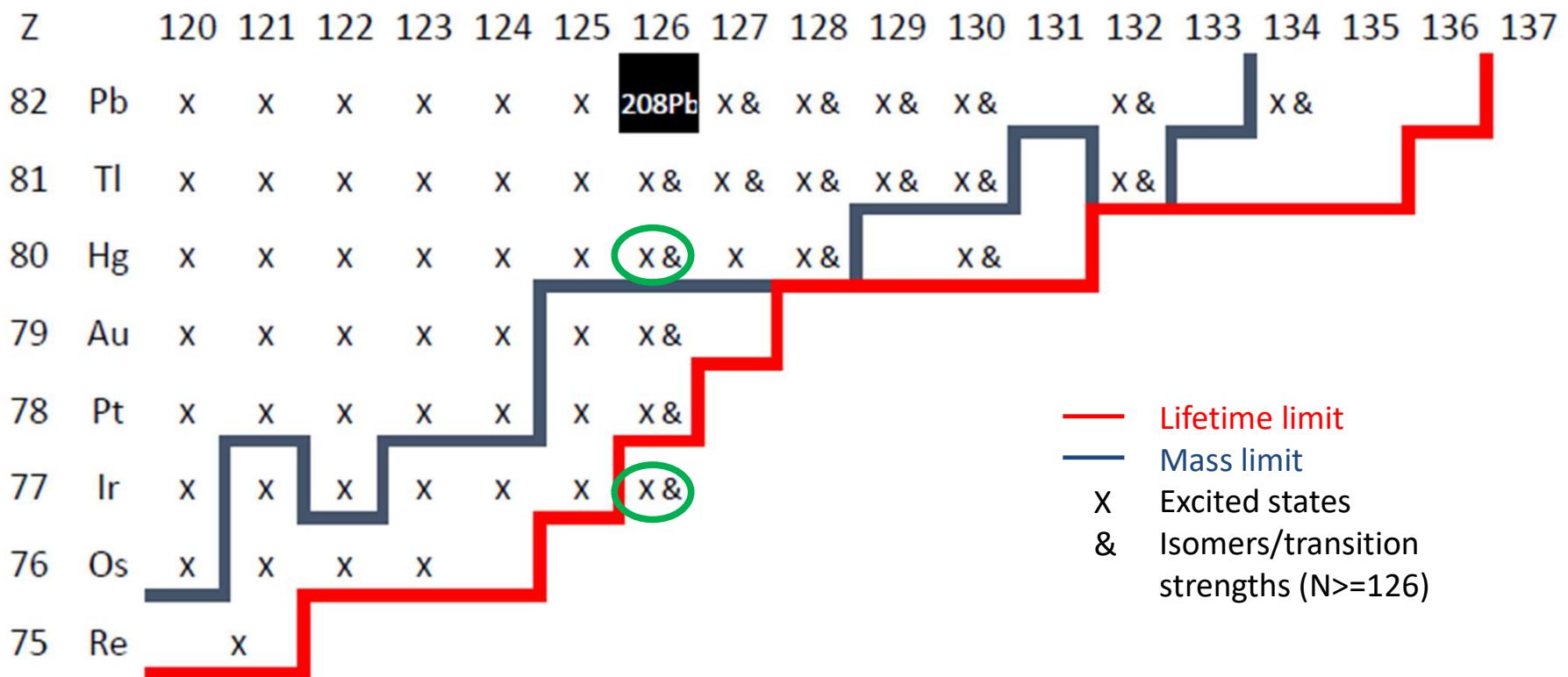


Towards the r-process path at N=126

Zsolt Podolyák



Experimental data in the N~126 region



Quadrupole and octupole collectivity in the semi-magic nucleus $^{206}\text{Hg}_{126}$

