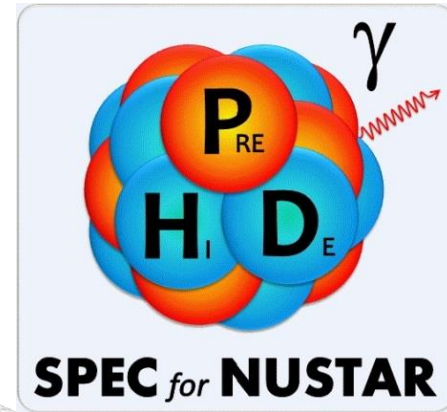
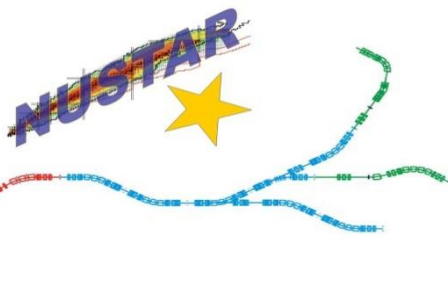


The DESPEC physics case for FAIR-0



Experiments at the FRS

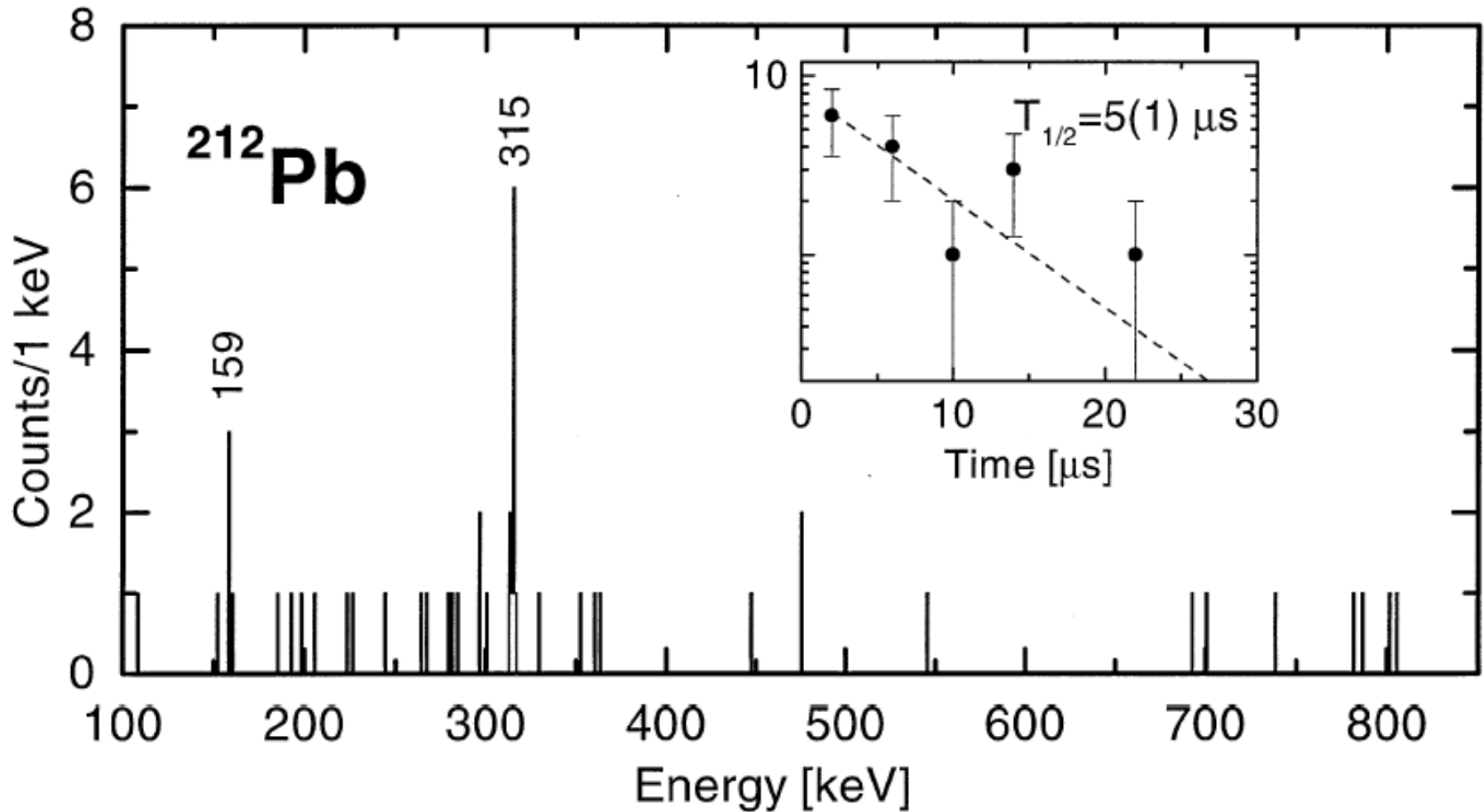


Zsolt Podolyák



DESPEC: very sensitive!

370 implanted ^{212}Pb ions!



decay of the $vg_{9/2}^2 8^+$ isomer

γ -ray spectroscopy at GSI (and FRS)

(large arrays)



PreSPEC phase



2004

2006

2008

2010

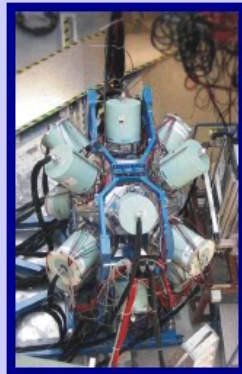
2012

μ ~2015

**RISING
Fast Beam**



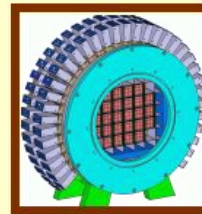
g-RISING



**RISING
Stopped**

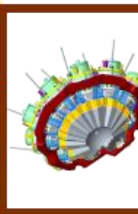
passive

active



LYCCA-0
plunger

...



