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Structure of the ^{252}Es ground state

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Nuclear Physics

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Known assignments for ^{252}Es g.s.

⇒ deformed odd-odd nucleus
- Z=99 – just ***below*** the Z=100 deformed shell gap
- N=153 – just ***above*** the N=152 deformed shell gap

⇒ ENSDF
Kπ=(5-), π3/2[521] ν7/2[613]

⇒ NUBASE2020
Kπ=(4+), π7/2[633] ν1/2[620]

Nuclear Physics **A208** (1973) 269–286; © *North-Holland Publishing Co., Amsterdam*

NUCLEAR SPECTROSCOPIC STUDIES OF ^{252}Es

73Fi06

P. R. FIELDS, I. AHMAD, R. F. BARNES and R. K. SJOBLOM

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⇒ ^{252}Es ε decay to ^{252}Cf, systematics
Kπ=5-, π3/2[521] ν7/2[613]

Nuclear Physics A563 (1993) 21–73

Decay properties of heavy mendelevium isotopes

93Mo18

K.J. Moody, R.W. Lougheed, J.F. Wild, R.J. Dougan, E.K. Hulet, R.W. Hoff, C.M. Henderson, R.J. Dupzyk, R.L. Hahn [1], K. Sümmerer [2], G.D. O'Kelley [3], G.R. Bethune †

University of California, Lawrence Livermore National Laboratory, Livermore, CA 94551, USA

⇒ ^{256}Md α decay to ^{252}Es; systematics
Kπ=4+, π7/2[633] ν1/2[620]

IOP PUBLISHING

J. Phys. G: Nucl. Part. Phys. **35** (2008) 095105 (10pp)

Characterization of two-quasiparticle levels in the odd–odd nucleus ^{252}Es

08Sa31

M Sainath[1], K Venkataramaniah and P C Sood

⇒ systematics
Kπ=4+, π7/2[633] ν1/2[620]

Current ENSDF assignment for ^{252}Es

E(level)	J^π	$T_{1/2}$	XREF	Comments
0.0	(5^-)	471.7 d *19*	A	%ε=22 *2*; %α=78 *2* %ε,%α: from 1973Fi06 based on the measured ratio of α and 785.1γ (0.7 photon per ε decay) intensities. $T_{1/2}(\beta^-)$>20 y (1956Ha80). J^π: β^- decay to (3^+) with log *ft*=8.3 *4*; no β^- and ε branches to $K^\pi=0^+$ g.s. bands in ^{252}Cf and in ^{252}Fm. Possible $K^\pi=5^-$, $\pi 3/2^-[521]\otimes\nu 7/2^+[613]$ configuration for ^{252}Es g.s. is consistent with its β decay and with the α decay from ^{256}Md. $T_{1/2}$: from 1977Ah03. Other: ≈140 d (1956Ha80), 350 d *50* (1973Fi06), 471 d *5* (1975AhZW).
35 *11*			A	
436 *9*			A	
476 *8*	(1^-)		A	J^π: favored α from ^{256}Md g.s, which was suggested to be $J=1^-$, $K=0$ with configuration $\pi 7/2^-[514]\otimes\nu 7/2^+[613]$ (1993Mo18).
542 *9*			A	

