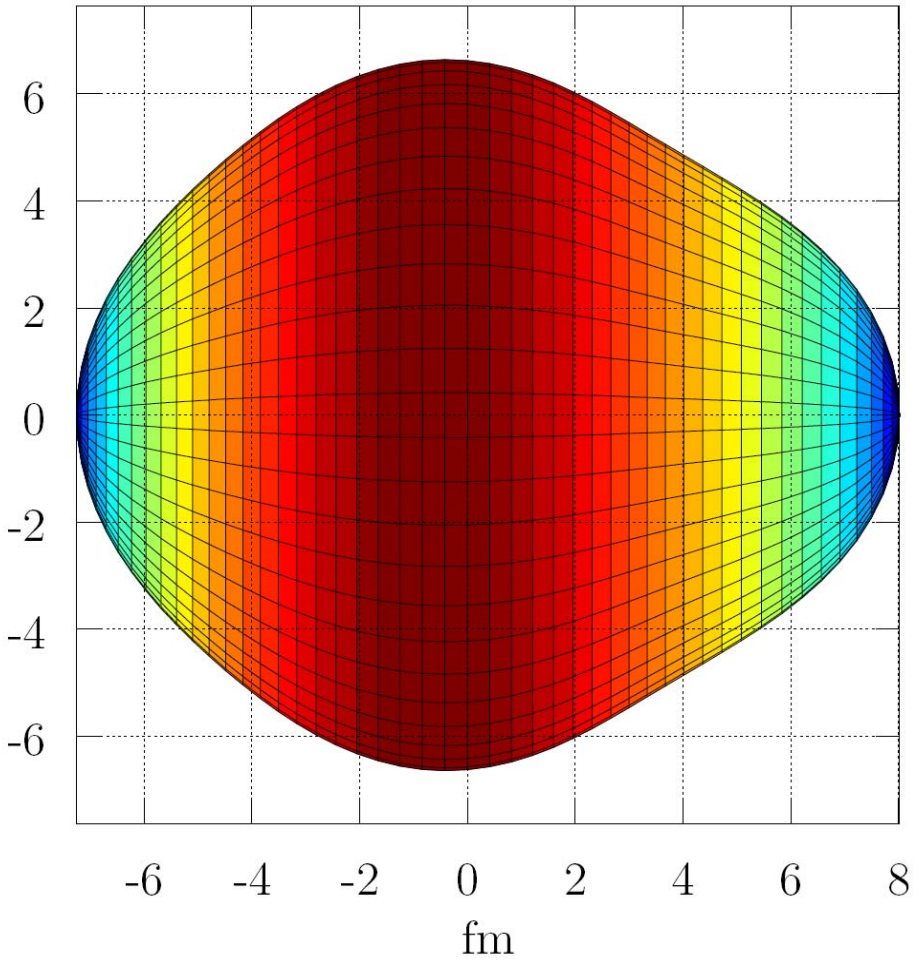
Эксперименты с лазерным ионным источником

А. Е. Барзах, П. Л. Молканов,
М. Д. Селиверстов, Д. В. Федоров,

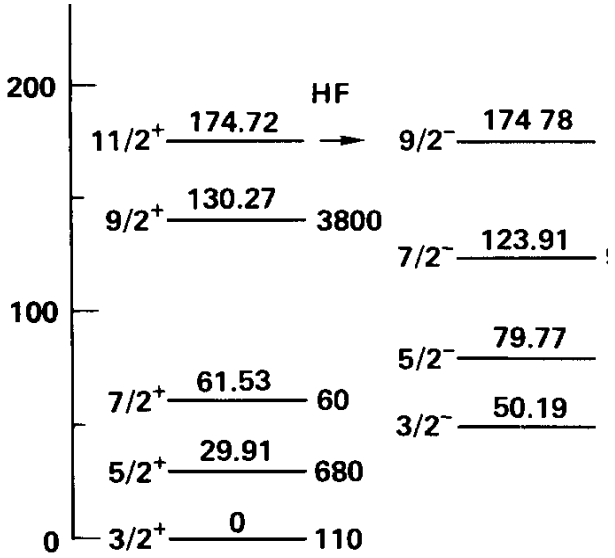
Octupole deformation

^{224}Ra



EDM search: enhancement at octupole deformation

parity doublets



$d_{\rm at} \propto S$, nuclear Schiff moment

$$\hat{S}_0 = \frac{e}{10}\sqrt{\frac{4\pi}{3}}\sum_i \left(r_i^3 - \frac{5}{3}\overline{r_{\rm ch}^2} r_i \right) Y_0^1(\Omega_i) + \ldots.$$

$$S \equiv \langle \Psi_0 | \hat{S}_0 | \Psi_0 \rangle \approx \sum_{i \neq 0} \frac{\langle \Psi_0 | \hat{S}_0 | \Psi_i \rangle \langle \Psi_i | \hat{V}_{PT} | \Psi_0 \rangle}{E_0 - E_i} + \text{c.c.}$$

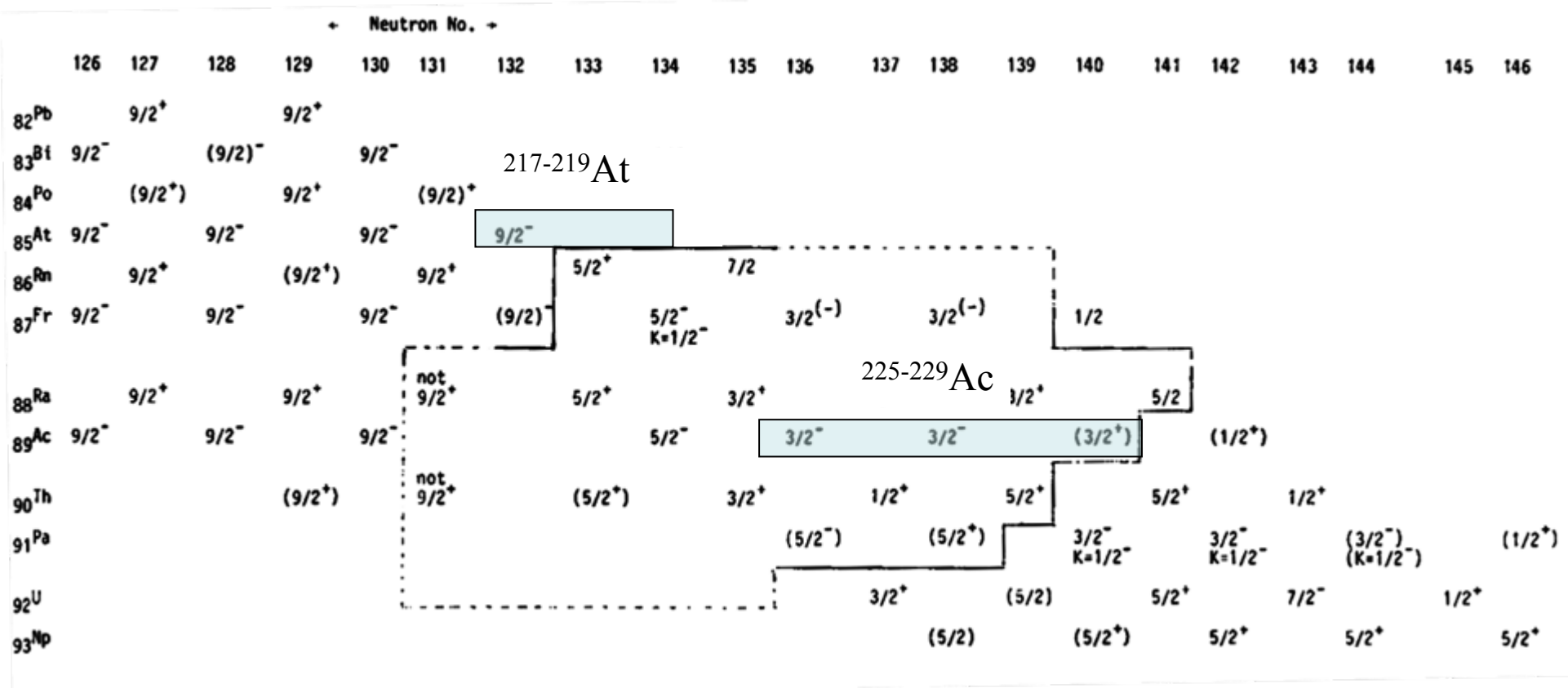
$$S \approx -2 \frac{\langle \Psi_0 | \hat{S}_0 | \bar{\Psi}_0 \rangle \langle \bar{\Psi}_0 | \hat{V}_{PT} | \Psi_0 \rangle}{\Delta E}$$