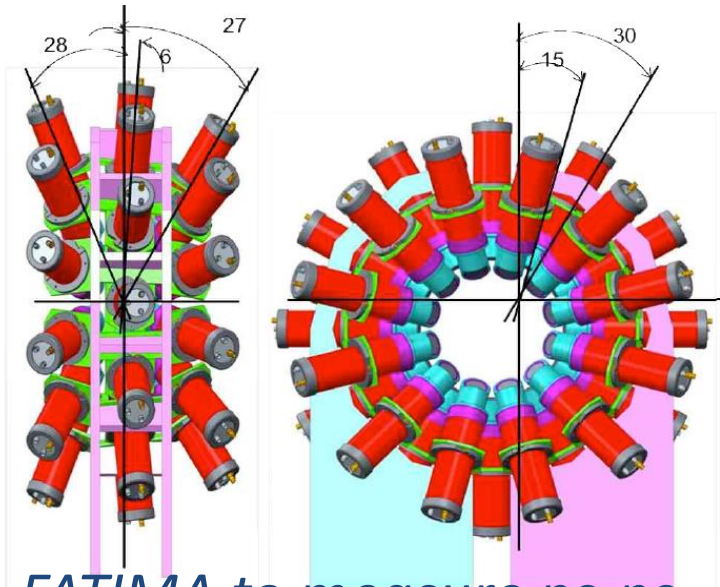
AGATA-D

Fast Beam

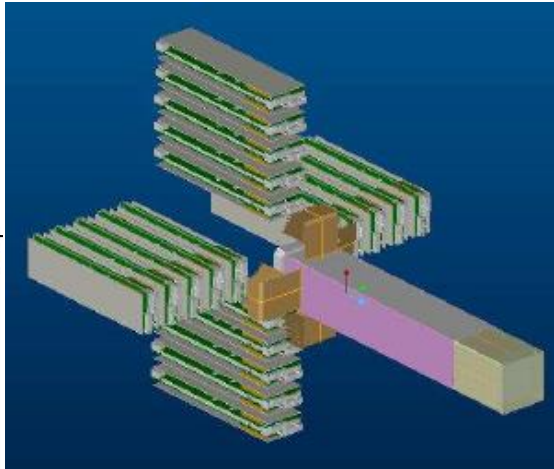
HISPEC/DESPEC

commissioning of new HISPEC/DESPEC
equipment via inclusion in experiments

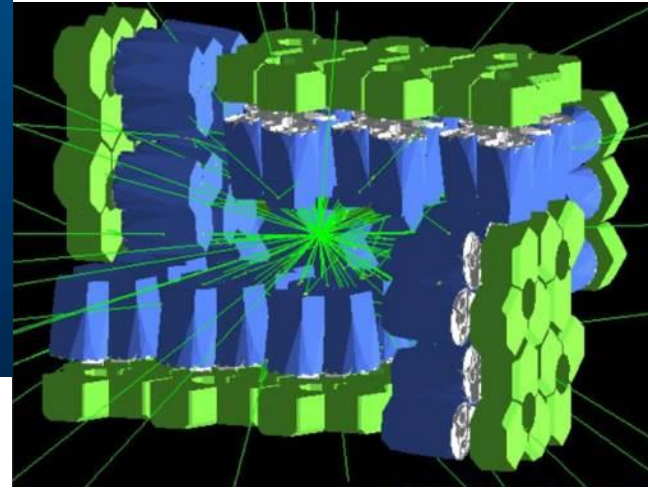
Developed equipment



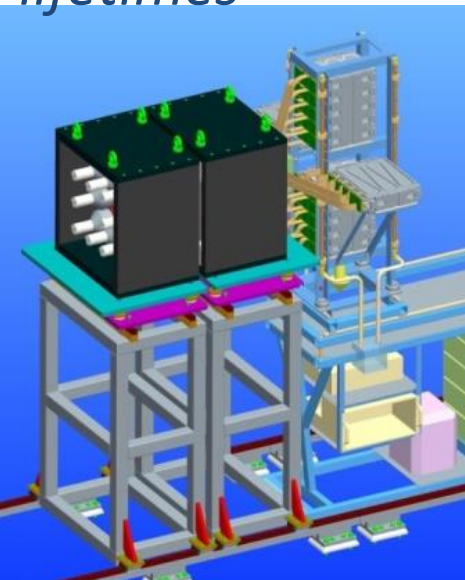
FATIMA to measure ps-ns lifetimes



AIDA implantation and decay detector

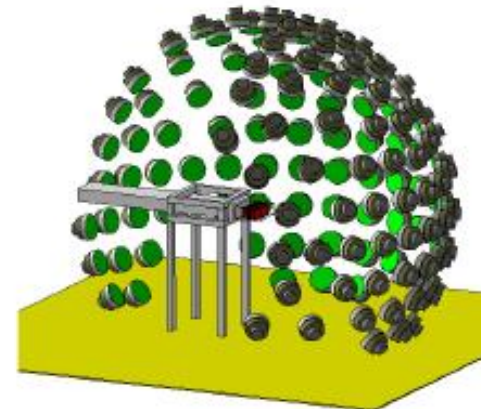


DEGAS for high-resolution spectroscopy



DTAS for β -strength distributions

MONSTER for neutron spectroscopy



DESPEC (phase 0)