Isomeric decay spectroscopy of $^{203}\text{Ir}_{126}$

Shell (non-)evolution and collective (vibrational) octupole

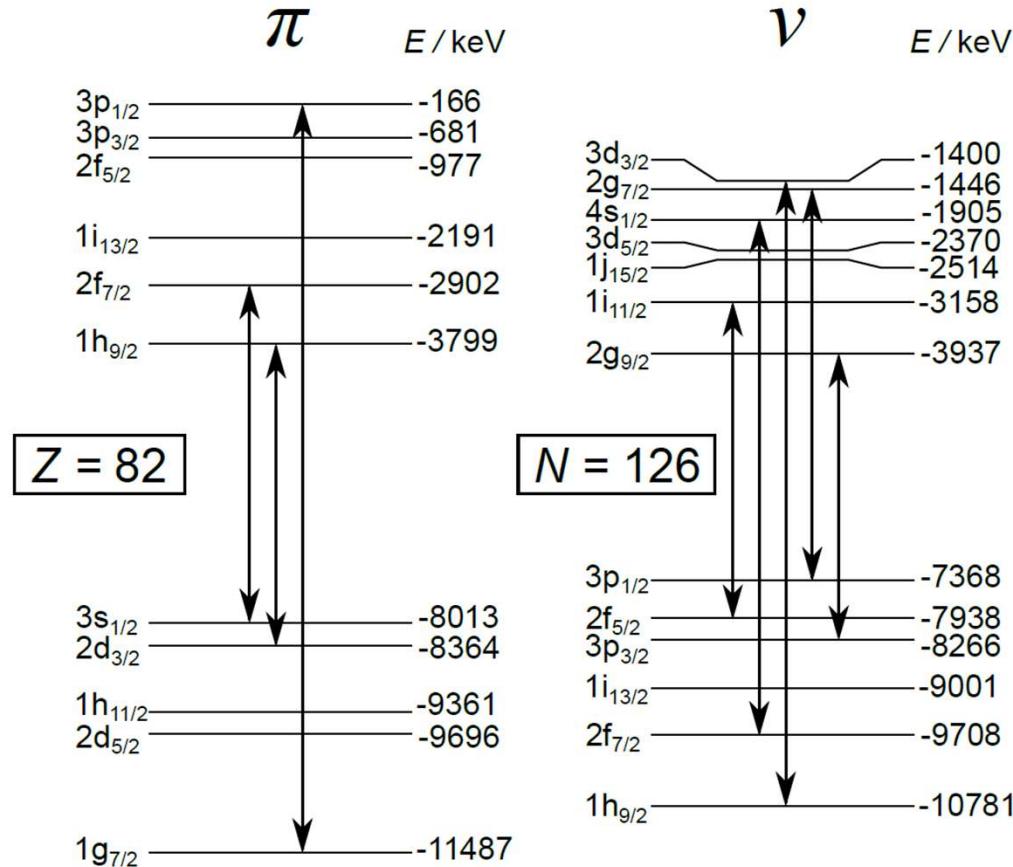
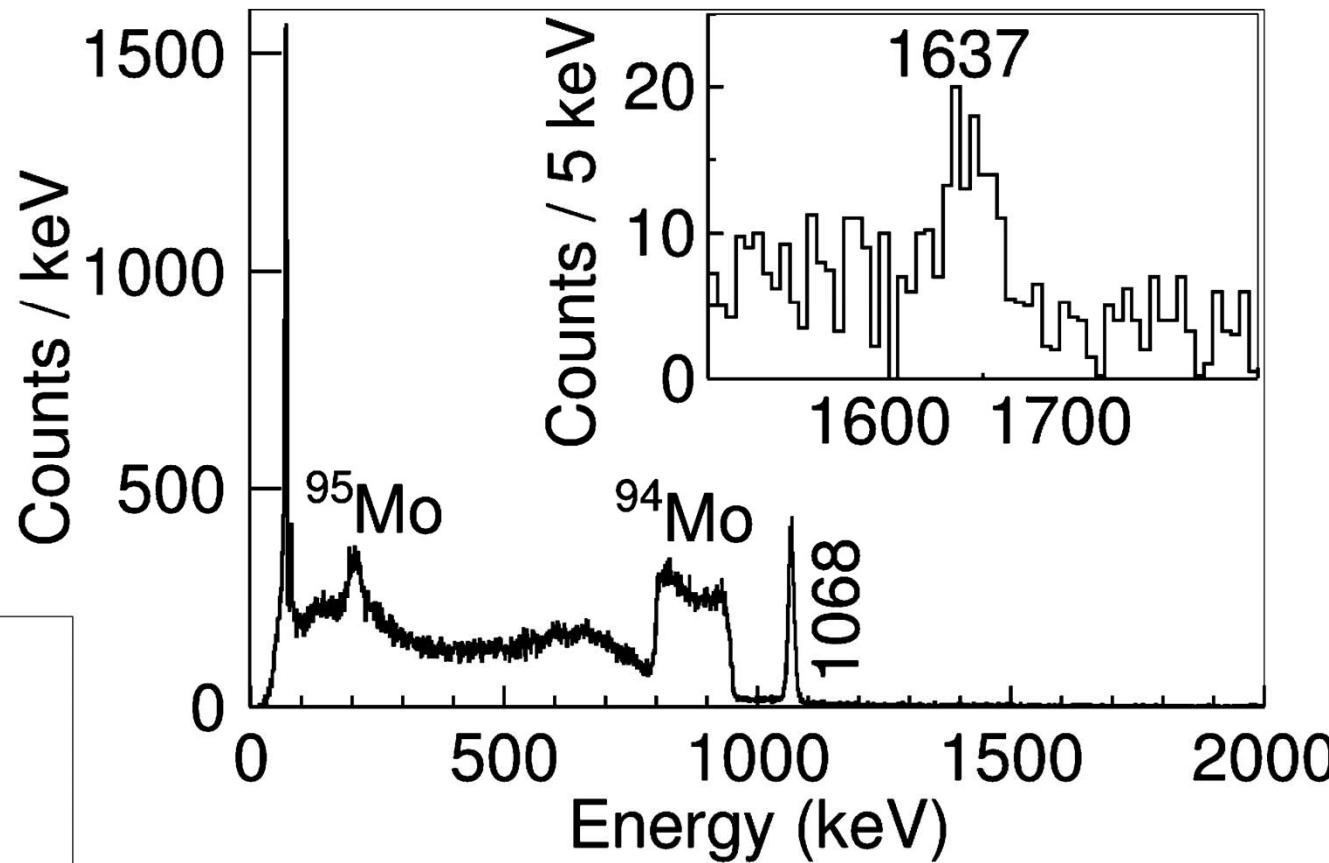
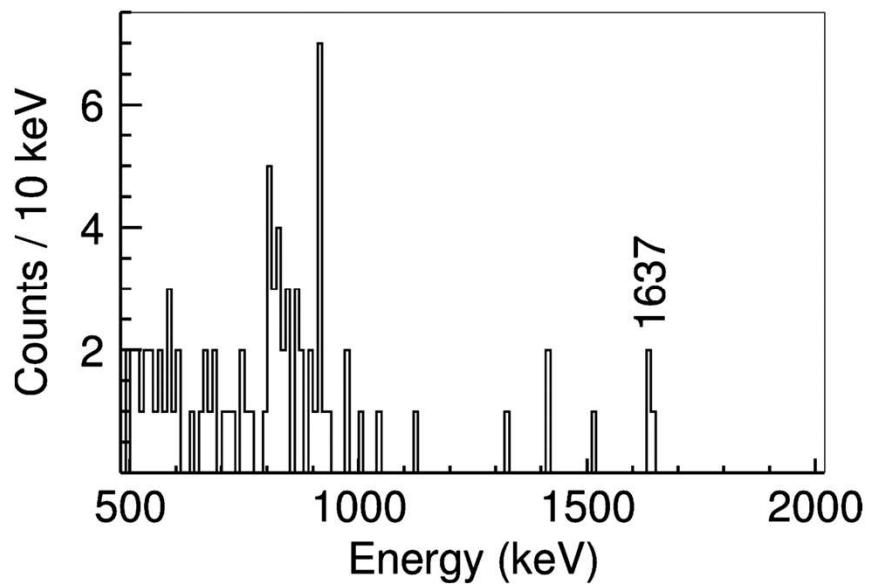


