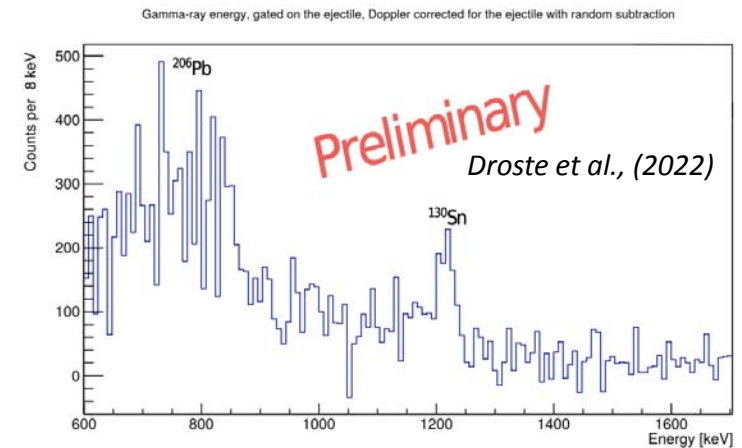
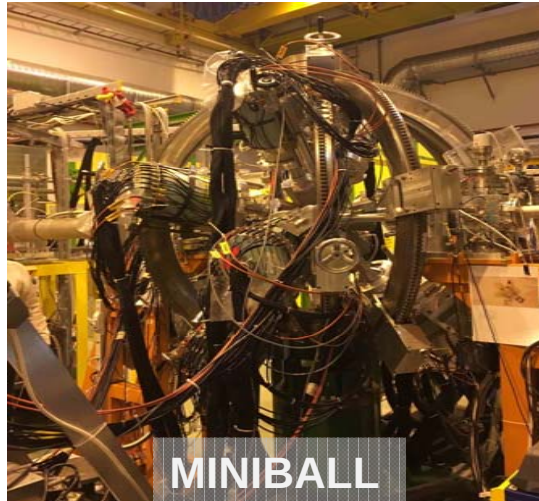
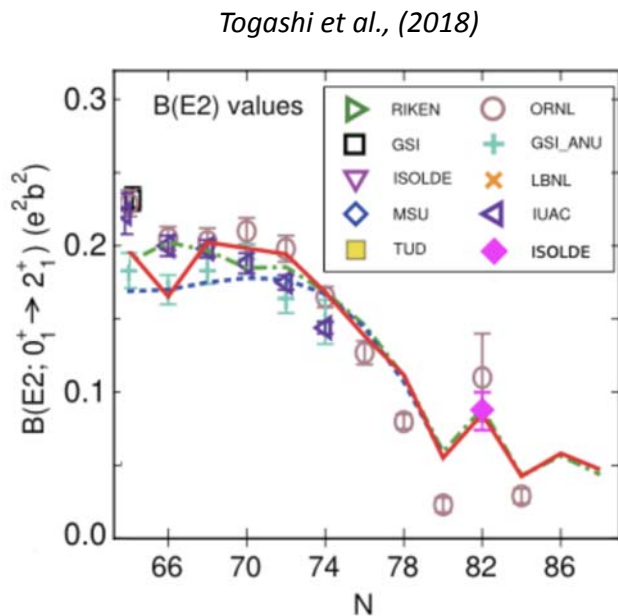
- Nouveaux articles en presse Physical Review Letters:
 - L. Nies et. al., Phys. Rev. Lett. 131, 022502 (2023)
 - J. G. Cubiss et al., Phys. Rev. Lett. 131, 202501 (2023)
 - L. Nies. et al., Phys. Rev. Lett. 131, 222503 (2023)
- Proposition scientifique (porte parole V. Manea) pour étudier la couche $N = 126$ dans la chaîne d'Au (IS726).
 - Première manipe de test en Juin 2024

Demande 2025:

- 2.5 kE de mission pour Vladimir Manea (et nouveau doctorant)
- 2.5 kE pour S. Naimi et M. Benhatchi
- 1.0 kE pour D. Lunney
- 4 kE fonctionnement ISOLTRAP