Enhancement Factor: EDM (^{225}Ra) / EDM (^{199}Hg)

Skyrme Model	Isoscalar	Isovector
SIII	300	4000
SkM*	300	2000
SLy4	700	8000

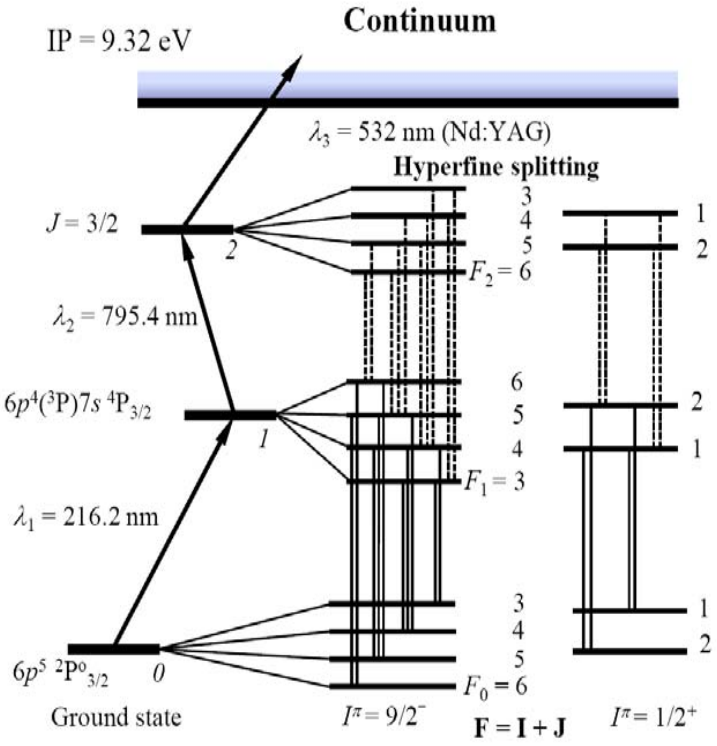
Schiff moment of ^{225}Ra, Dobaczewski, Engel (2005)
Schiff moment of ^{199}Hg, Ban, Dobaczewski, Engel, Shukla (2010)