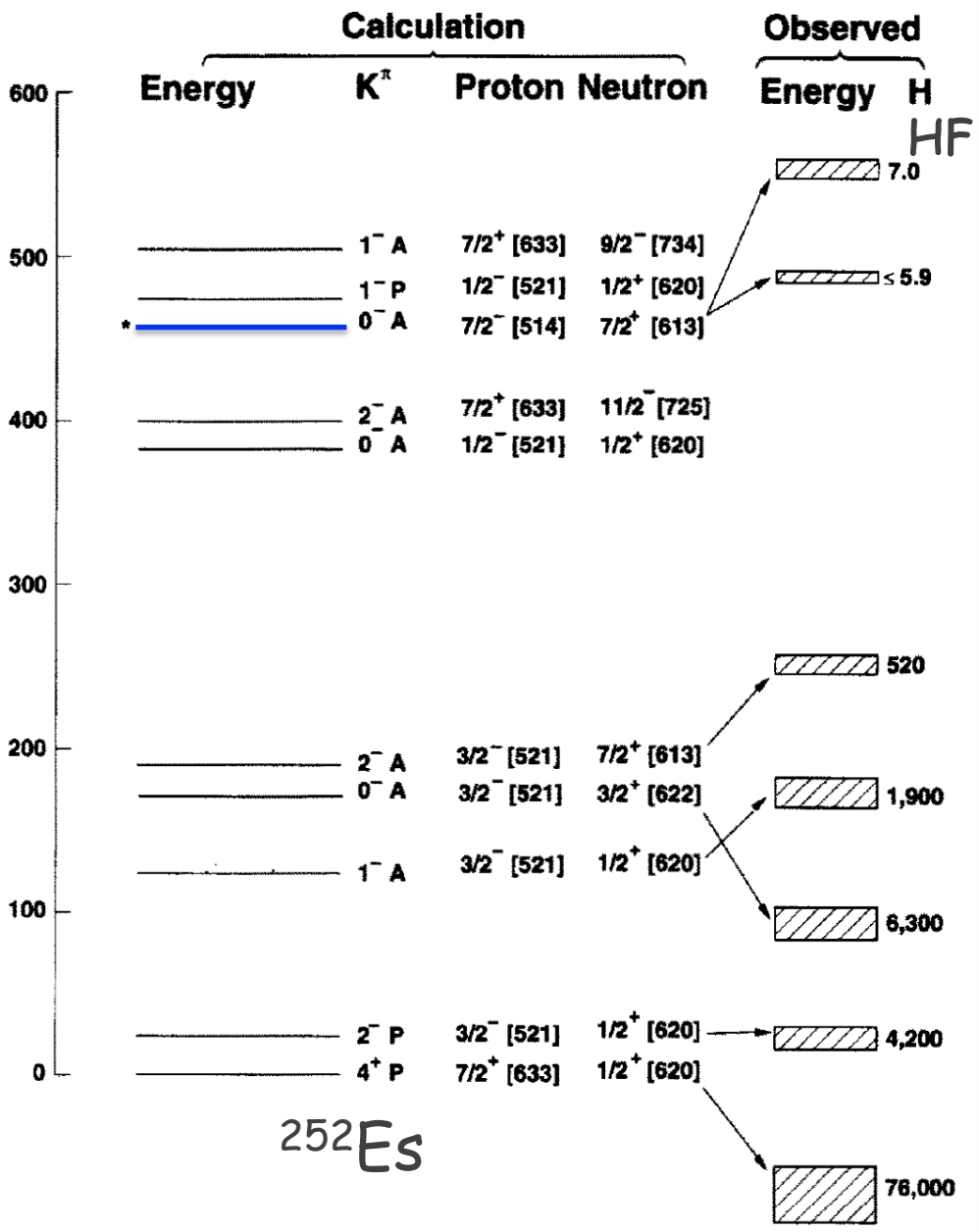
Jπ arguments:

- log *ft* =8.3(4) to (3+) in ^{252}Cf (^{252}Es ε decay)

CONF (and Jπ) arguments:

- consistent with its β decay (ε decay)
- consistent with α decay from ^{256}Md

^{256}Md α decay



Jπ & CONF arguments:

- consistent with α decay from ^{256}Md

Kπ=0-,Iπ=1-

^{256}Md

Kπ=0-, π7/2[514] ν7/2[613]

E_α

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CONCLUSION

- HF=76000
- it is not Kπ=0- & π7/2[514] ν7/2[613]

consistent with Kπ=5- & π3/2[521] ν7/2[613] ???