HIE-ISOLDE: Coulomb excitation around ^{132}Sn with MINIBALL & REX



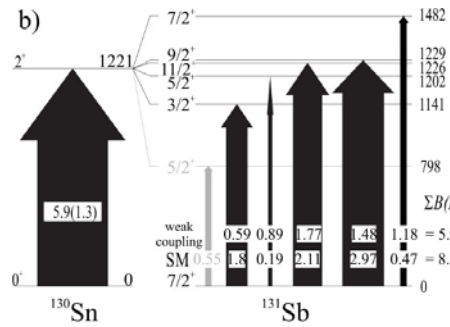
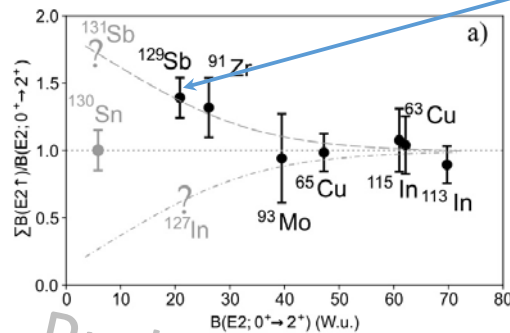
Measure $^{130}\text{Sn} \rightarrow ^{134}\text{Sn}$ « Safe » Coulex and compare with lifetime measurements
 Addendum IS-702: ^{130}Sn experiment (2023, 2024), new experiment ^{134}Sn (2025)

IS-702: Probing the doubly magic ^{132}Sn shell closure by
 Coulomb excitation of neutron-rich $^{130,134}\text{Sn}$
P. Reiter (U. Cologne) T. Kröll (TU Darmstadt)

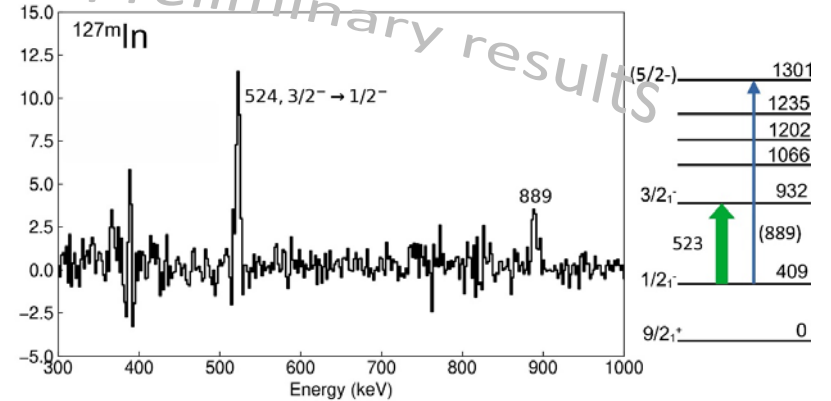
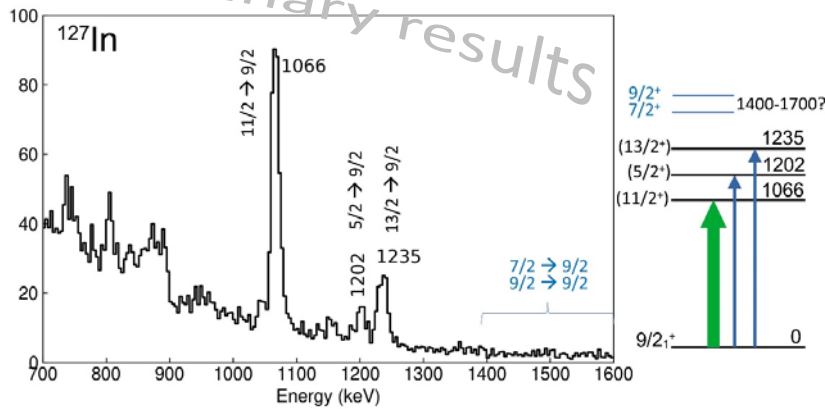
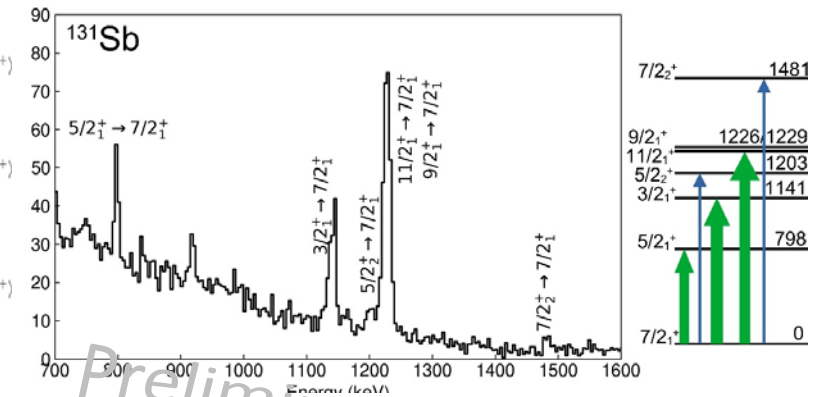
Request 2025: R. Lozeva (+V. Piau)
1-2 travels + 1-2 week mission = 2.5 k€