Physics workshop held in September 2016

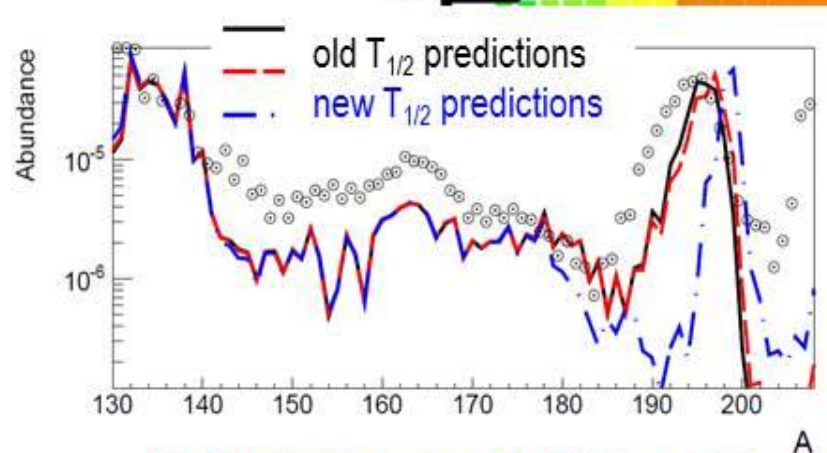
Focus on heavy neutron-rich nuclei

^{208}Pb and ^{238}U beams

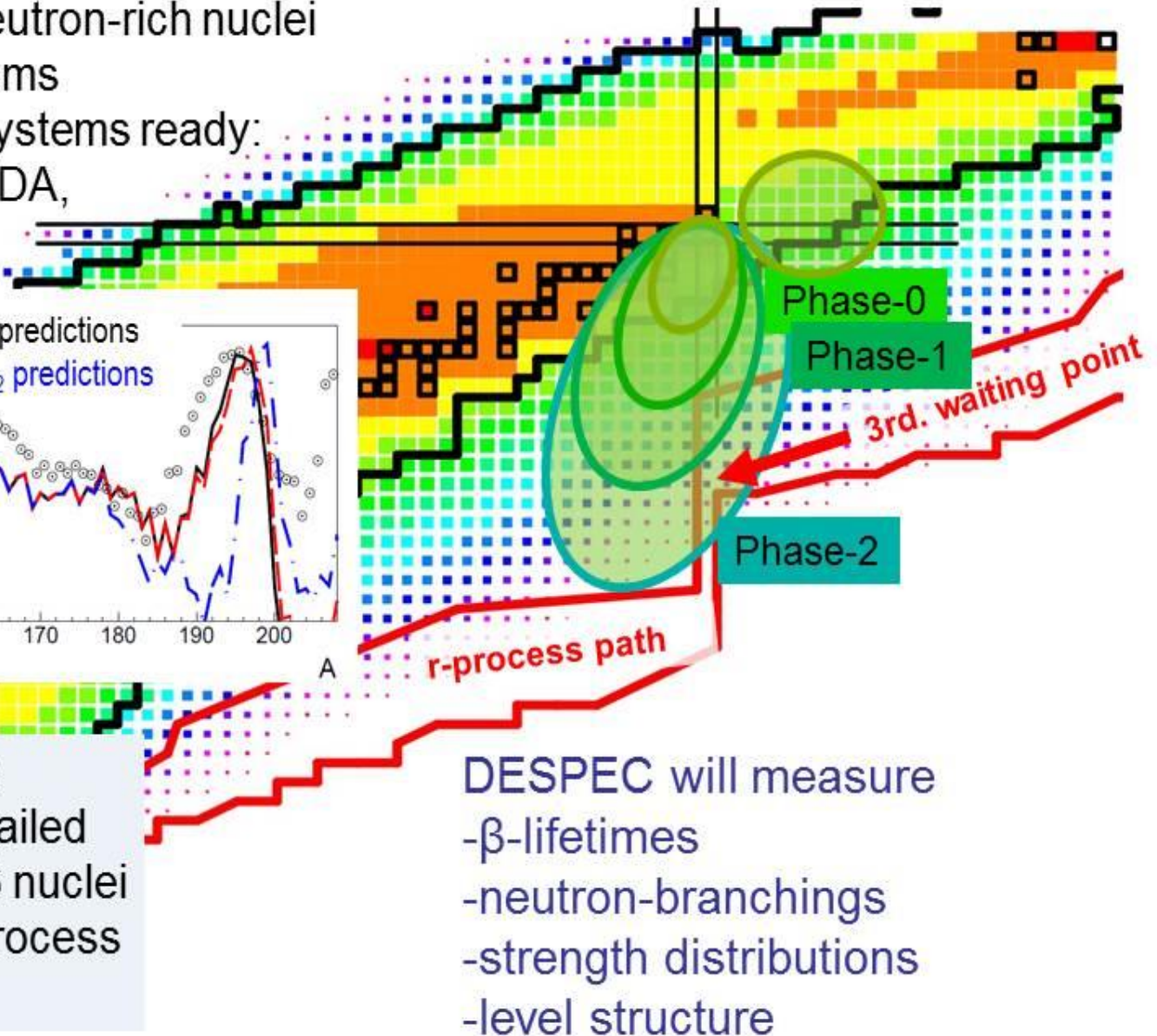
Several detector systems ready:

DTAS, FATIMA, AIDA,

DEGAS, BELEN



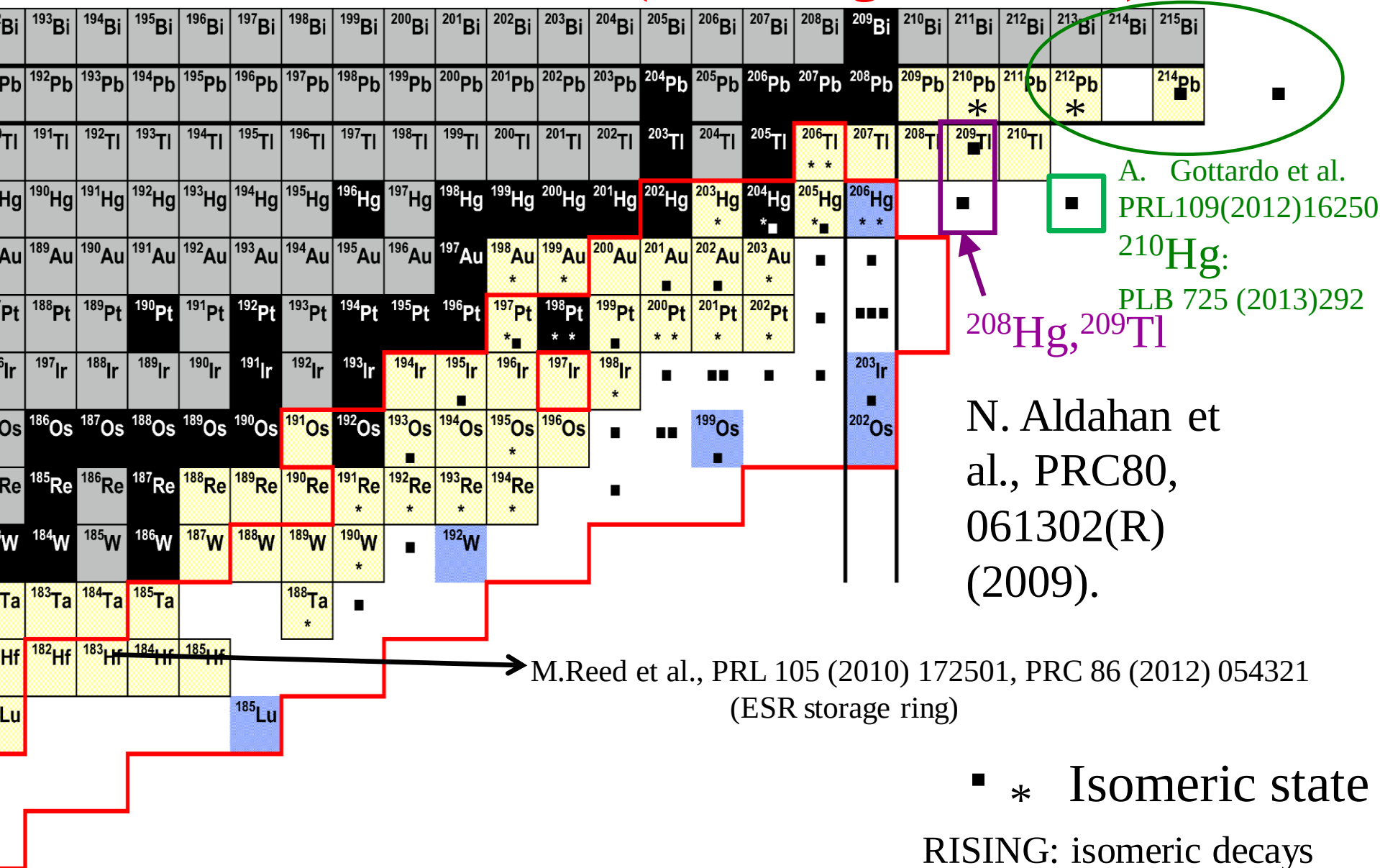
Mass abundances depend on the detailed structure of N=126 nuclei around the 3rd r-process waiting point



DESPEC will measure

- β -lifetimes
- neutron-branchings
- strength distributions
- level structure

Isomeric states (from fragmentation)