Figure 1.1: Empirical energies [3–5] of single-particle orbitals around the ^{208}Pb shell gaps, relative to ^{208}Pb [6]. Arrows show $\Delta l = \Delta j = 3$ orbital pairs across the gap.

^{206}Hg two transitions

1.4 GeV proton ($0.6 \mu\text{A}$) on liquid lead
 $7.8 \times 10^5 \text{ pps } ^{206}\text{Hg}$ (laser ionised)
+ $3 \times 10^5 \text{ pps } ^{130}\text{Xe}$
4.195 MeV/u; 3.33 Hz HIE-ISOLDE
2 mg/cm² ^{94}Mo (and ^{104}Pd) targets
Miniball + DSSD

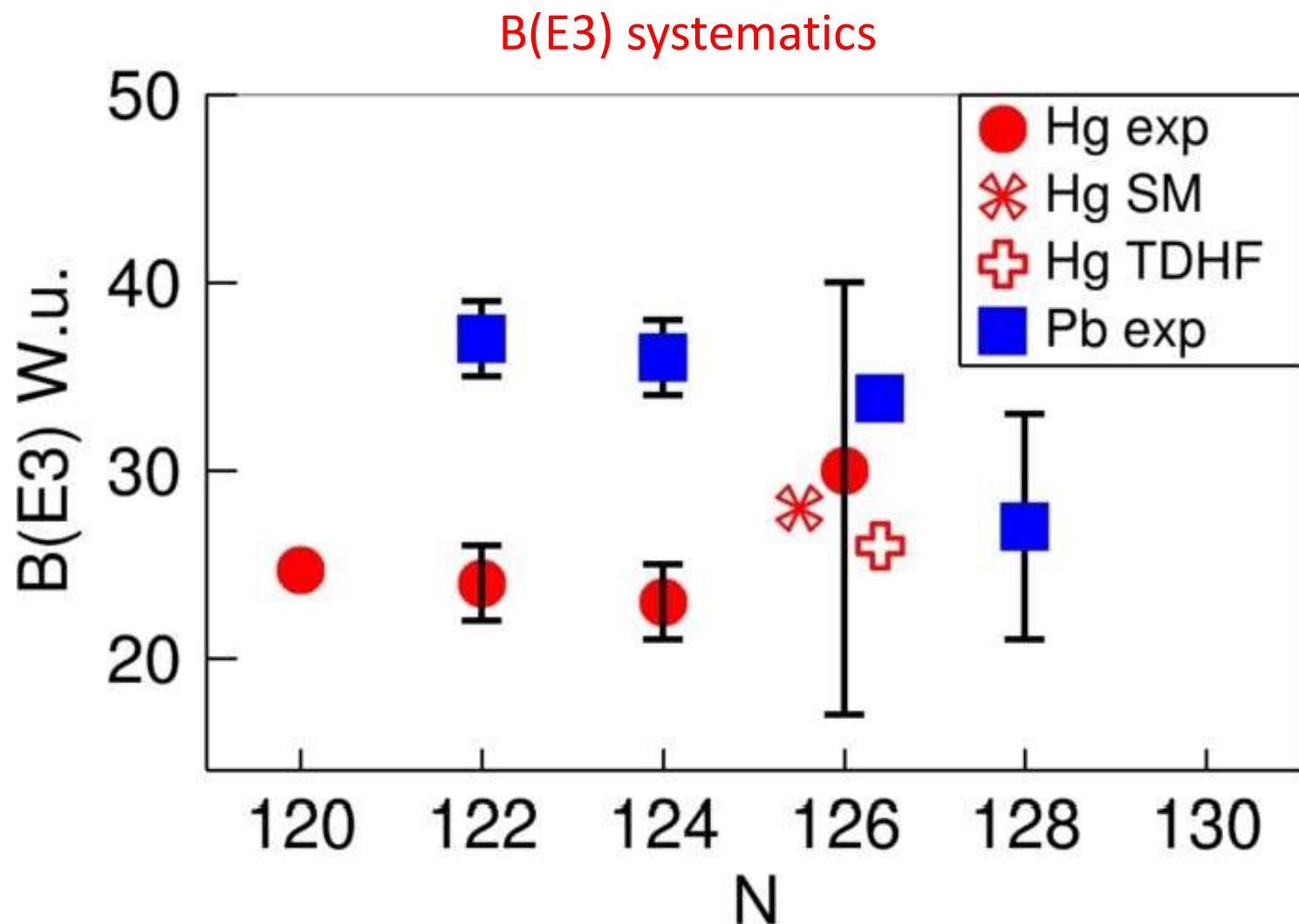


Comparison with theory

Comparison of the relevant experimental energies and electromagnetic properties with theoretical values based on the shell model (SM) and time-dependent Hartree-Fock (TDHF) calculations in ^{206}Hg . For details see the text.

Observable	Exp.	SM	TDHF
$E(2_1^+)$ (keV)	1068	1068	-
$B(E2; 2_1^+ \rightarrow 0_1^+)$ (W.u.)	4.4(6)	5.42	-
$E(3_1^-)$ (keV)	2705(2)	2657	2990
$B(E3)$ (W.u.)	30_{-13}^{+10}	28	26
$Q_s(2_1^+)$ (eb)	0.0(6)	0.41	-
$B(E2; 10^+ \rightarrow 8^+)$ (W.u.)	0.84(7) ^a	0.87	-
$Q_s(5^-)$ (eb)	0.74(15) ^b	0.57	-

Fixes $e_\pi = 1.5e$ (E2)