HIE-ISOLDE: Coulomb excitation studies of n-rich odd-mass **Sb** and **In** (including isomeric states)

Breakdown of particle-core sum rule observed in ^{129}Sb for $B(E2) < 40$ W.u. [Gray et al., PRL124, 032502 (2021)]
 E2 sum as a tool & a measure of **developing collectivity**



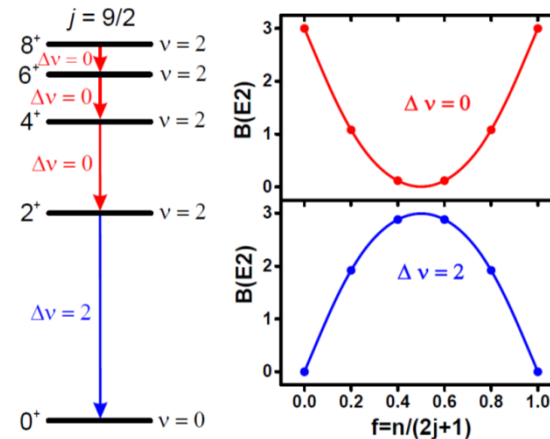
$$B(E2; 0^+ \rightarrow 2^+)_{core} = \sum_i B(E2; I_{gs} \rightarrow I_i)_i$$



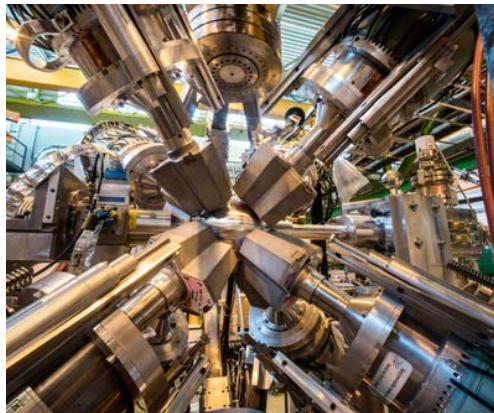
- Experiment, using post-accelerated isomeric beams (^{127m}In) performed at HIE-ISOLDE in October 2023
- Coulex of ^{133}Sb – still to be scheduled (in 2024 or 2025)

Nuclear structure near doubly magic ^{208}Pb – how well do we understand it within the Shell Model?

- Seniority-like pattern in the semi-magic nuclei adjacent to ^{208}Pb (e.g. ^{210}Pb , ^{210}Po , ^{212}Rn , ^{214}Ra etc.)
- g factors of the higher spin (8^+ , 6^+) states are quasi-identical $\rightarrow$ support this representation
- discrepancies between theory and experiment for the low-lying (2^+ , 4^+) states in ^{210}Po and ^{210}Pb
- breaking of the seniority scheme when moving away from ^{208}Pb – ^{210}Rn , ^{212}Rn , ^{212}Ra , ^{214}Ra ???
- can ^{212}Po be regarded as an alpha particle on top of the ^{208}Pb ? (alpha clustering in the heavy nuclei)