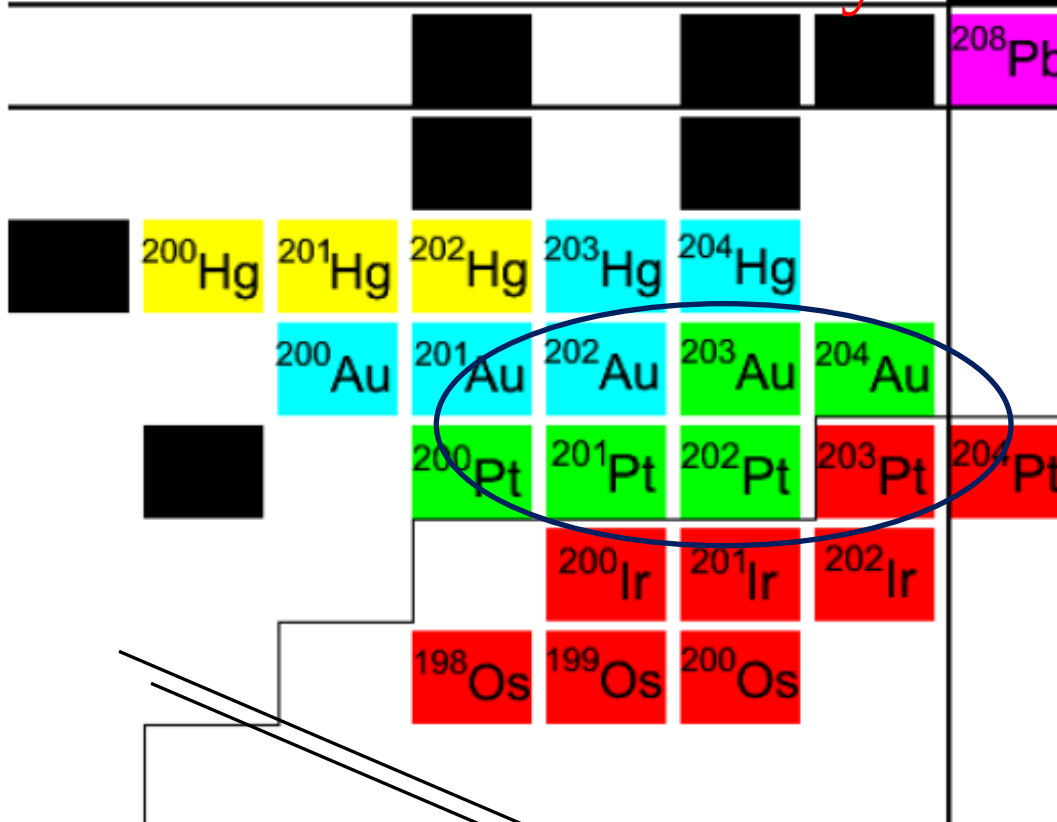


S. Steer et al., Phys. Rev. C 84 (2011) 044313

Beta decay

$T_{1/2}$: G.Benzoni et al.,
PLB 715 (2012) 293

A.I. Morales et al.,
PRC 89 (2014) 014324



A.I. Morales et al.,
PRC 88 (2013) 014319

126

194Os

194Re

N. Al-Dahan et al., PRC85 (2012) 034301

188W

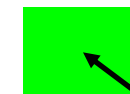
190W

192W