B(E3) in Pb > B(E3) in Hg

Collective (vibrational) octupole

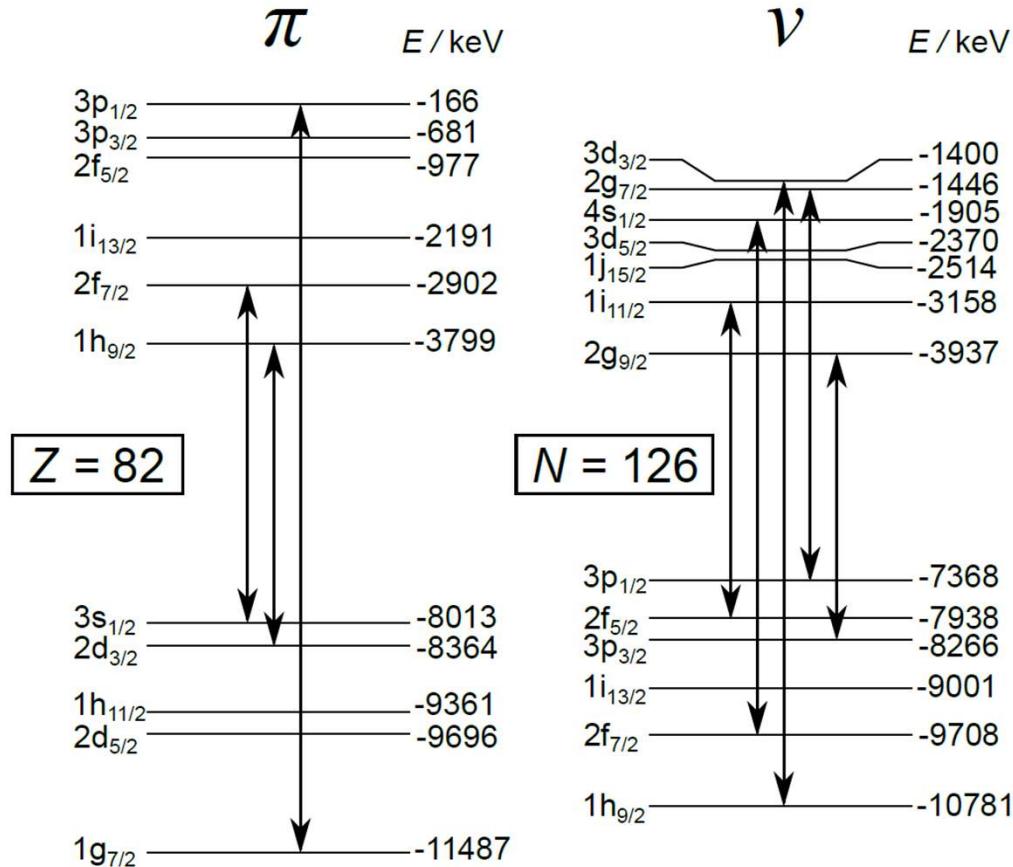
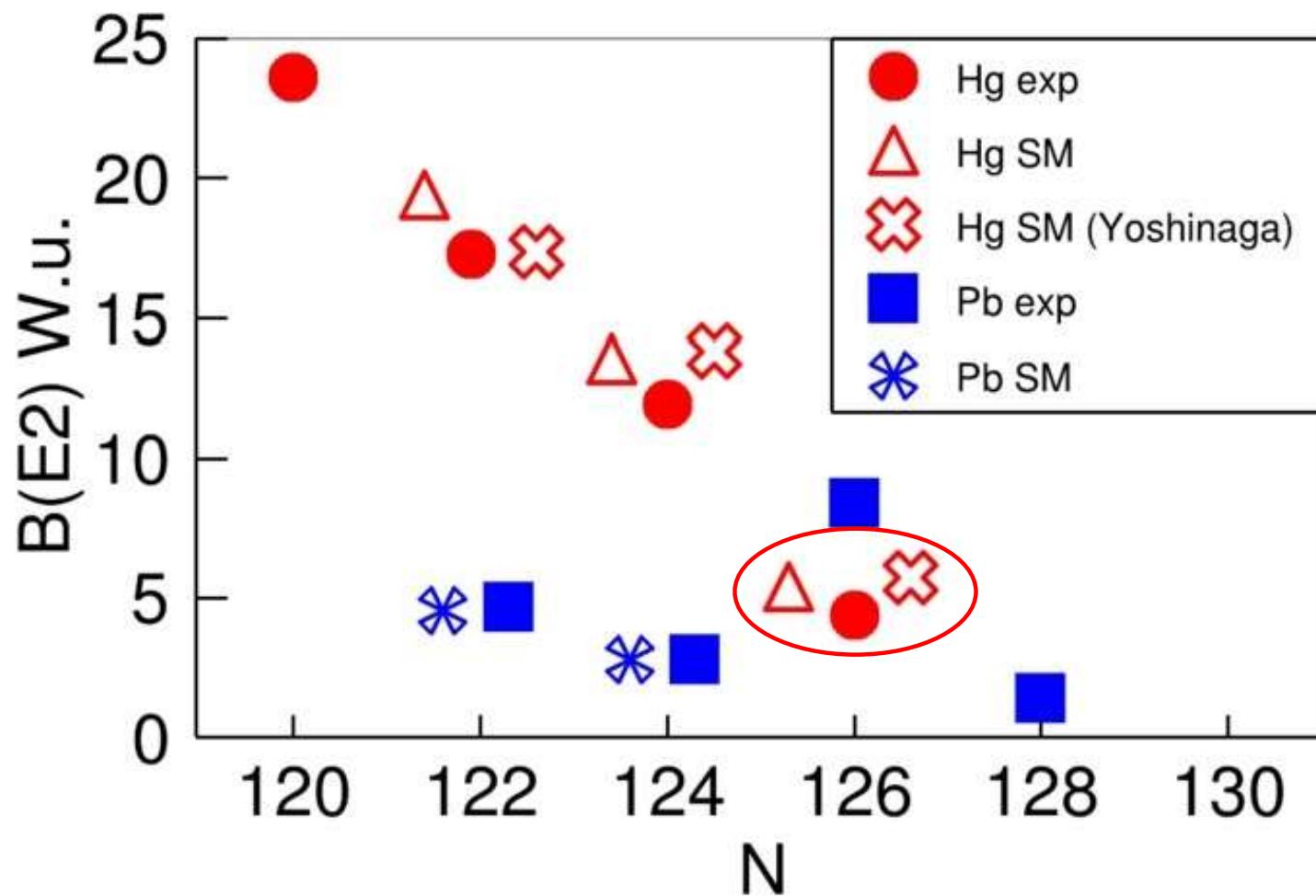