α Fr210 3.18 m 6+	α Fr211 3.10 m 9/2-	α Fr212 20.0 m 5+	α Fr213 34.6 s 9/2-	Fr214 5.0 ms (1-)	α Fr215 86 ns 9/2-	Fr216 0.70 μ s (1-)
EC	EC	EC	EC	α	α	EC
α Rn209 28.5 m 5/2-	α Rn210 2.4 h 0+	α Rn211 14.6 h 1/2-	α Rn212 23.9 m 0+	Rn213 25.0 ms (9/2+)	Rn214 0.27 μ s 0+	α Rn215 2.30 μ s 9/2+
EC	EC	EC	α	α	α	α
α At208 1.83 h 6+	α At209 5.41 h 9/2-	α At210 8.1 h (5)+	At211 7.214 h 9/2-	At212 0.314 s (1-)	At213 125 ns 9/2-	At214 558 ns 1-
EC	EC	EC	EC	EC	α	α
α Po207 5.80 h 5/2-	α Po208 2.898 y 0+	α Po209 102 y 1/2-	α Po210 138.376 d 0+	α Po211 0.516 s 9/2+	Po212 0.299 μ s 0+	Po213 4.2 μ s 9/2+
EC	EC	EC	EC	EC	α	α
α Bi206 6.243 d 6(+)	α Bi207 31.55 y 9/2-	α Bi208 3.68E+5 y (5)+	Bi209 100 9/2-	Bi210 5.013 d 1-	Bi211 2.14 m 9/2-	Bi212 60.55 m 1(-)
EC	EC	EC	100	β_{α}	β_{α}	α, β_{α}
Pb205 1.53E+7 y 5/2-	Pb206 0+ 5/2-	Pb207 1/2- 0+	Pb208 0+ 9/2+	Pb209 3.253 h 9/2+	Pb210 22.3 y 0+	Pb211 36.1 m 9/2+
EC	EC	EC	EC	EC	β_{α}	β_{α}



Coulomb excitation with Miniball @ HIE-ISOLDE:

- IS-720: Transition probabilities of low-lying states in ^{210}Po and ^{210}Pb
- IS-748: Seniority-2 configurations in N = 126 & 124 isotones

Nuclear moment studies @ IDS with TDPAC

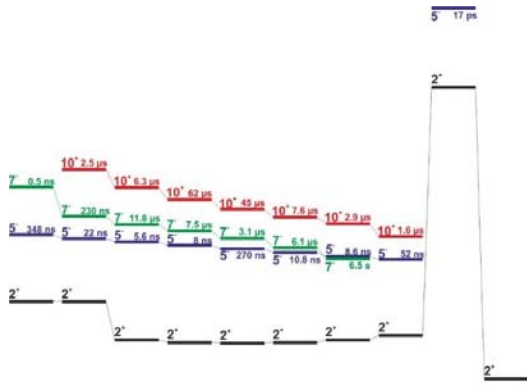
- I-239 - Seniority versus alpha-clustering in the Po isotopes.



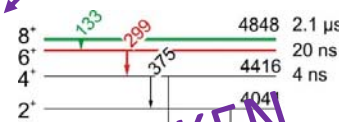
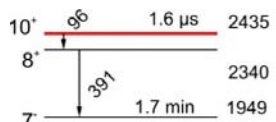
G. Georgiev, co-spokesperson

IS-673: Nuclear structure near doubly magic ^{132}Sn – transition probabilities and nuclear moments