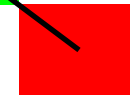
188Ta

190Ta

192Ta



decay into



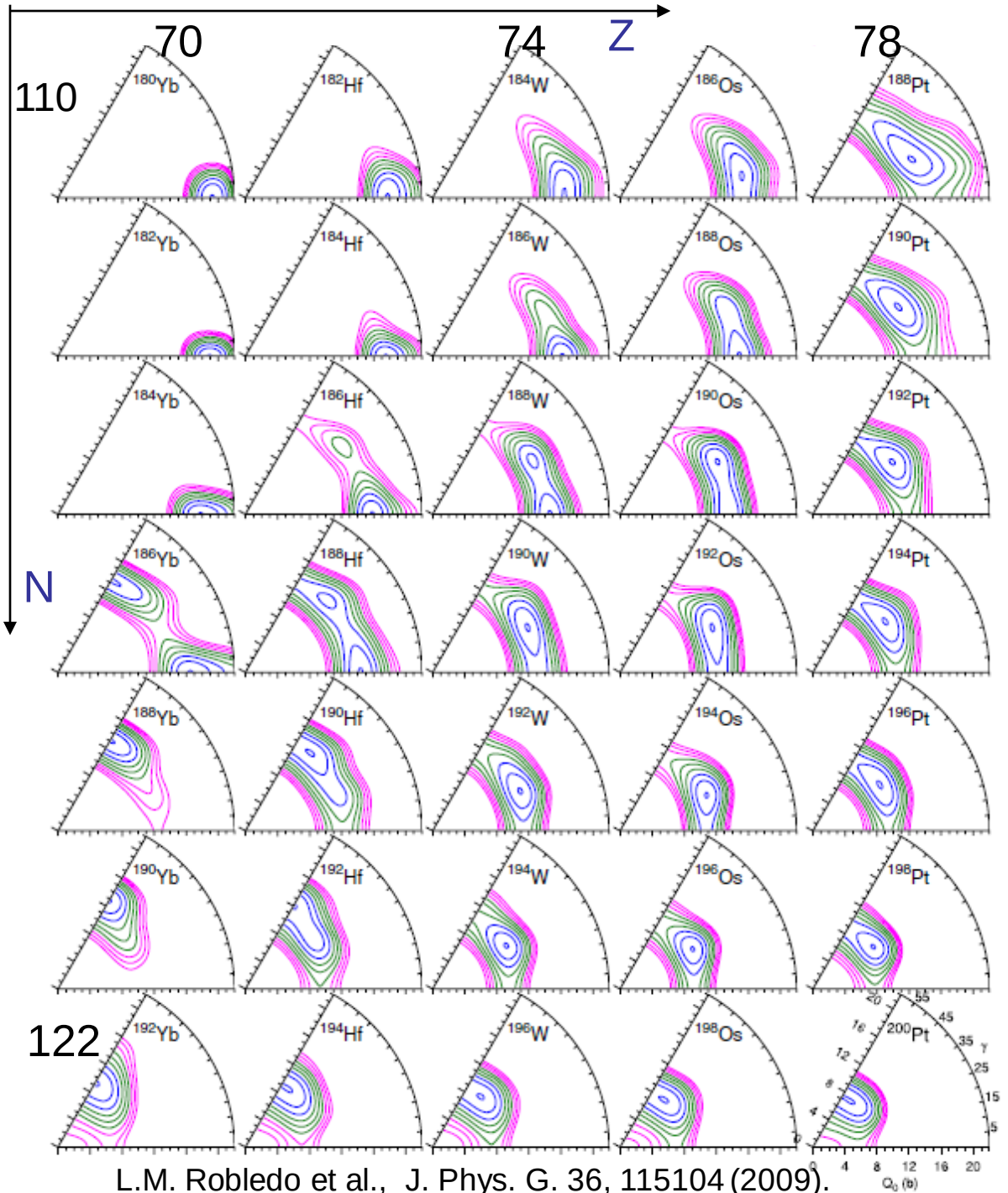
implanted

N. Alkhomashi et al., PRC80 (2009) 064308

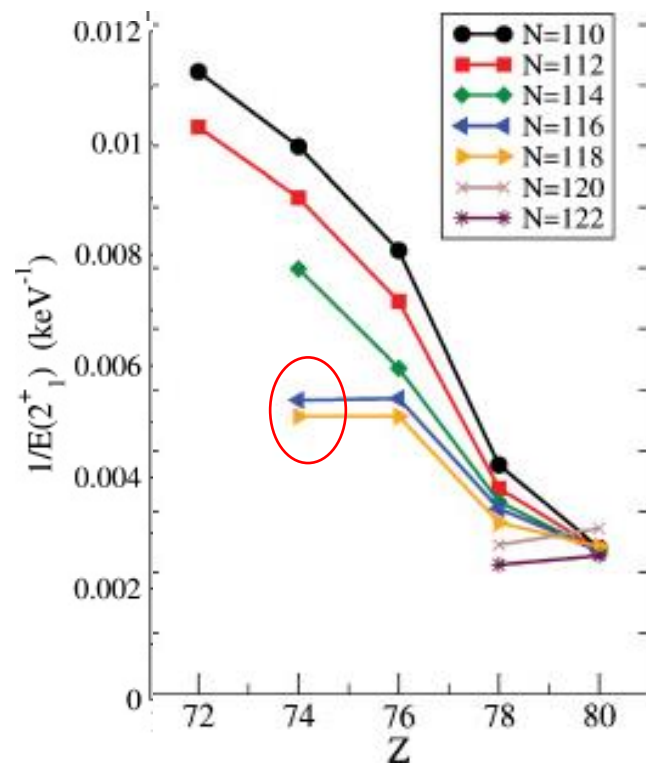
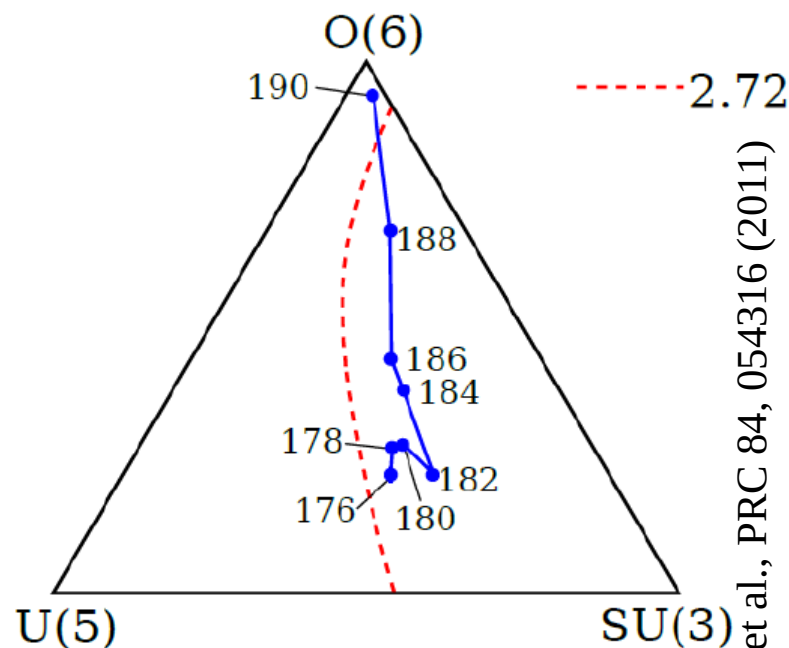
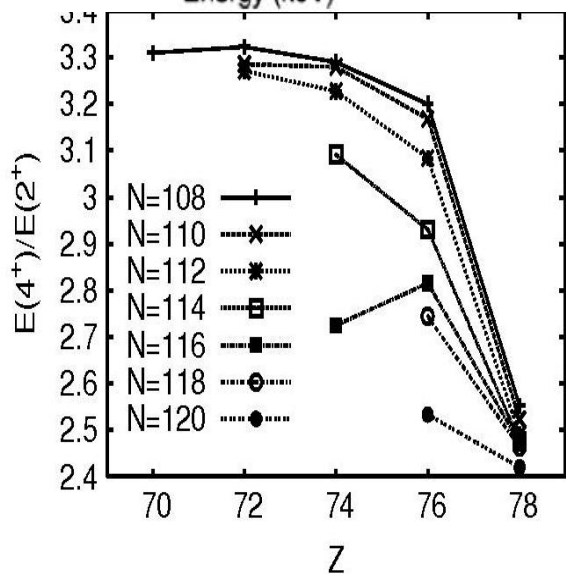
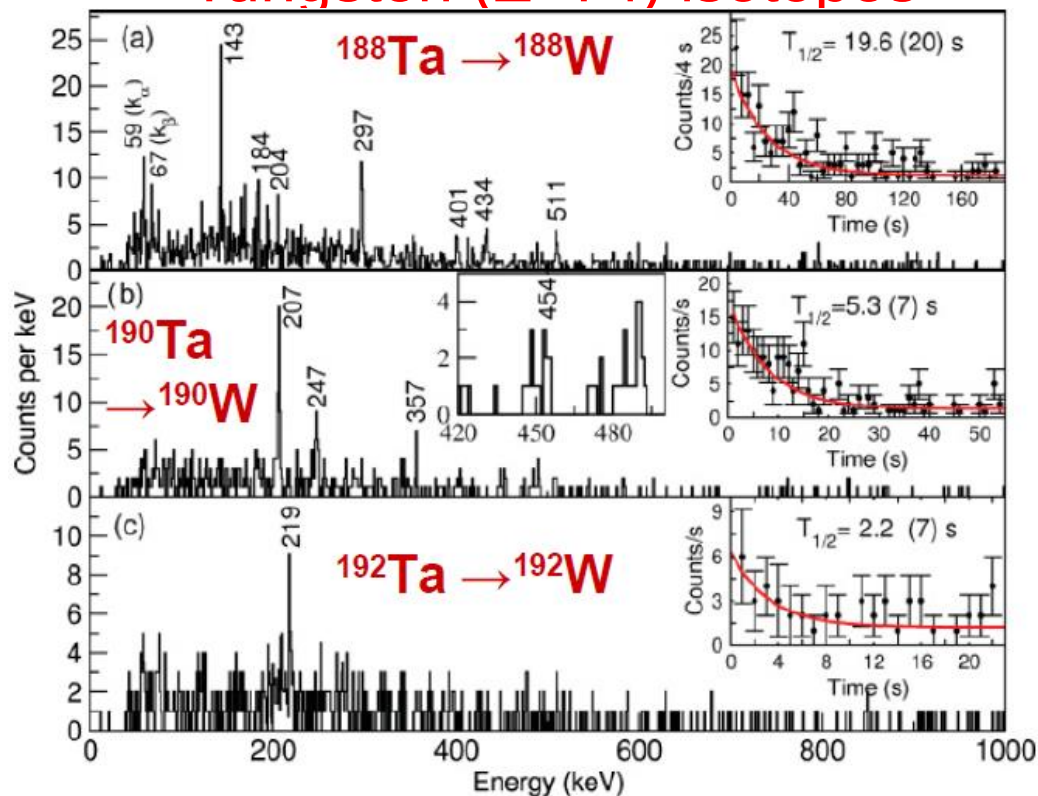
Shape transition,
triaxiality
neutron-rich $A \sim 190$