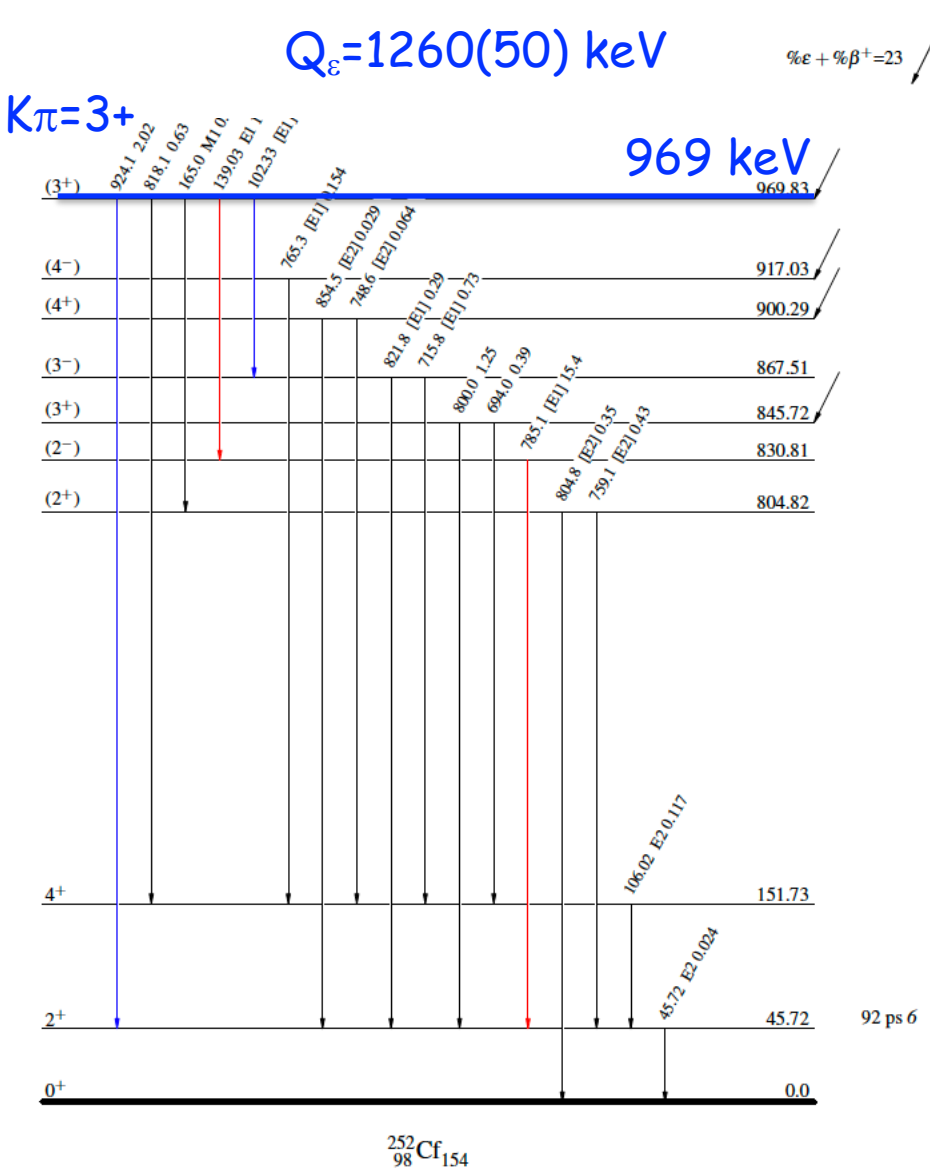
^{252}Es ε decay

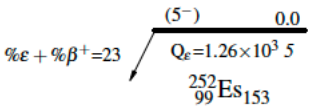
Jπ arguments in ENSDF (and 73Fi06):
log *ft* =8.3(4) to (3+) in ^{252}Cf (^{252}Es ε decay)

Q_ε=1260(50) keV

Kπ=3+

969 keV





Iε	Log *ft*
20	8.3 1u
0.16	11.25
0.095	11.54
1.64	10.1 1u

Kπ=5-, π3/2[521] ν7/2[613]