Region of octupole deformation



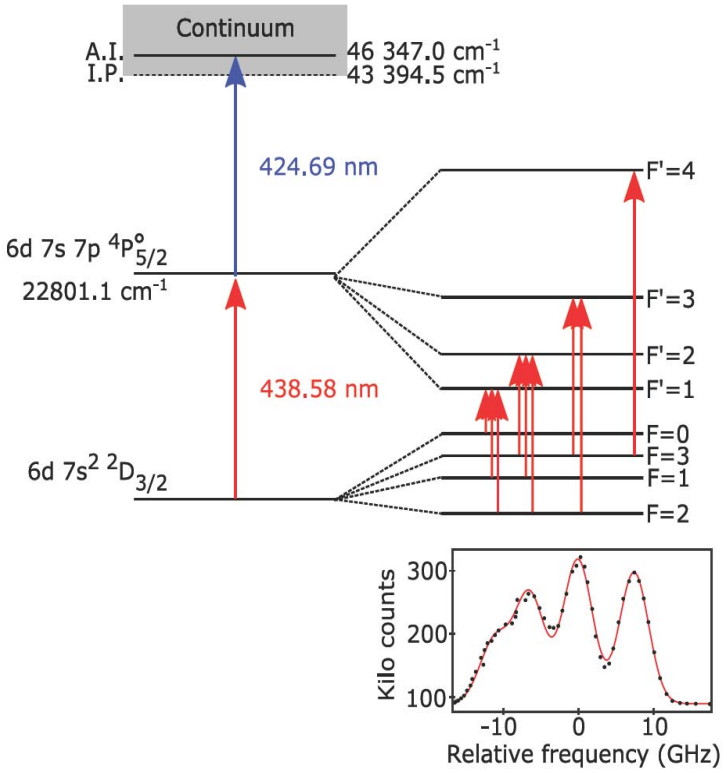
Ionization schemes

Astatine



A. E. Barzakh *et al*,. Phys. Rev. C **99**, 054317 (2019)

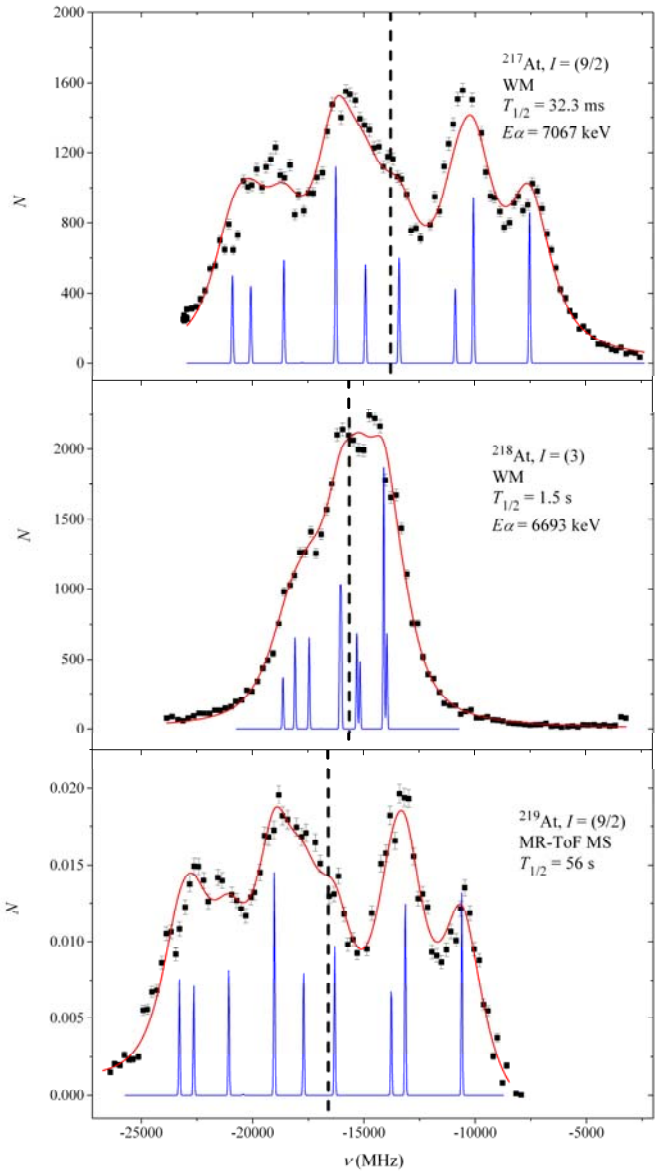
Actinium



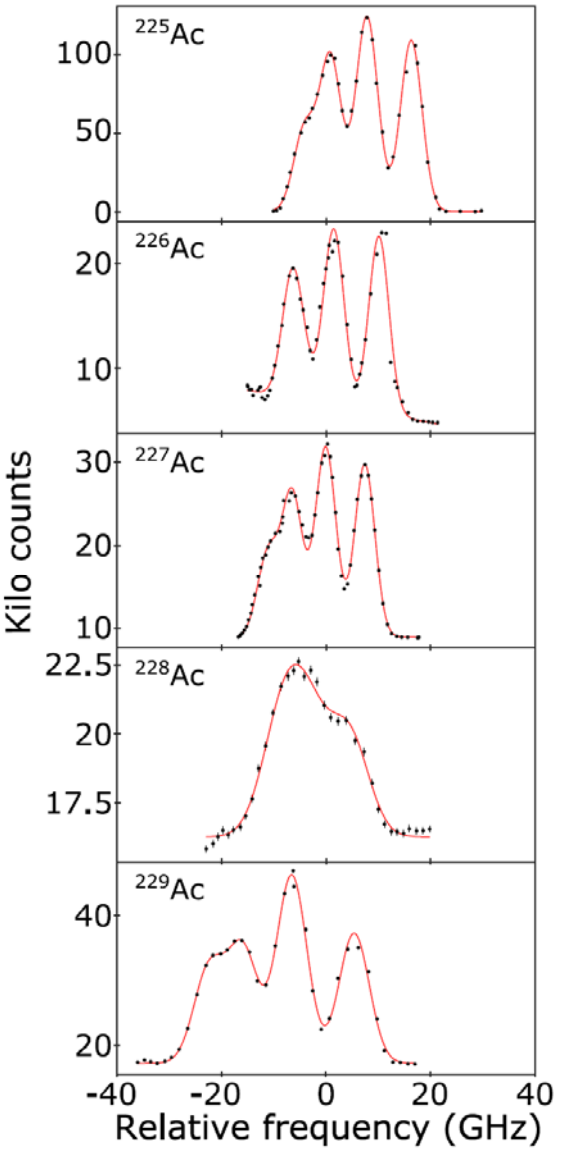
E. Verstraelen *et al*,. Phys. Rev. C **100**, 044321 (2019)