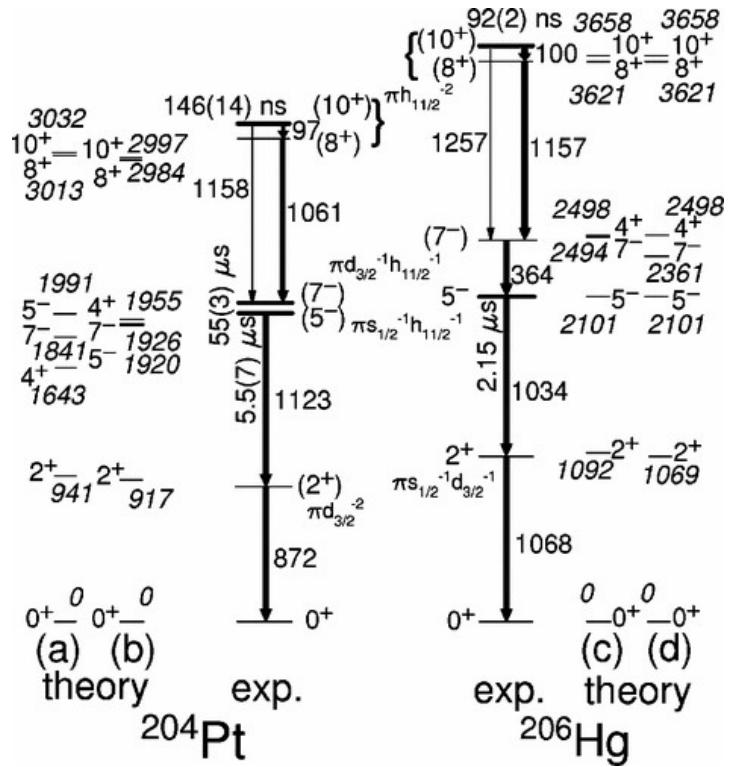
Figure 1.1: Empirical energies [3-5] of single-particle orbitals around the ^{208}Pb shell gaps, relative to ^{208}Pb [6]. Arrows show $\Delta l = \Delta j = 3$ orbital pairs across the gap.

Hg: $\pi s_{1/2}$ is empty \Rightarrow the $3^- \rightarrow 0^+$ misses the $s_{1/2}$ - $f_{7/2}$ correlations

B(E2) systematics



The 2^+ state wave function is poorly understood



$B(E3; 5^- \rightarrow 2^+)$ values in W.u.

	exp.	the(a)	the(b)
^{206}Hg	0.18(2)	1.17	0.90
^{204}Pt	0.039(5)	0.713	0.612

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

...discrepancy is common to both ^{206}Hg and ^{204}Pt and most likely due to the 2^+ wave function, which in a pure proton model space is poorly described. Note that E3 transitions are mediated by the $h_{11/2} \rightarrow d_{5/2}$ conversion,...

S.J. Steer et al., Phys.Rev. C 78, 061302 (2008)

DESPEC FAIR-0 experiment at GSI, May 2022

^A Ex $T_{1/2}$	β^- Decay										²⁰⁴ Pb	²⁰⁵ Pb 2 x 10^7 y	²⁰⁶ Pb	²⁰⁷ Pb	²⁰⁸ Pb	²⁰⁹ Pb 3.2 h	²¹⁰ Pb 22.2 y				
	● β^- Decay (Discovered at GSI after 2010)										²⁰³ Tl	²⁰⁴ Tl 3.8 y	²⁰⁵ Tl	²⁰⁶ Tl 4.2 m	²⁰⁷ Tl 4.8 m	²⁰⁸ Tl 3.1 m	²⁰⁹ Tl 2.2 m				
	● Stable										²⁰³ Hg	^{46.6} d	²⁰⁴ Hg	²⁰⁵ Hg 5.1 m	²⁰⁶ Hg 8.3 m	²⁰⁷ Hg 2.9 m	²⁰⁸ Hg 41 m				
	■ Isomeric states										²⁰² Hg	■	²⁰³ Au	²⁰⁴ Au 39.8 s	²⁰⁵ Au 32.5 s	²⁰⁶ Au 40 s	²⁰⁷ Au >300 ns				
											¹⁹⁸ Au 2.7 d	■	¹⁹⁹ Au 3.1 d	²⁰⁰ Au 48.4 m	²⁰¹ Au 26.0 m	²⁰² Au 28.4 s	²⁰³ Au 60 s	²⁰⁴ Au 39.8 s			
											¹⁹⁷ Pt 19.9 h	■	¹⁹⁸ Pt	¹⁹⁹ Pt 30.8 m	²⁰⁰ Pt 12.6 h	²⁰¹ Pt 2.5 m	²⁰² Pt 44 h	²⁰³ Pt 10 s			
											¹⁹⁴ Pt	■	¹⁹⁵ Pt	^{19.9} h	²⁰¹ Pt 2.5 m	²⁰⁴ Pt 10.3 s	²⁰⁵ Pt >300 ns				
											¹⁹³ Ir 19.3 h	¹⁹⁴ Ir 19.3 h	¹⁹⁵ Ir 2.3 h	¹⁹⁶ Ir 52 s	¹⁹⁷ Ir 5.8 m	¹⁹⁸ Ir 8 s	¹⁹⁹ Ir 6 s	²⁰⁰ Ir >300 ns			
											¹⁹² Os 30.1 h	¹⁹³ Os 30.1 h	¹⁹⁴ Os 6.0 y	¹⁹⁵ Os ~9 m	¹⁹⁶ Os 34.9 m	¹⁹⁷ Os 2.8 m	¹⁹⁸ Os ■■	¹⁹⁹ Os 5 s	²⁰⁰ Os 6 s		
											¹⁹¹ Re 9.8 m	■	¹⁹² Re 16 s	¹⁹³ Re >160 ns	¹⁹⁴ Re 5 s	¹⁹⁵ Re 6 s	¹⁹⁶ Re 3 s	¹⁹⁷ Re >160 ns			
											¹⁸⁸ Re 17.0 h	¹⁸⁹ Re 24.3 h	¹⁹⁰ Re 3.1 m	¹⁹¹ Re 9.8 m	¹⁹² Re 16 s	¹⁹³ Re >160 ns	¹⁹⁴ Re 5 s	¹⁹⁵ Re 6 s	¹⁹⁶ Re 3 s	¹⁹⁷ Re >160 ns	
											¹⁸⁷ W 24.0 h	¹⁸⁸ W 69.78 d	¹⁸⁹ W 10.7 m	¹⁹⁰ W 30.0 m	¹⁹¹ W >300 ns	¹⁹² W >300 ns	¹⁹³ W >300 ns	¹⁹⁴ W >300 ns	¹⁹⁵ W >160 ns	¹⁹⁶ W >160 ns	¹⁹⁷ W >160 ns
											¹⁸⁶ Ta 10.5 m	¹⁸⁷ Ta 2.3 m	¹⁸⁸ Ta 19.6 s	¹⁸⁹ Ta >300 ns	¹⁹⁰ Ta 5.3 s	¹⁹¹ Ta >300 ns	¹⁹² Ta 2.2 s	¹⁹³ Ta >160 ns	¹⁹⁴ Ta >160 ns		
											¹⁸⁵ Hf 3.5 m	¹⁸⁶ Hf 2.6 m	¹⁸⁷ Hf 0.27 μ s	¹⁸⁸ Hf >160 ns	¹⁸⁹ Hf >160 ns	¹⁹⁰ Hf >160 ns					