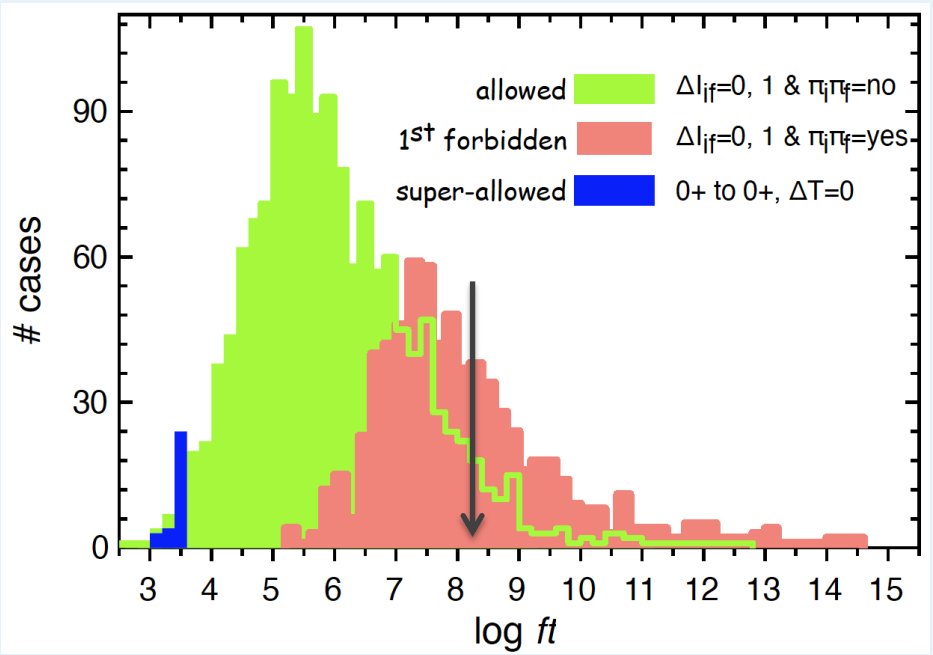
~100% branch to Kπ=3+, ν^2{1/2[620],7/2[613]}

⇒ log *ft* of 8.3 is not unique to 1FFU ($\Delta J=2, \pi_i\pi_f=-1$)

⇒ it is ΔK=2 forbidden – log *ft* ~8.3 + 4 ~ 12.3

P.M. Walker, F.G. Kondev, EPJ ST (2024)

π3/2[521] -> ν1/2[620] -> 1FF ($\Delta J=1, \pi_i\pi_f=-1$),
but NOT 1FFU ($\Delta J=2, \pi_i\pi_f=-1$)