Experimental hfs spectra

$^{217–219}$At

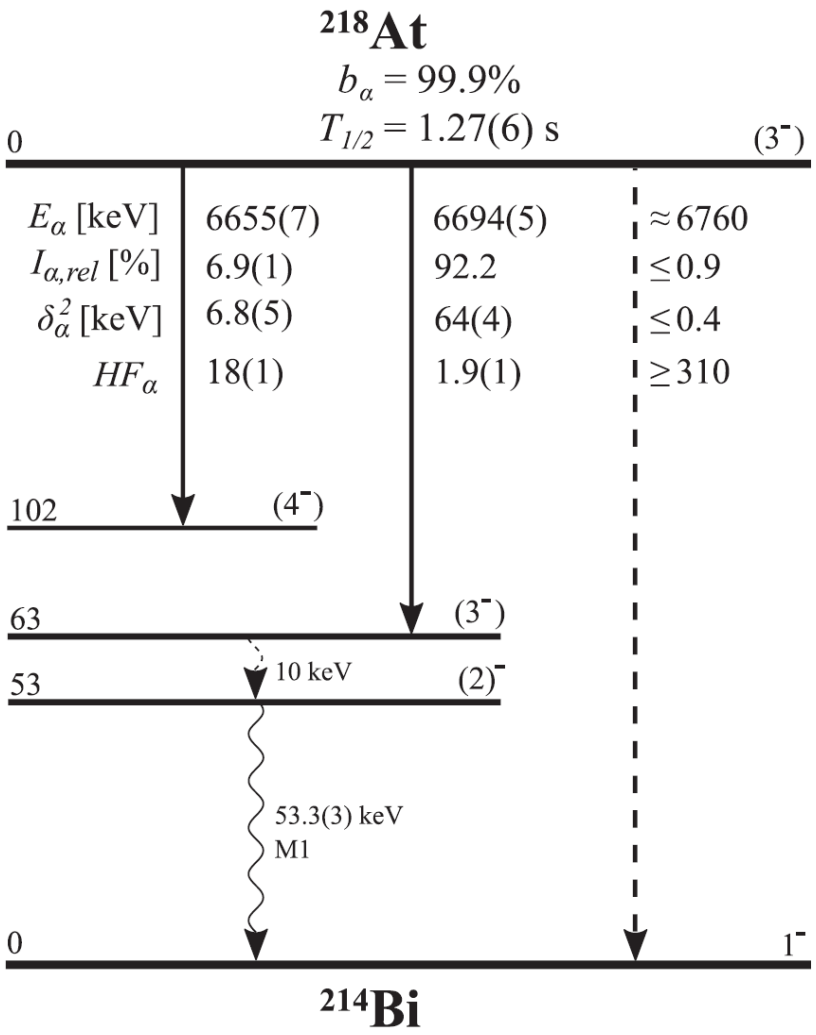


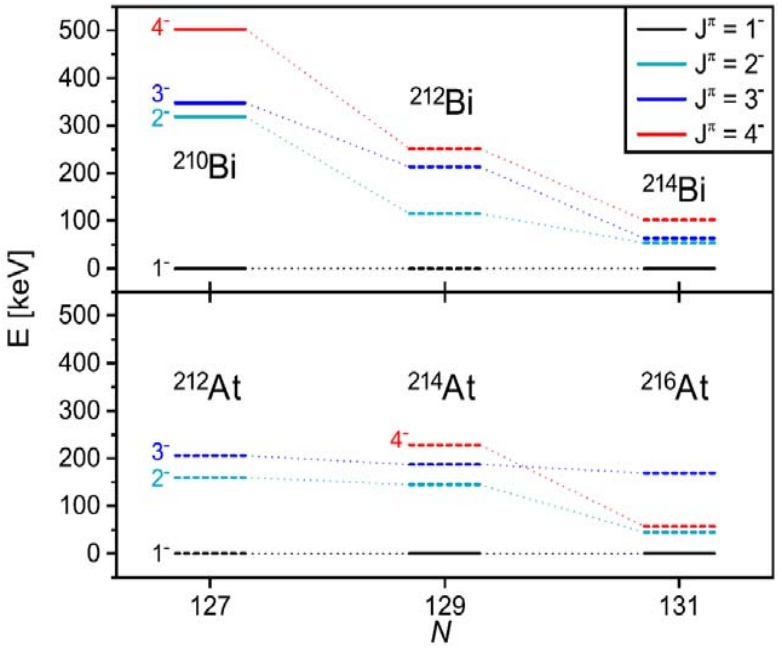
$^{225–229}$Ac



M. D. Seliverstov et al., Hfi, accepted

^{218}At: α-decay scheme





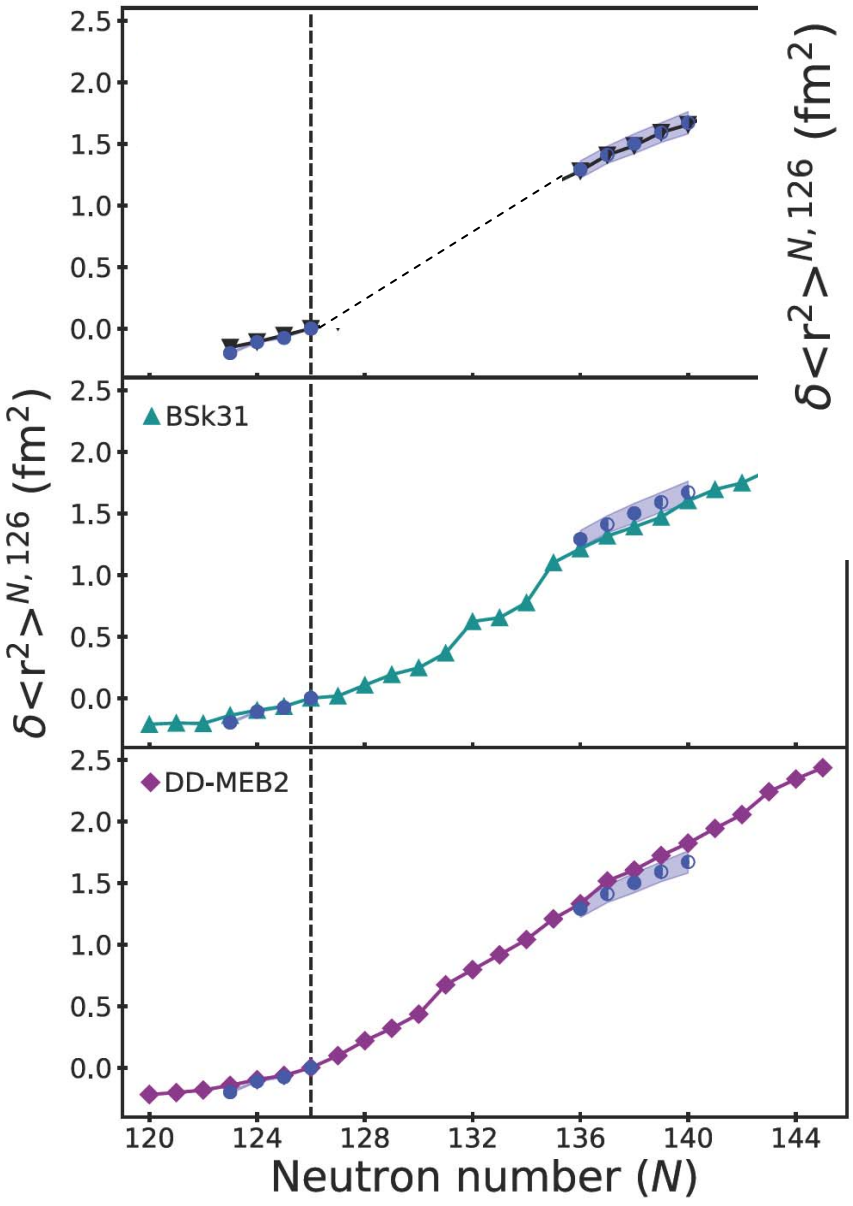
evolution of $\pi 1h9/2 \otimes \nu 2g9/2$ multiplet
→ information on *pn* forces

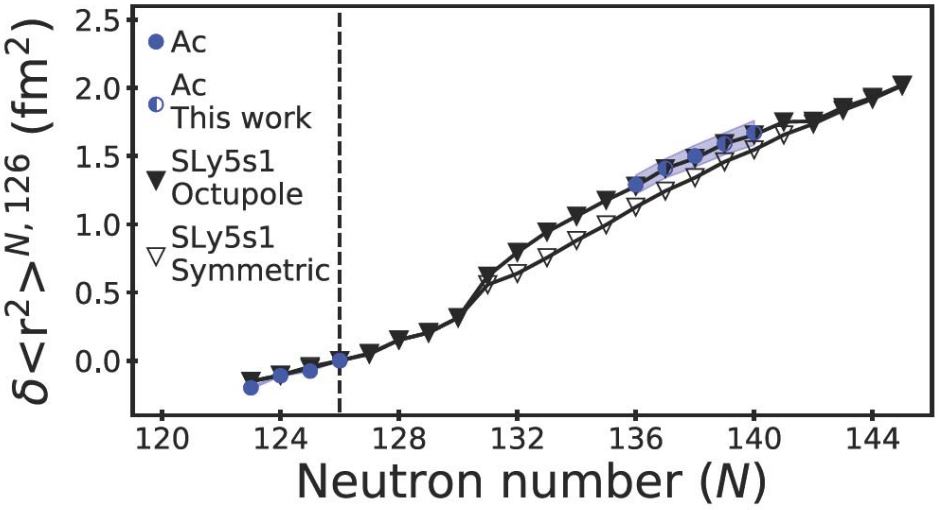
ground-state spin of ^{218}At: $I^\pi = (3^-)$

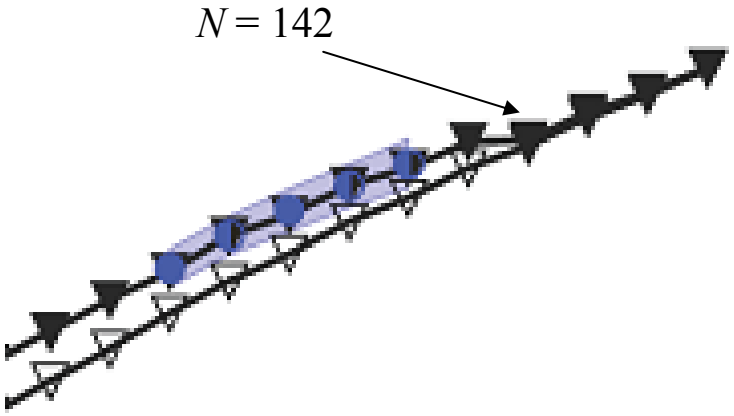
J. G. Cubiss et al., Phys. Rev. C **99**, 064317 (2019)