Stringent test of
theories/models

(SLy4 Skyrme interaction)



Tungsten (Z=74) isotopes



S452

The Prolate-Oblate Shape Transition around $A \sim 190$



Spokespersons: W. Witt^{1,2}, J. Jolie⁴, N. Pietralla¹, P.H. Regan³

Collaborators:

¹**TU Darmstadt:** P.-A. Söderström, V. Werner, P.R. John, R. Kern, P. Koseoglou, M. Lettmann, P. Napiralla

²**GSI:** T. Arici, J. Gerl, M. Gorska-Ott, S. Saha, H. Schaffner, I. Kojouharov, S. Pietri, J. Vesic

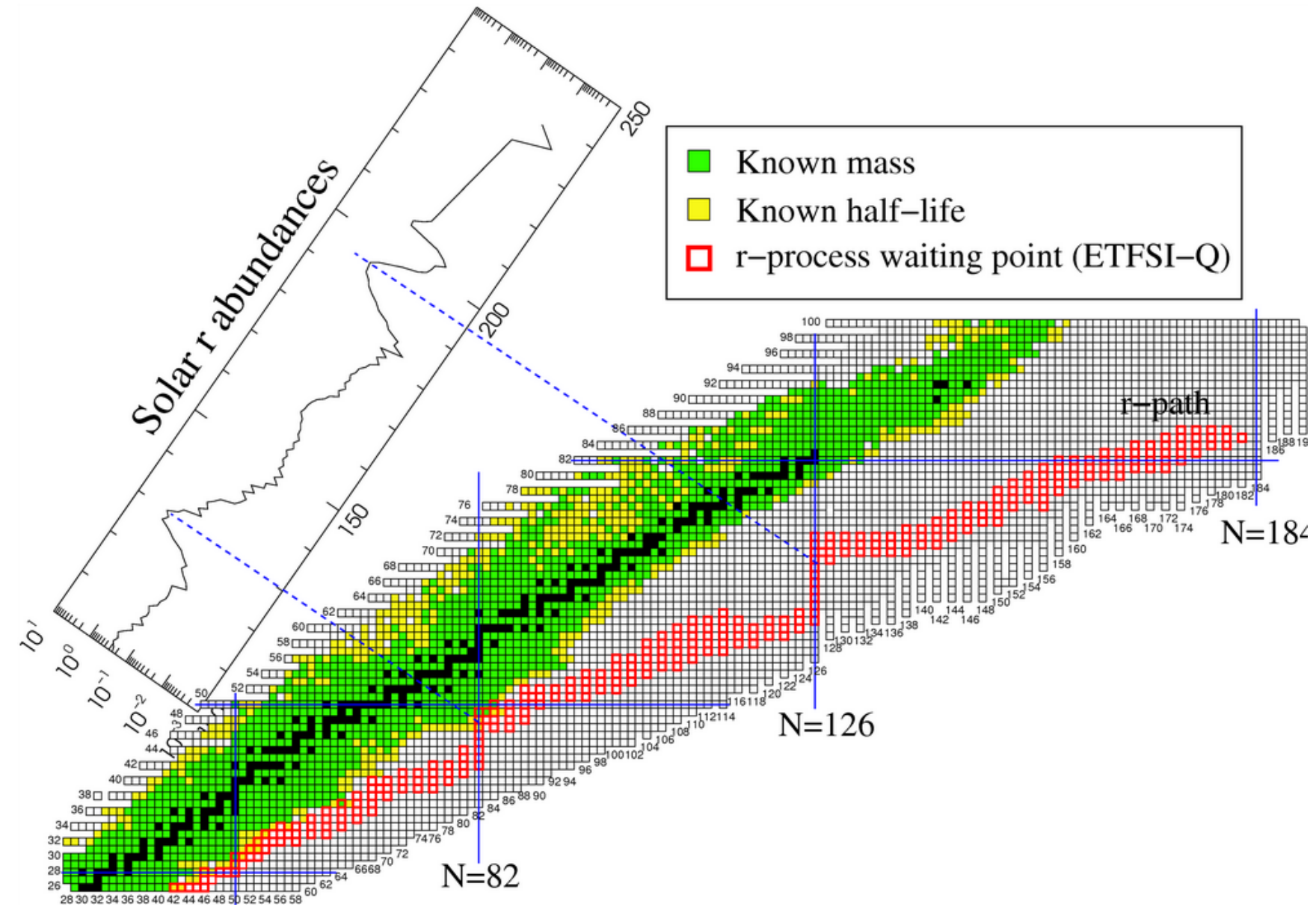
³**Uni. of Surrey:** T. Berry, R. Canavan, L. Morrison, Zs. Podolyak, M. Rudigier

⁴**Uni. Cologne:** A. Blazhev, A. Esmaylzadeh, V. Karayonchev, K. Moschner, J.-M. Regis