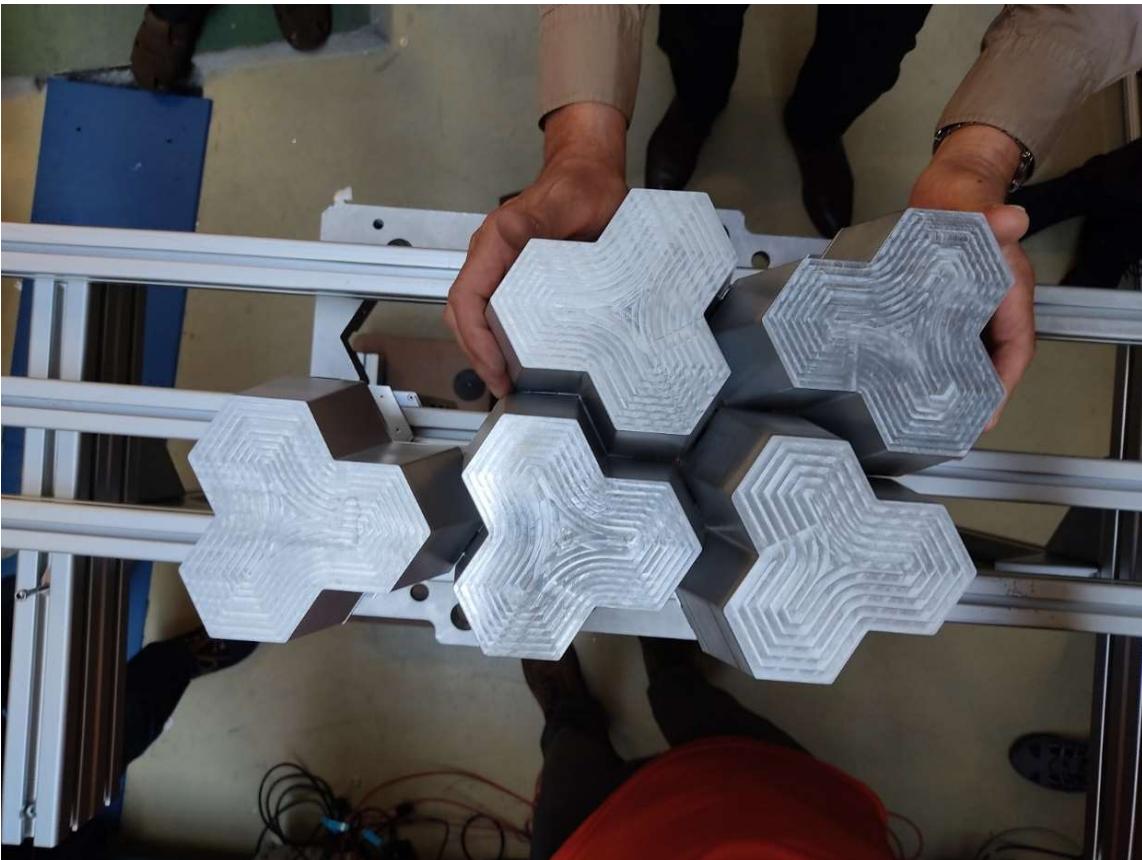
Nucleus Total nuclei Previous exp in 2006⁺
Ir-203 31,885 8,000
(Os-202) ? 20

Spokesperson: Zs. P.