Ac: radii, comparison with HF calculations

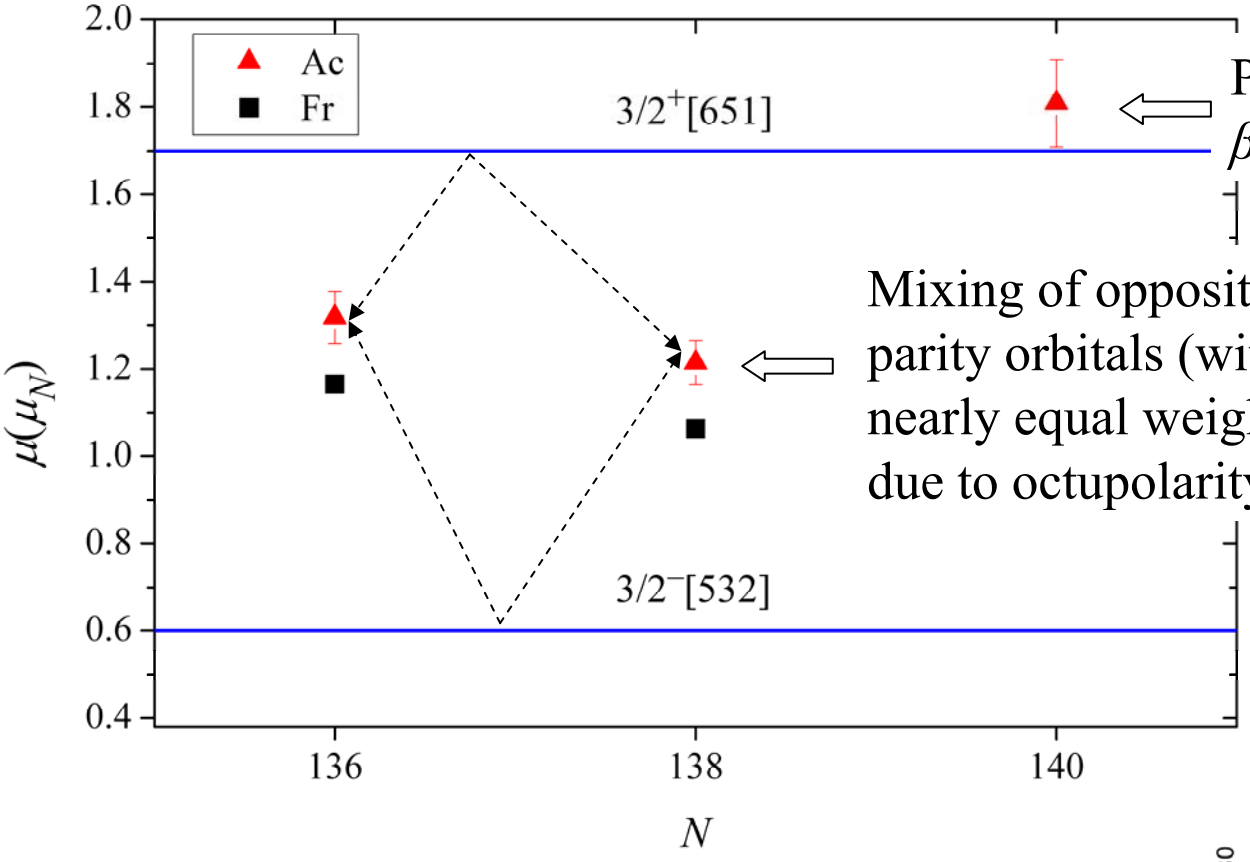
Ac





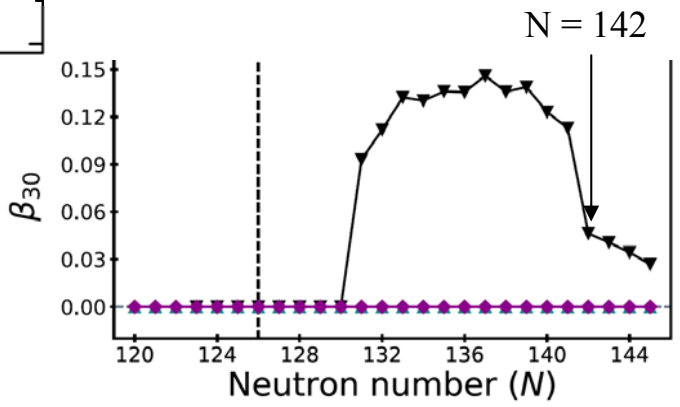


Magnetic moment of odd Ac isotopes as indicator of the octupolarity



Pure $3/2^+[651]$ state at $\beta_3 \approx 0$?

Mixing of opposite parity orbitals (with nearly equal weights) due to octupolarity



μ(^{218}At) can be explained by inclusion of octupole deformation

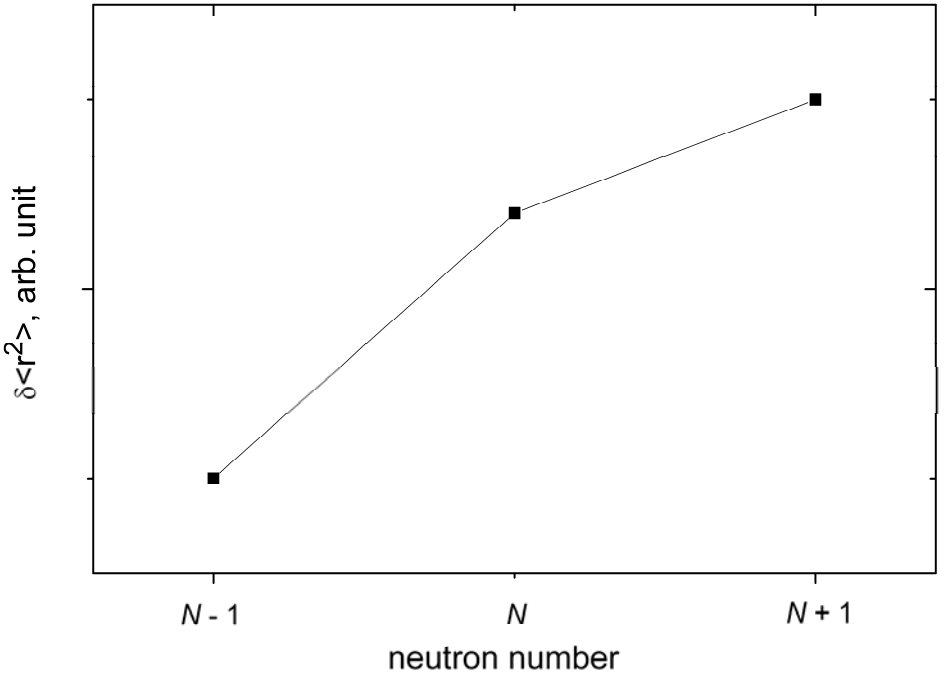
Odd-even staggering in radii

staggering parameter: $\gamma(N) = \dfrac{2 \cdot \delta \left\langle r^2_{N,\,N-1} \right\rangle}{\delta \left\langle r^2_{N+1,\,N-1} \right\rangle}$ N — odd