S460, S468 & the DESPEC collaboration

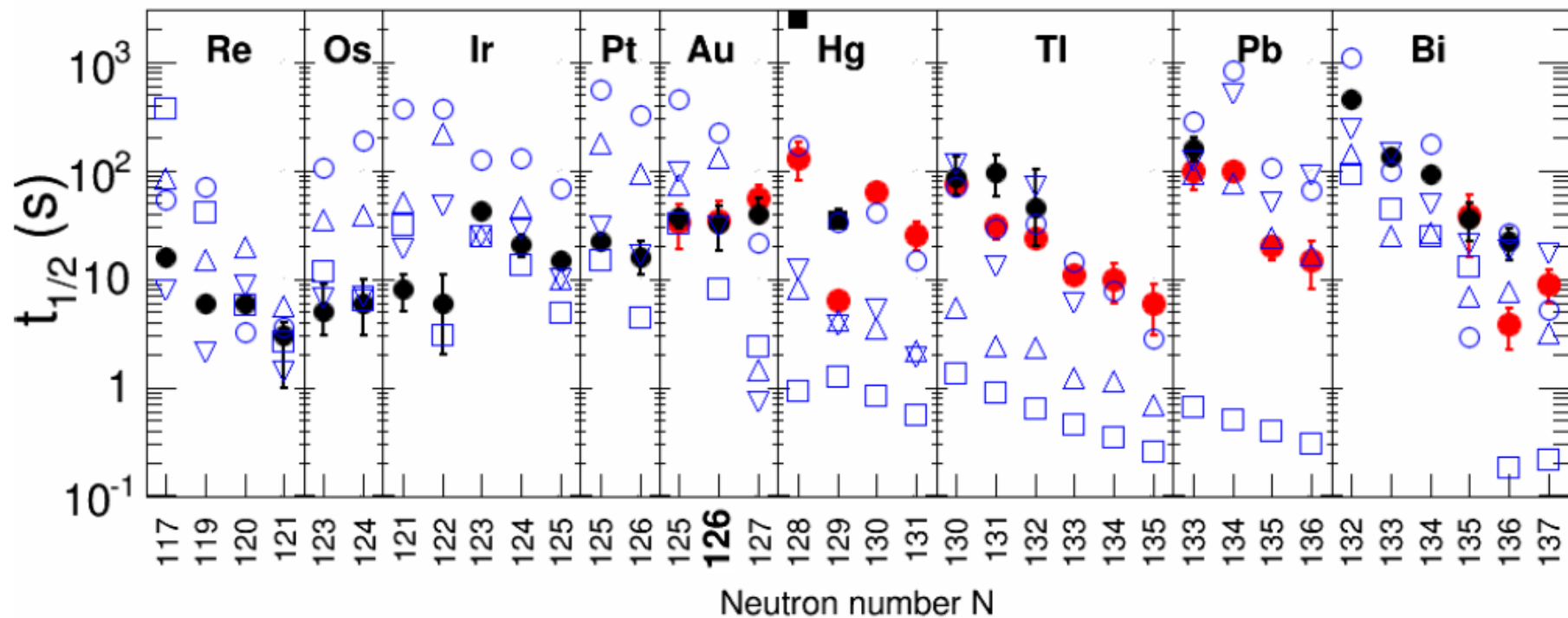
Aim:	Measure lifetimes and energies in n-rich Os, W, Hf
Method:	Fast Electronic Scintillation Timing, γ -Spectroscopy
Instruments:	AIDA + plastic scint., FATIMA, (DEGAS) Ge-det.
SIS18 beam:	^{208}Pb at 1 GeV/u, nominal intensity 10^9
Granted beamtime:	24 shifts (~ 30. Sept. - 7. Oct)

N=126 nuclei and the *r* process

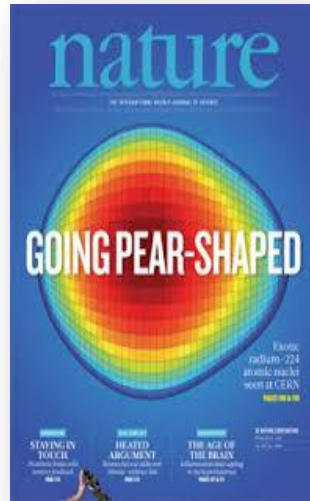
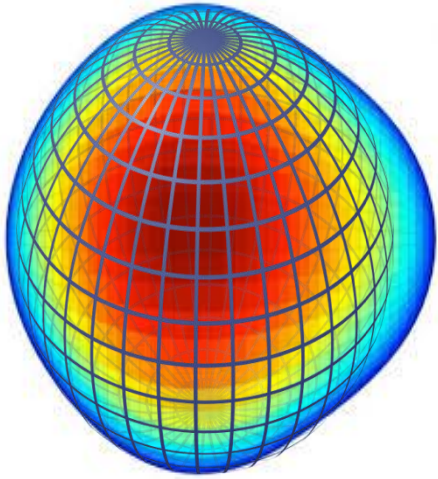


Lifetime measurements

- This work
- Prev. Experiment A.I. Morales, et al. (2014,2015)
- Prev. Experiment Z. Li, et al. (1998)
- FRDM+QRPA
- △ KTUY
- RHB+RQRPA
- ▽ DF3+cQRPA



