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# High-spin Yrast Isomers in <sup>204</sup>Hg

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	At 204	AI 205	At 206	At 207	At 208	At 209	At 210	At 211	At 212	At 213	A 214	At 215
	9,2 m	26,2 m	29,4 m	1,8 h	1,63 h	5,4 h	8,3 h	7,22,h	119 ms 314 ms	0,11 μs	1999 an 1997 per 1996 and	0,1 ms
	a 5,951 y 684: 516;	β' y 719: 669:	α 5.703 γ 701: 477:	o 5.759 y 815: 588;	α 5.640 γ 696: 660;	a 5,647 7 545; 782;	5,442; 5,361 y 1181; 245;	ο 5.867 γ (687)	e 7,94; c 7,68; 7,50; 7,62; 9,63; 5,69;		~ 5.755 + 8.819 	ar 8,026
	426	629 : g	396	901; g	177	790	1483	1	5 F	0.008	· • •	y (405)
	Po 203	Po 204 3.53 h	Po 205	Po 206 8.8 d	Po 207	Po 208 2.898 a	Po 209 102 a	Po 210 138.38 d	PO 211 25.2 s - 0.516 s	PO 212 45.1 s 17.1 nsl 0.3s	PO 213 4.2 us	PO 214 164 µs
20	*10 <sup>+</sup> x 0.584	5.077	ε; β <sup>+</sup>	e: α 5,2233	*/B <sup>4</sup>	ec 5,1152	ac 4,881	n 5,30438	n 1 275. 6	1163 (j. 774;		
	n 506; 1001; 804; ∞641	→ BB4: 270; 1016	→ 872; 1001; 850; 837	286: 807 em.g	1, 305: 3902; 269: 745 301 912. J. d	γ (292: 571) 1	γ (895; 261; 263)	4 < 0.0005 - < 0.030	1051. s (556 b) \$70	Y <sup>250</sup> 19 402 560 973 - 1 0.0027 -16386	a 8.376 y (779)	x 7.6869 y (800; 298)
	Bi 202	Bi 203	Bi 204	Bi 205	Bi 206	Bi 207	Bi 208	Fi 209	Bi 210	Bi 211	Bi 212	Bi 213
	1,72 h	11,76 h	11,22 h	15,31 d	6,24 d	31,55 a	3,68 · 10 <sup>5</sup> a	100	3,0-10 <sup>5</sup> a 5,013 d	2,17 m	9 m 25 m 60,10 m +0.34 T 23	45,59 m
	• β γ 961; 422;	e: 37 1.4. 7 820: 825:	* 7 899; 375;	β*	t 8 <sup>1</sup>	6 <sup>+</sup>		Second Second	4 205 . n 4,680 1 200 4,086	α 6/6229; 6/2788 β	10 10 EEL 175	α 5.87 α 5.87
	9	g; m	g; m	988.	1719; 537	1770	- 2.15		0004 200	0-10 B-10	10 141 pointe	1100)
	Pb 201	Pb 202	Pb 203	Pb 204	Pb 205	Pb 200	Pb 21 2	08	253 b	Pb 210	Pb 211	Pb 212
Jn	618 9/4 ft	3,64 0 3,23-1918 1,961; 1,22	6,2 8 51,0 h	64.2 m	1,5 · 10 · a			<b>D</b>	235 11	BT 0,02; 0,08	00,1 11	10,0411
	~ 330) 901	787	v 826. v 279.	1-531; 1*2:	e nov	- 0.030	r D 70		.6	γ 47; 67; g at 3,72	97 1,4 7405; 832;	p= 0.3; 0.8 5 239; 300
	TI 200	TI 201	TI 202	TI 203	T 204	TI 205	TI 206		TI 208	TI 209	TI 210	TI 211
	26,1 h	73,1 h	12,23 d	29,524	3,78 a	70,476	3,7 m 4,20 m	1,	3,053 m	2,16 m	1,30 m	
	ε β <sup>#</sup>	Non-Sec.			β=0,8, +		455 216		β <sup>-</sup> 1.8. 2.4	β= 1.8	β=1,9, 2,3	
	y 368; 1205; 579; 828	γ 167: 135	ý 440; (520)	And Andrewson	noγ: g σ 22	e 0.11	258. f. 1.5 1321	γ1 IQ (5°1.4 351 γ-(393)	511; 860; 277	y 1567; 455; 117	9800; 298 Gil	
-	Hg 199	Hg 200	Hg 201	Hg 202	Hg 203	Hg 204	Hg 205	lg 206	Hg 207	Hg 208	Hg 209	Hg 210
	42,6 m 16,87	23,10	1018	29,66	46,59 0	6,87	∋,2 m	15 m	2,9 m β=1,8	~ 42 111	35 8	21.840
IY	hy 158: 394				p= 0,2		β= 1,5	y 305; 650	y 351; 997, 1637	β <sup>=</sup>	β-	
•	Au 109	100	Au 200	Au 201	ALL 202	Au 203	Au 204	9 Au 205	uv" č	1 1 a / a	y 329	
	2,30 d 2,6943 d	2,139 d	18,7 h 48,4 m	26,4 m	28 s	60 s	39,8 s	31 s				
	10.215	β <sup>+-</sup> 0.3; 0,5 γ158; 208	1-96 3123. 1-96 400 1-920	β <sup></sup> 1,3	β= 3,5	β <sup>−</sup> 2.0	β <sup>-</sup> γ437; 1511;	8-				
	130 1412	9 # 30	575,290 1236; J=233	y 543; 517; 813; 167	-v440; 1125; 1307; 1204	7218: 44; 51; 318: 369	692; 723; 1392	γ 379: 467; 946: 813…				
_	Pt 197	Pt 198	Pt 199	Pt 200	Pt 201	Pt 202						
Df	94,4 m 18,3 h 8706:	7,2	13,6 s 30,8 m	12,5 h	2,5 m	~ 43,6 h						
	4 <sup>-</sup> 4 <sup>-</sup> 1 <sup>-</sup> 0.7 181		57 1.7 7 545 489 32 317 194	776; 136; 244; 60; 227.	β= 2.7			~				
	n 07.9	vir:0,027 + 4.0	e* - 10	cī:g	y 1760	β-	•	0'				