$\gamma = 1$ — no staggering

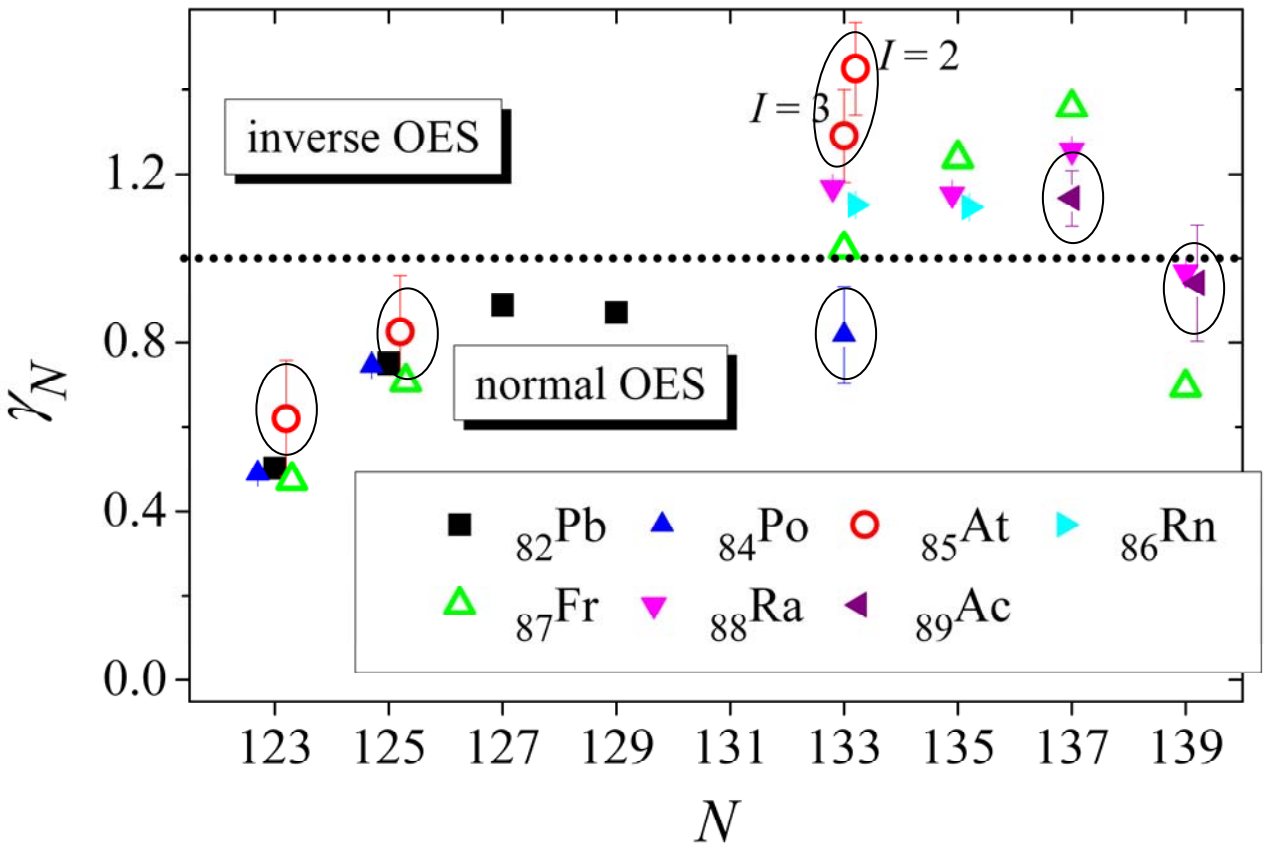
$\gamma < 1$ — normal staggering

$\gamma > 1$ — inverse staggering



inverse radii staggering strongly correlated with octupole collectivity

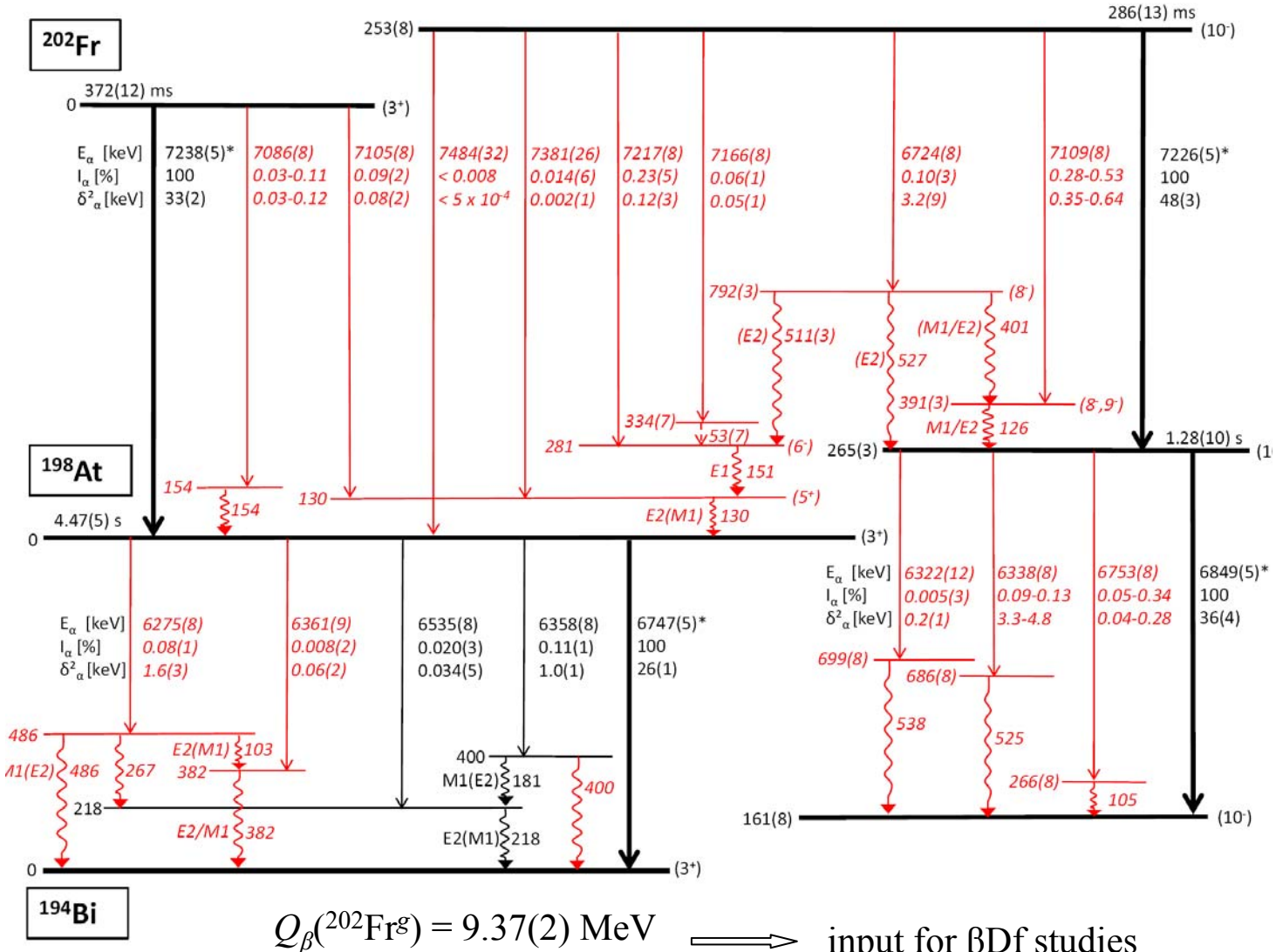
Inverse radii staggering: Ac and At



Q_S (^{218}At) = 0.55(33) b $\Longrightarrow$ $\beta_2 = 0.04(2)$

Octupole deformation without quadrupole one? — cf. ^{216}Fr.
Qualitative explanation by Otten is questioned (β_3 on top of β_2)