S. Turkat et al., ADNDT 152 (2023) 101584

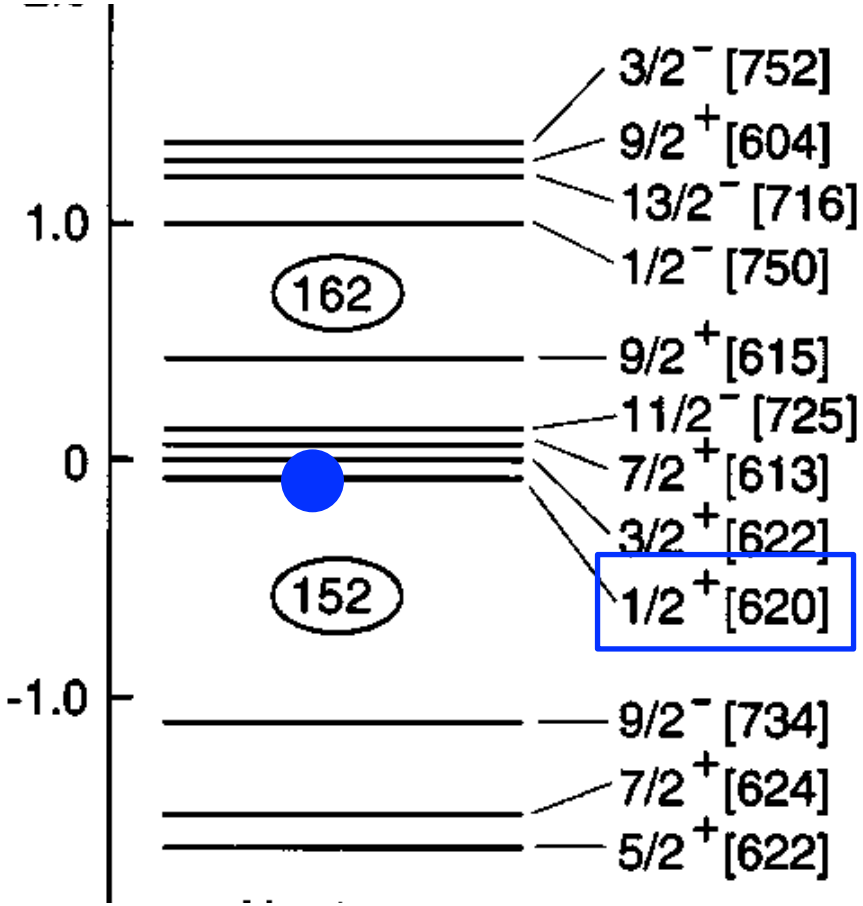
^{252}Es systematics

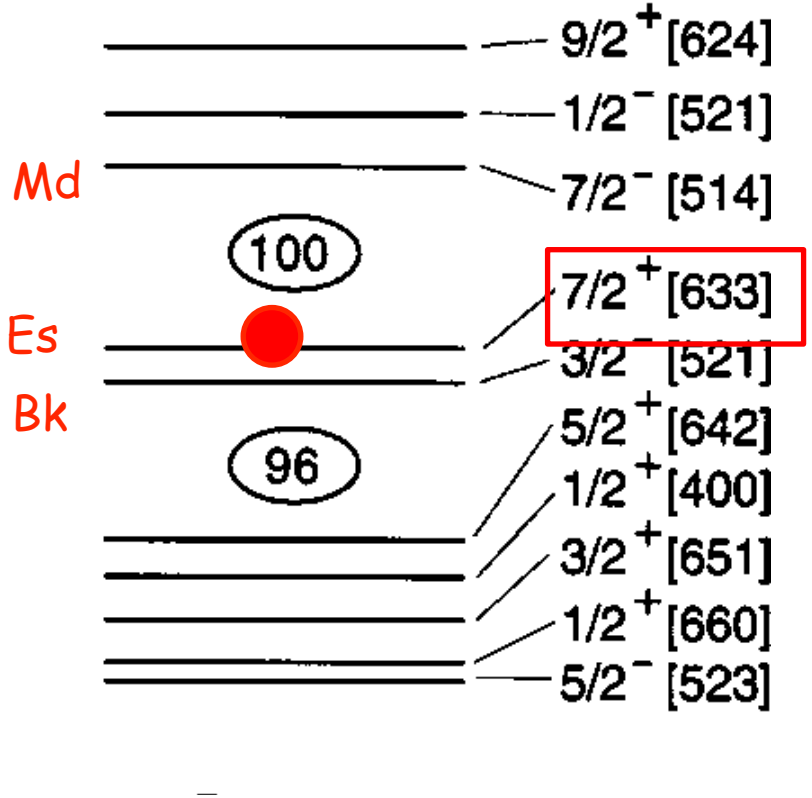
⇒odd-Z @ Z=99: ^{253}Es

Kπ=7/2+, π7/2[633] at the Fermi surface

⇒odd-N @N=153: ^{251}Cf, ^{253}Fm, ^{255}No