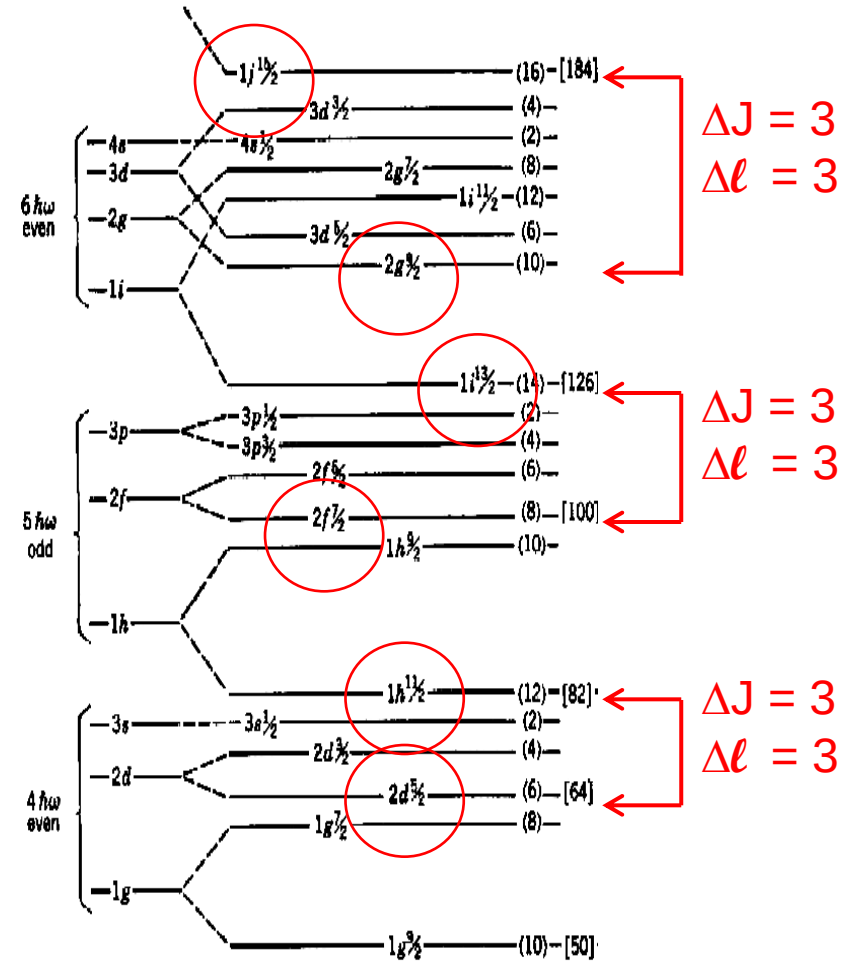
Octupole Correlations



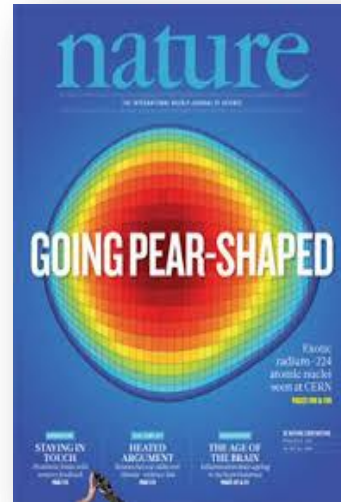
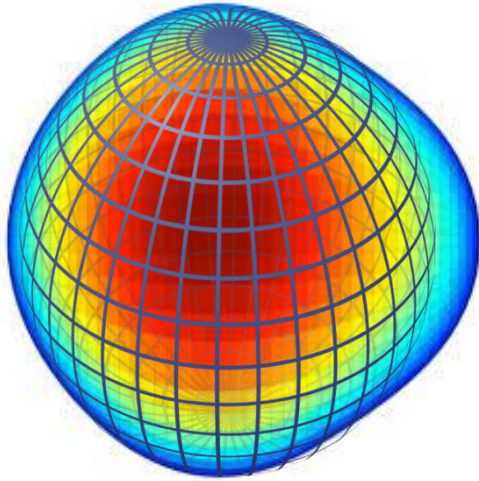
Pending questions:

- ☐ Maximum of octupole deformation
- ☐ Static or dynamic deformation
- ☐ Role of quadrupole-octupole coupling

- The strongest octupole correlations are expected around n-rich $A \sim 150$ and **$A \sim 225$**

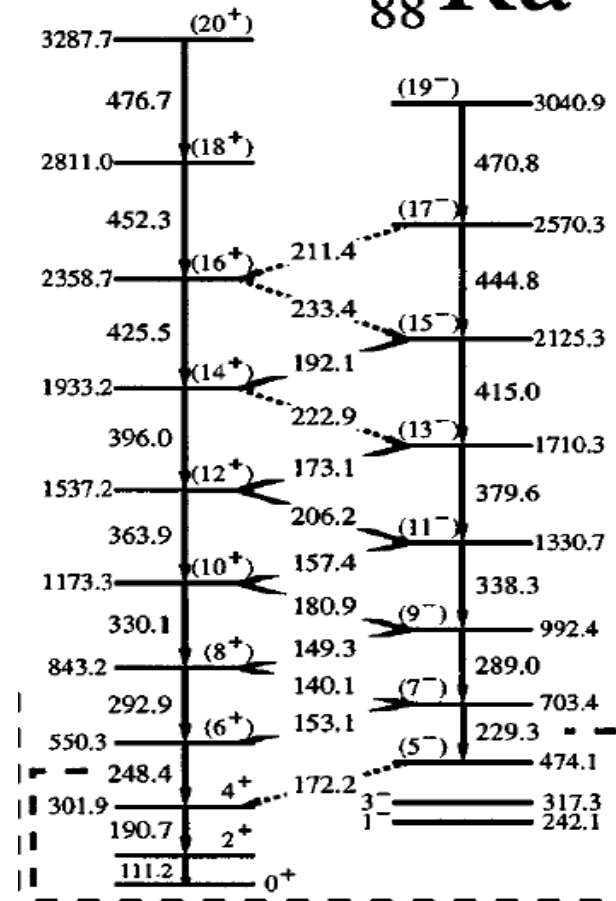


Octupole Correlations



➤ Octupole-deformed (pear-like) shapes appear under particular conditions:

$^{222}_{88}\text{Ra}$



Particular features:

- ❑ Large $B(E1)$ transition probabilities
- ❑ Large $B(E3)$ strengths → difficult to measure
- ❑ Interleaved positive- and negative-parity states

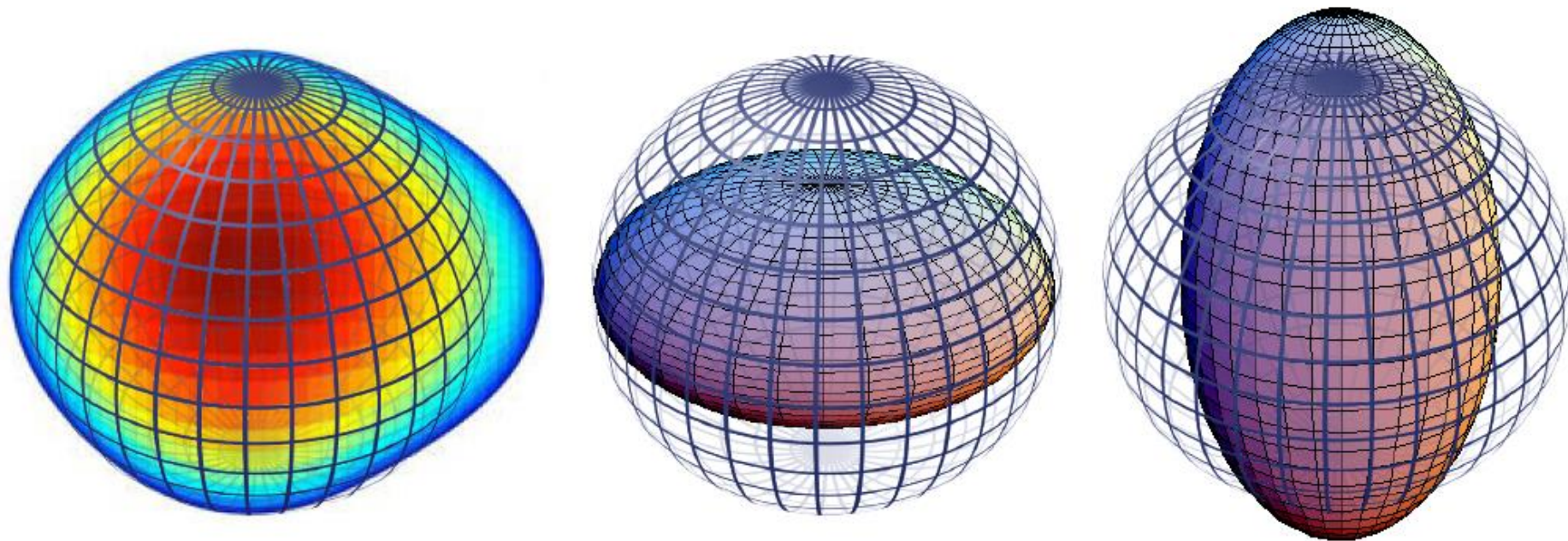
S460: Investigation of $220 < A < 230$ Po-Fr nuclei lying in the south-east frontier of the $A \sim 225$ island of octupole deformation

SPOKEPEOPLE

A.I. Morales (IFIC Valencia), G. Benzoni (INFN Milano) and J.J. Valiente-Dobón (LNL Legnaro)

LOCAL CONTACT

M. Górska



Summary

Decay spectroscopy is very sensitive: first info on excited states

Equipment developed for DESPEC

Experiments unique for GSI/FAIR (heavy neutron-rich)

Fundamental questions addressed:

- $N=126$ nuclei, shell evolution, r-process
- octupole correlations, terra incognita, EDM
- prolate-oblate-spherical shape evolution

Thanks!