$^{202,\ 200}$Fr: α-decay scheme

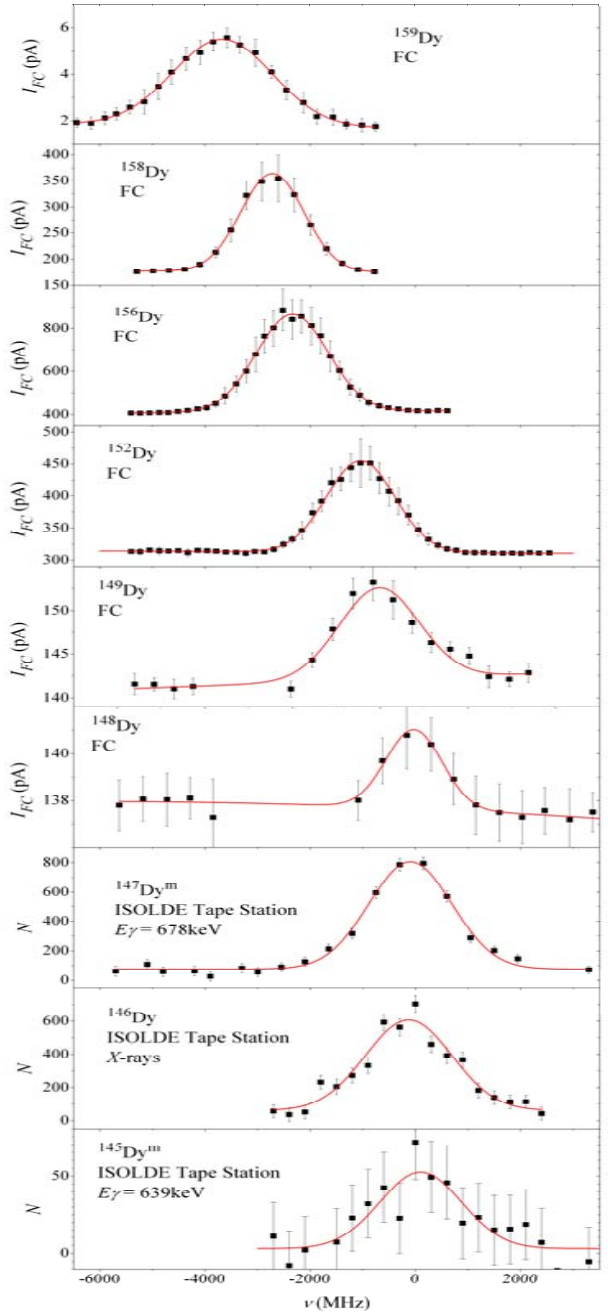


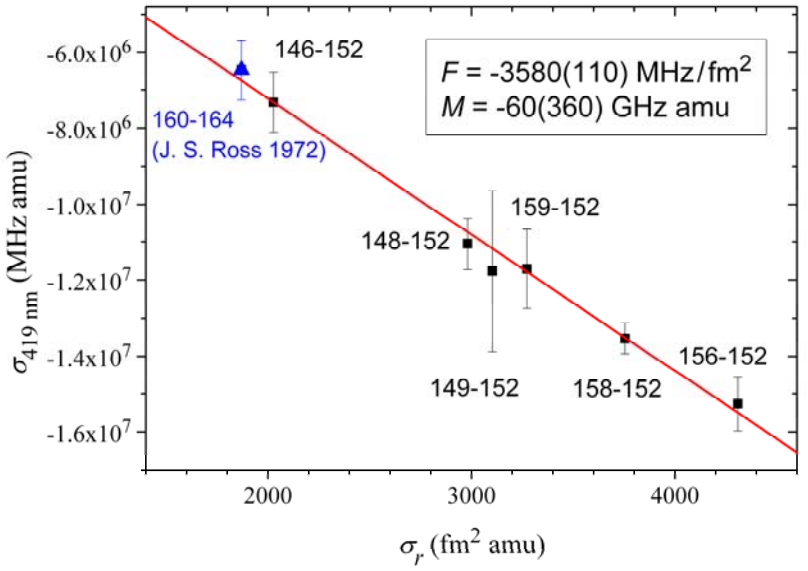
$Q_\beta(^{202}\mathrm{Fr}^g) = 9.37(2)$ MeV

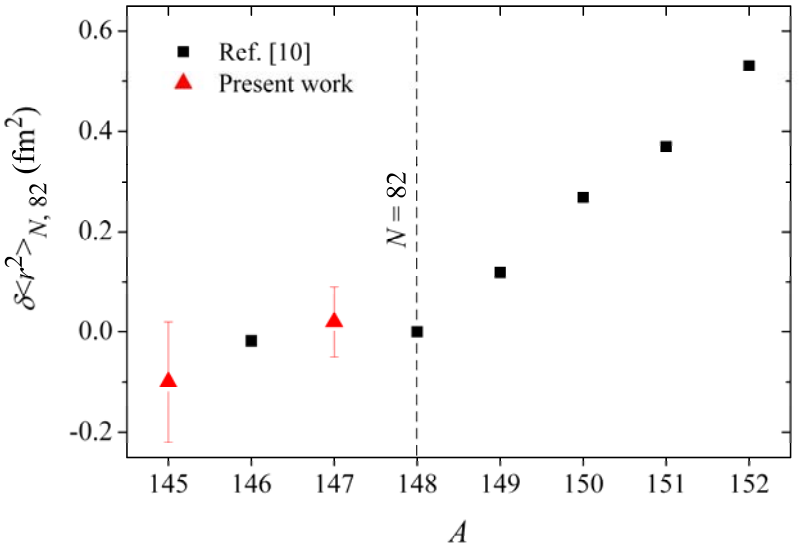
$Q_\beta(^{202}\mathrm{Fr}^m) = 9.62(2)$ MeV $\Longrightarrow$ input for βDf studies