Kπ=1/2+, ν1/2[620] at the Fermi surface

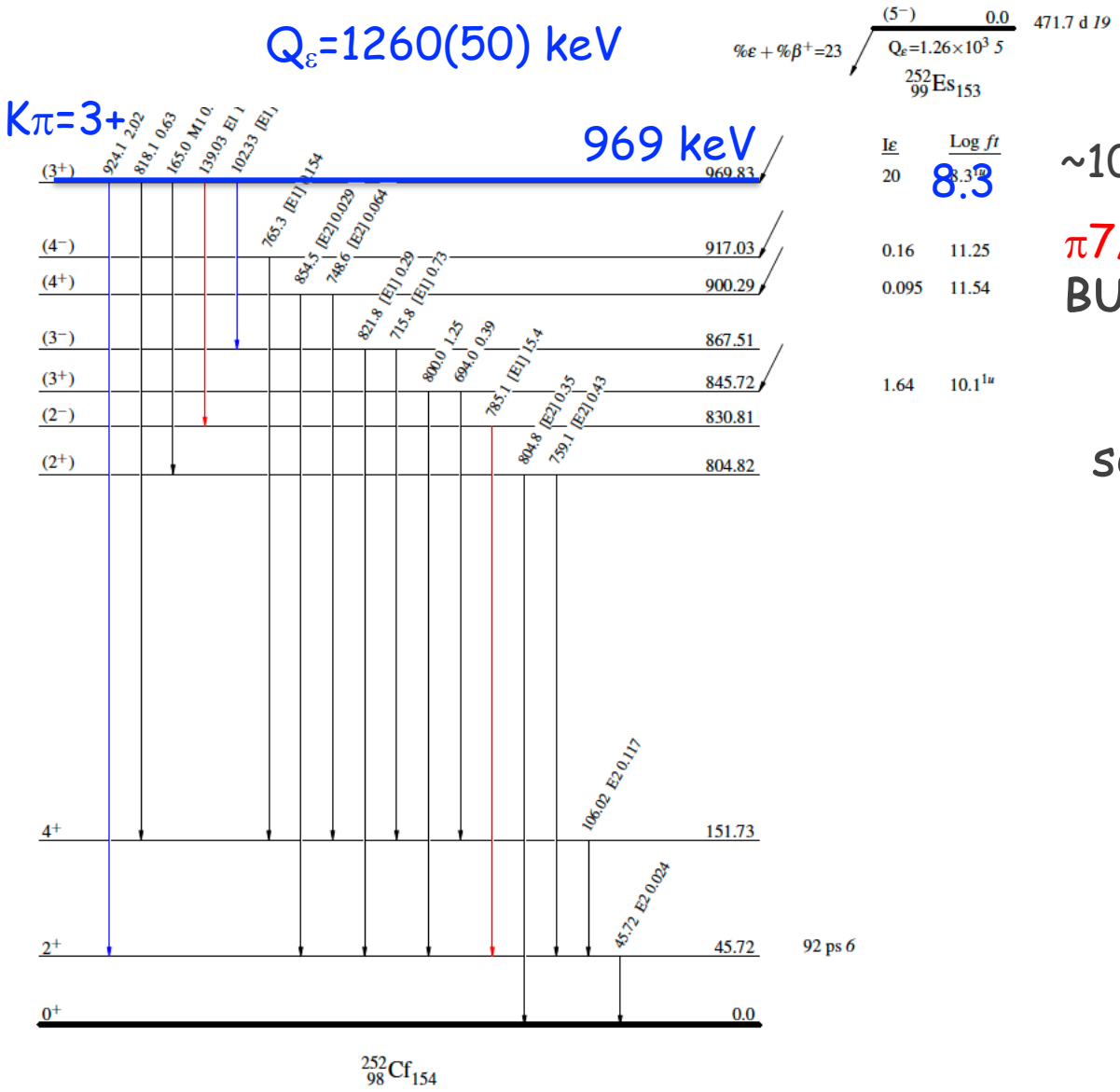




Kπ=4+, π7/2[633] ν1/2[620] – is expected to be g.s.

^{252}Es ε decay

Q_ε=1260(50) keV



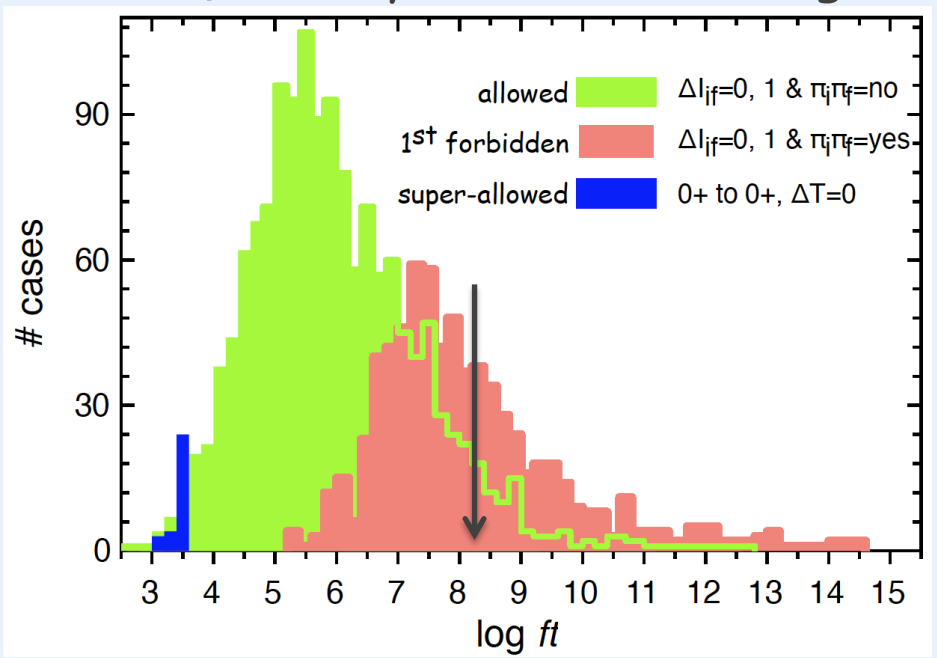
Kπ=4+, π7/2[633] ν1/2[620]