#### HIGH-SPIN STATES BEFORE PRESENT STUDY



# Valance hole configurations

tentative (8+)



#### Incomplete – fusion reaction A.R. Poletti *et al.*, A473 (1987) 595

## **EXPERIMENTS**:

**Deep-inelastic reactions** successful application for spectroscopic study around <sup>208</sup>Pb

ANL Argonne -

- GAMMASPHER Array 101 detectors,
- Atlas accelerator
- <sup>208</sup>Pb (1360 MeV) + <sup>238</sup>U thick target 50mg/cm<sup>2</sup> pulsed beam 1.65 µs repetition time events: ~ 2.3 x 10<sup>9</sup>
- $^{48}Ca (330 \text{ MeV}) + ^{238}U$

#### $\gamma$ - $\gamma$ TIME CORRELATIONS





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#### limit τ>1μs (424,965) x (437,692,1062) 6258 6162 6052 (47) τ=9.1(9) ns (95) τ=33 ns (424) x (536,1127,921) + <sup>1000</sup> (965,598) × ( 1127,921) τ=9.1 ns 2263 2191 τ=33(3) ns -150 -100 -50 -200 <sup>204</sup><sub>80</sub>Hg<sub>124</sub> time difference [ns]

## **LIFE-TIME DETERMINATION**

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counts

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#### LEVEL SCHEME

### Observed prompt gamma transitions



#### SPIN & PARITY ASSIGMENT

Electron conversion coefficients Decay patern



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2436

2195

1944

τ>1us

(25-



### SHELL MODEL CALCULATION

B(E3,  $22^+ \rightarrow 19^-$ ) < 0.86 W.u. B(E2,  $14^+ \rightarrow 12^+$ ) =5.1(5) W.u. B(E3,  $7^- \rightarrow 4^+$ ) =1.4(2) W.u.

![](_page_10_Figure_2.jpeg)

 $\pi_{h11/2}^{-2} vi_{13/2}^{-2}$   $\pi h_{11/2}^{-2} vi_{13/2}^{-1} f_{5/2}^{-1}$   $\pi h_{11/2}^{-1} d_{3/2}^{-1} vi_{13/2}^{-2}$   $10^{+} \rightarrow 7^{-206} Hg$   $\pi h_{11/2}^{-1} d_{5/2}^{-1}$   $12^{+} \rightarrow 9^{-206} Pb$   $vi_{13/2}^{-1} f_{7/2}^{-1}$ B.Fornal et al., Phys.Let. 87 (2001) 212501-1

#### OXBASH CODE

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Configuration space between <sup>132</sup>Sn and <sup>208</sup>Pb based on Kuo-Herling interactions proton-proton & proton-neutron interactions: L.Rydstroem, J. Blomqvist et al., Nucl. Phys. A512 (1990) 217 J.B. Mcgrory and T.T.S. Kuo, Nucl. Phys. A274 (1975) 283

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#### **SUMMERY**

Deep-inelastic reaction of a ~1.4 GeV  $^{208}$ Pb beam on a thick  $^{238}$ U target successfully used to populate high-spin states in  $^{204}$ Hg up to 25<sup>-</sup>.

New high-spin isomer with  $\tau > 1 \mu s$  found with pure configuration arising from the maximum spin coupling of the valance holes to 22<sup>+</sup>.

The observed  $\gamma$ -ray decay established the yrast states below long isomer, including another isomer with  $\tau = 33(3)$  ns.

Spin and parity assignments based on total conversion coefficients deduced from intensity balance and on the observed γ-decay patterns.

Observed good agreement of established level scheme with shell model calculations that include four holes in the entire configuration space between <sup>132</sup>Sn and <sup>208</sup>Pb supports spin-parity assignment.