L. Ghys et al., Phys. Rev. C **100**, 054310 (2019)

Dysprosium: test for future experiments

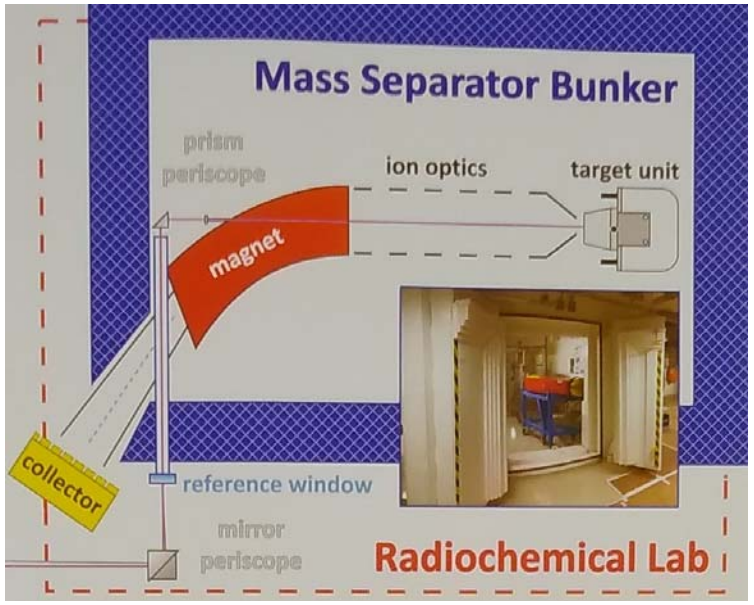




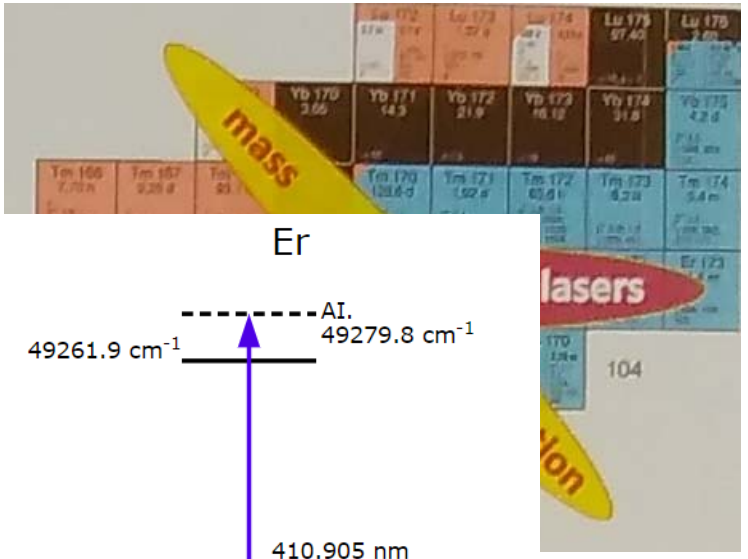


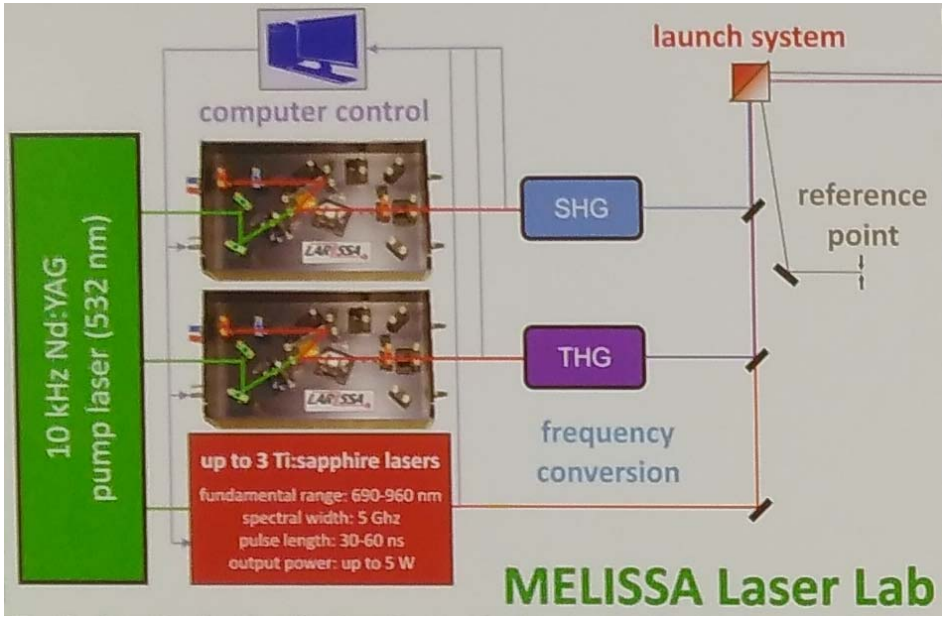
K. Chrysalidis *et al*., NIM B, accepted

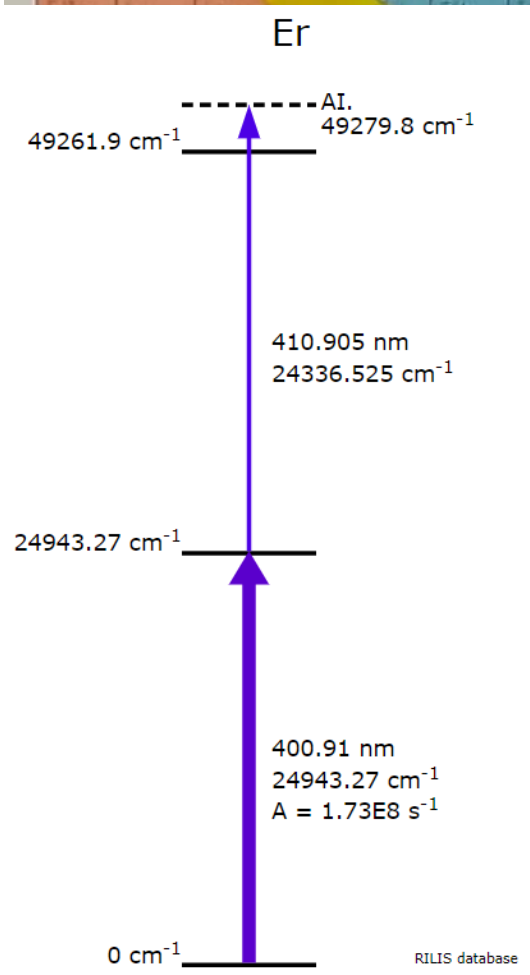
MEDICIS-ISOLDE



^{169}Er
9d







Publications & Conferences 2019

A. E. Barzakh *et al*,. Phys. Rev. C **99**, 054317 (2019)
J. G. Cubiss et al., Phys. Rev. C **99**, 064317 (2019)
E. Verstraelen *et al*,. Phys. Rev. C **100**, 044321 (2019)
L. Ghys et al., Phys. Rev. C **100**, 054310 (2019)

M. Piersa, et al., *β-Decay of ^{133}In: emission from neutron-unbound states in ^{133}Sn*, Phys. Rev. C **99**, 024304 (2019).
S. Sels et al., *Shape staggering of mid-shell mercury isotopes from in-source laser spectroscopy compared with density functional theory and Monte Carlo shell model calculations*, Phys. Rev. C **99**, 044306 (2019).
I. Tomandl et al., *Measurement of the ^{7}Be(n, p) cross section at thermal energy*, Phys. Rev. C **99**, 014612 (2019).
F. Flavigny et al., *Microscopic structure of coexisting 0^{+} states in ^{68}Ni probed via two-neutron transfer*, Phys. Rev. C **99**, 054332 (2019).

Workshop on Electronic atomic factors and hyperfine anomalies for nuclear physics, 2019, Brussels, Belgium.
Workshop on the "Physics between lead and uranium: in preparation of new experimental campaigns at ISOLDE", 2019, Leuven, Belgium
International Conference Merger of the Poznan Meeting on Lasers and Trapping Devices in Atomic Nuclei Research and the International Conference on Laser Probing, 2019, Mainz, Germany.