Sb116 1 h 5.2 s	Sb117 2.40 h 5.2 s	Sb118 5.1 h 5.2 s	Sb119 38.19 h 5.2 s	Sb120 5.1 d 5.2 s	Sb121 5.2 s 5.2 s	Sb122 2.70 d 5.2 s	Sb123 7.2 s 5.2 s	Sb124 68.29 d 5.2 s	Sb125 2.79 d 5.2 s	Sb126 12.40 d 5.2 s	Sb127 3.85 d 5.2 s	Sb128 9.01 h 5.2 s	Sb129 4.40 h 5.2 s	Sb130 39.5 m 5.2 s	Sb131 25.01 m 5.2 s	Sb132 2.79 m 5.2 s	Sb133 2.5 m 5.2 s	Sb134 0.80 s 5.2 s	Sb135 1.71 s 5.2 s
EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC
Sn115 17 s 5.2 s	Sn116 14.5 s 5.2 s	Sn117 7.6 s 5.2 s	Sn118 24.2 s 5.2 s	Sn119 8.9 s 5.2 s	Sn120 32.9 s 5.2 s	Sn121 27.0 s 5.2 s	Sn122 3.2 s 5.2 s	Sn123 11.2 s 5.2 s	Sn124 5.79 s 5.2 s	Sn125 9.66 s 5.2 s	Sn126 31.1 s 5.2 s	Sn127 2.10 s 5.2 s	Sn128 38.27 s 5.2 s	Sn129 223 m 5.2 s	Sn130 132 m 5.2 s	Sn131 56.0 s 5.2 s	Sn132 16.1 s 5.2 s	Sn133 1.64 s 5.2 s	Sn134 1.64 s 5.2 s
EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC
In114 71.9 s 5.2 s	In115 4.11 s 5.2 s	In116 14.10 s 5.2 s	In117 43.2 m 5.2 s	In118 8.1 s 5.2 s	In119 2.4 m 5.2 s	In120 47.3 s 5.2 s	In121 23.1 s 5.2 s	In122 11 s 5.2 s	In123 5.96 s 5.2 s	In124 3.7 s 5.2 s	In125 2.36 s 5.2 s	In126 1.60 s 5.2 s	In127 1.09 s 5.2 s	In128 0.72 s 5.2 s	In129 0.61 s 5.2 s	In130 0.54 s 5.2 s	In131 0.282 s 5.2 s	In132 0.201 s 5.2 s	In133 180 ns 5.2 s
EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC	EC



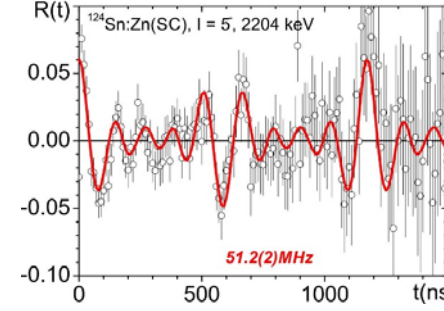
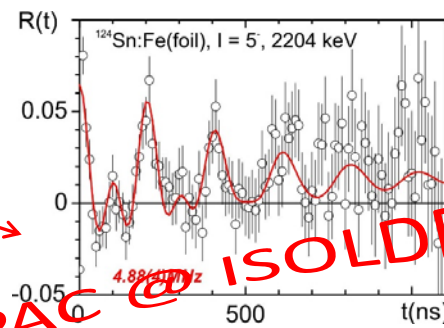
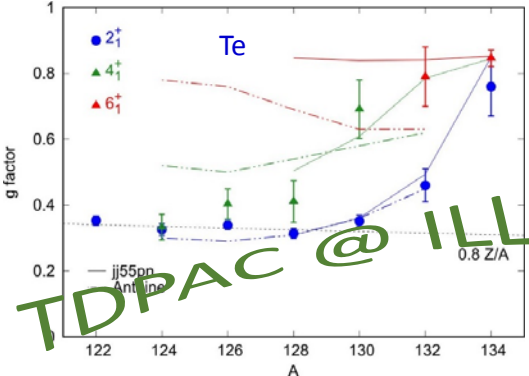
^{116}Sn ^{118}Sn ^{120}Sn ^{122}Sn ^{124}Sn ^{126}Sn ^{128}Sn ^{130}Sn ^{132}Sn ^{134}Sn



Single-particle properties vs. development of deformation

- nuclear moments of short-lived isomeric states (up to ^{132}Sn itself) – measurements *performed* (@ ISOLDE) and *planned* (@ RIKEN and @ ILL)

^{130}Te (6^+), ^{132}Te (6^+), ^{134}Te (4^+)