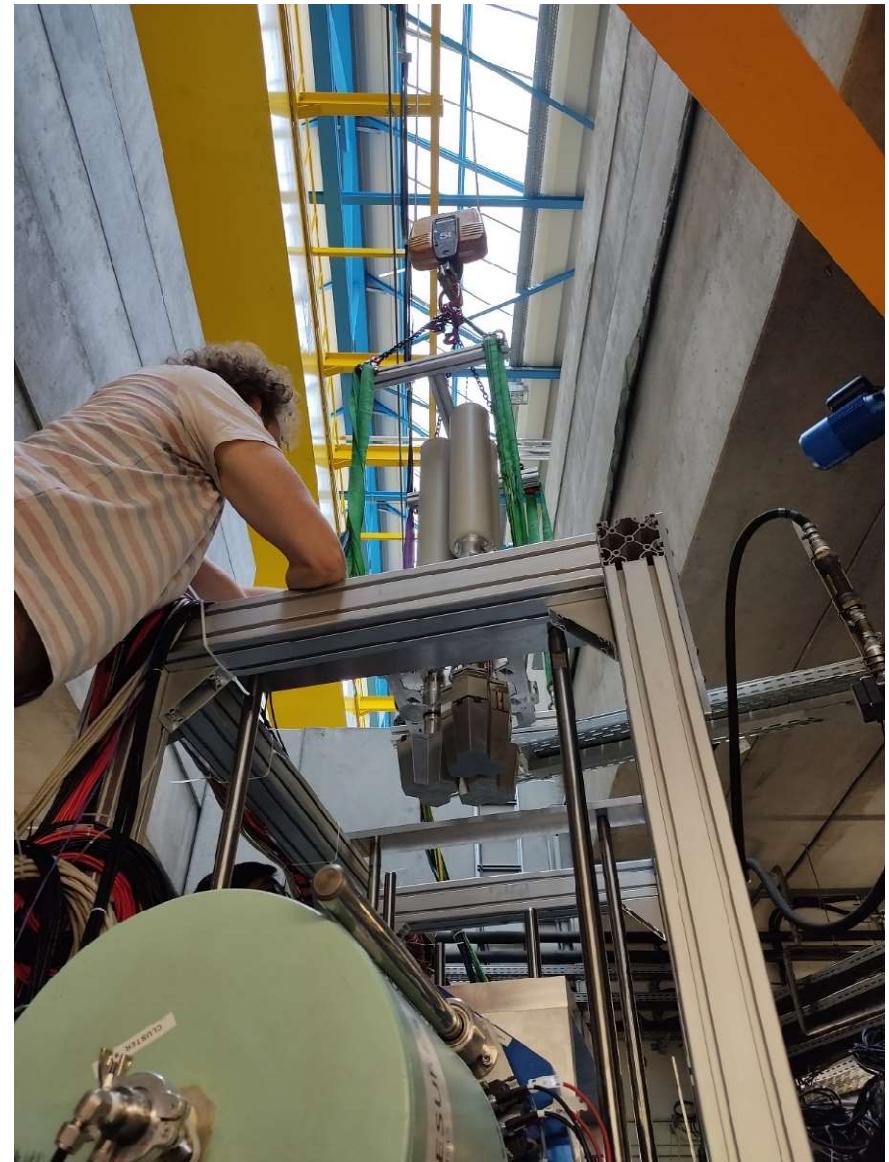
Analysis: Gee Bartram

⁺S. J. Steer et al, Int.J.Mod.Phys. E18, 1002 (2009)

DEGAS



I. Kojouharov, J. Gerl etc.



DEGAS + AIDA



8 triple
Detectors
+ 2 Clusters

I. Kojouharov, J. Gerl etc.

Conclusions

- safe Coulex of $^{206}\text{Hg}_{126}$ at MINIBAL, HIE-ISOLDE
- $E(3^+) = 2637 \text{ keV}$ $B(E3) = 30^{+10}_{-13} \text{ W.u.}$
- $B(E2) = 4.4(6) \text{ W.u.} < B(E2)_{\text{SM}} = 5.42 \text{ W.u.}$
- shell model and time-dependent Hartree-Fock calculations
- 2^+ wave function not completely understood

L. Morrison et al., Phys. Lett. B 838, 137675 (2023)

- S450 DESPEC exp. at GSI in May 2022
- DEGAS array
- ^{203}Ir isomer

DESPEC collaboration