~100% branch to Kπ=3+, ν^2{1/2[620],7/2[613]}

π7/2[633] -> ν7/2[613] -> allowed in terms of $\Delta J=0,1, \pi_i\pi_f=+1$
BUT $\Delta n_Z=2$ forbidden within the Nilsson model

G. Alaga, Phys. Rev. 100 (1955) 432
J. Fujita et al., Phys. Rev. C1, (1970) 2060

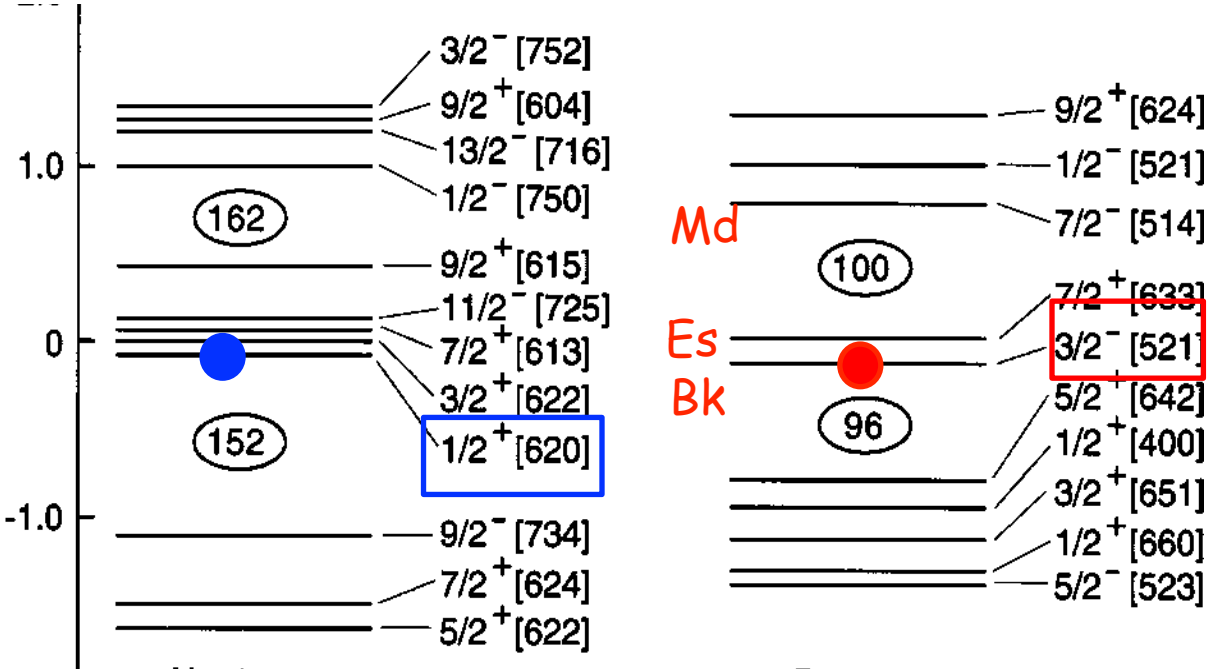
see also ^{156}Eu β⁻ decay: 0+ -> 0+ with log *ft*=9.83(4)



S. Turkat et al., ADNDT 152 (2023) 101584

odd-odd ^{250}Bk (Z=97 & N=153)

E(level)[f]	J^π	$T_{1/2}$[g]
0.0†	2^-	3.212 h *5*
		Kπ=2-, π3/2[521] ν1/2[620]
34.47†	(3^-)	
35.59‡	(4^+)	29 μs *1*
		Kπ=4+, π7/2[633] ν1/2[620]
78.33‡	(5^+)	
80.26†	(4^-)	
86# *2*	(7^+)	213 μs *8*
97.49@	(5^-)	38 ns *5*
		Kπ=5-, π3/2[521] ν7/2[613]
103.83&	(1^-)	
115.45a	(3^+)	



CONCLUSION for ^{252}Es

- Kπ=4+, π7/2[633] ν1/2[620] but NOT Kπ=5-, π3/2[521] ν7/2[613]