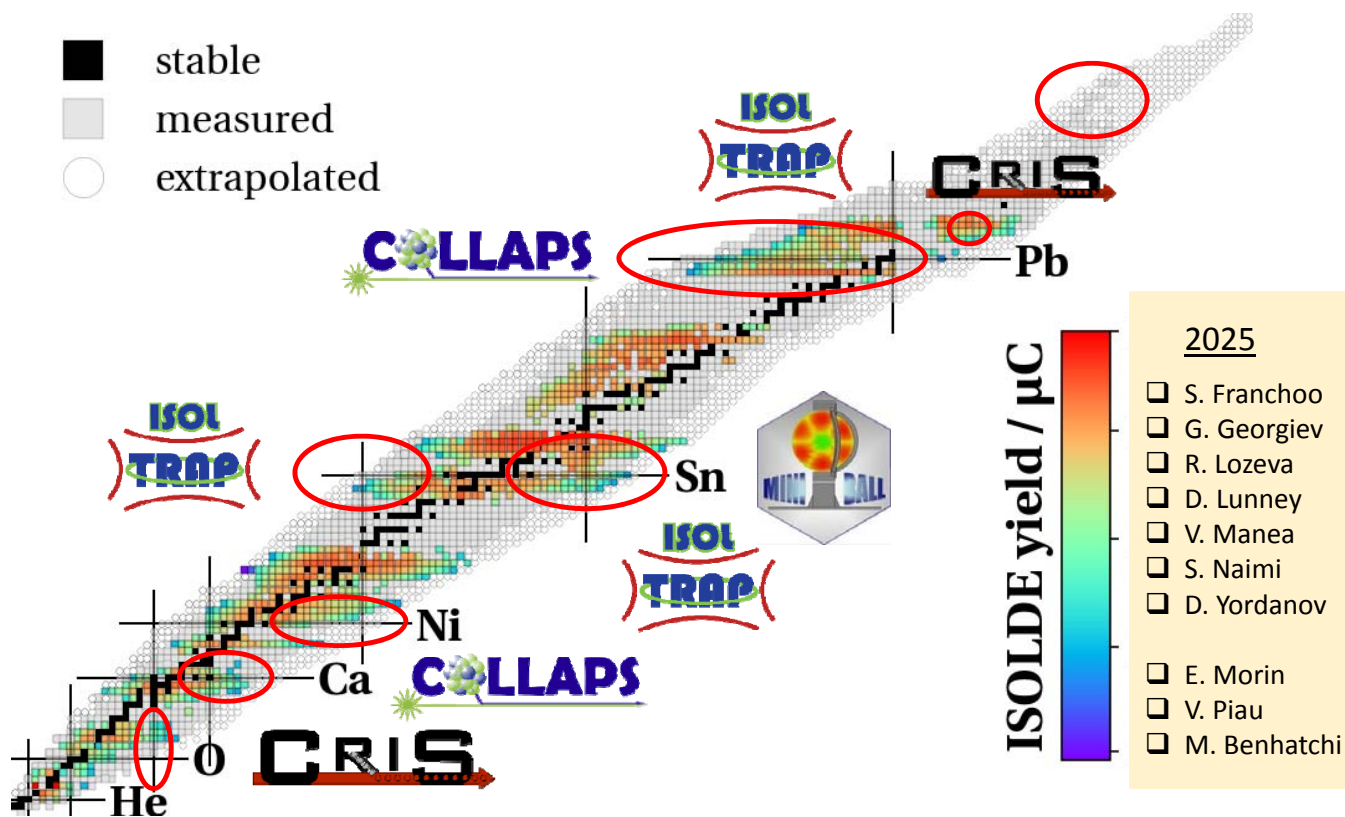


TDPAD & TDPAC @ RIKEN

TDPAC @ ILL

TDPAC @ ISOLDE

Request 2025: G. Georgiev (plus post-doc?)
Missions: 10 k€
Equipement: 4.5 k€



Demande 2023

Missions (27 weeks):	25 k€
Fonctionnement:	8.5 k€
Equipement (TDPAC):	25 k€
TOTAL	58.5 k€ (rcvd 35 k€)

Demande 2024

Missions (26 weeks):	32.5 k€
Equipement (TDPAC):	5 k€
TOTAL	37.5 k€ (rcvd 25 € k)

Demande 2025

Missions (28 weeks):	22.5 k€
Equipement (TDPAC)	4.5 k€
Fonctionnement	12.0 k€
TOTAL	39.5 k€