Search For Mixed-symmetry States In The Vicinity Of The Doubly-magic Nucleus ^{208}Pb

Robert Stegmann - TU Darmstadt

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Motivation

Mixed-Symmetric Quadrupole States

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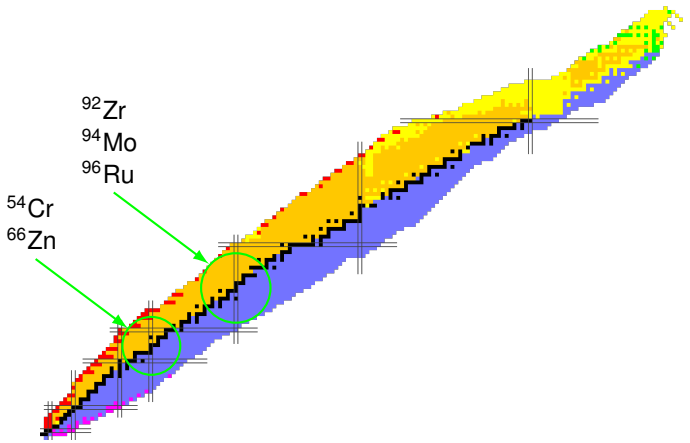

Motivation

^{94}Mo

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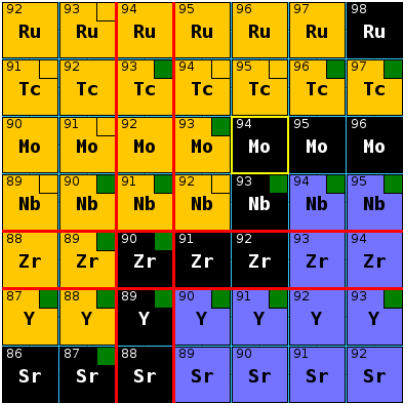
- Example of pronounced mixed-symmetry states
- Doubly-magic ^{90}Zr core + α particle
- Large orbital momenta for valence π and ν
  $\Rightarrow$ Large M1 transition strength
- $B(M1; 2_3^+ \rightarrow 2_1^+) = 0.56\,(5)\,\mu_N{}^2$
- Single dominant MSS



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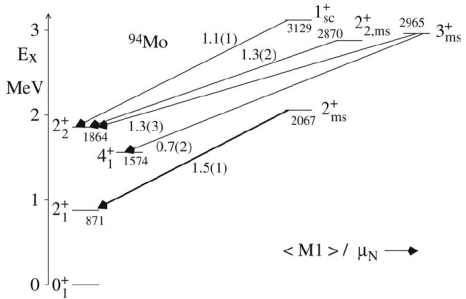
- Also two-phonon MSS identified



N. Pietralla, P. von Brentano and A. F. Liseskiy, PPNP **60**, 225 (2008).

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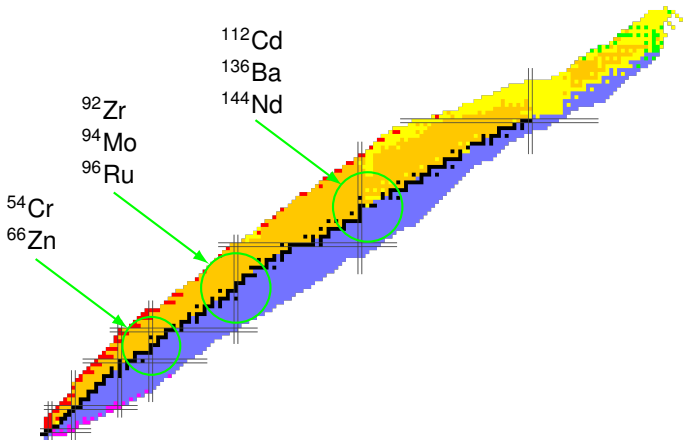

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N = 80 Isotones

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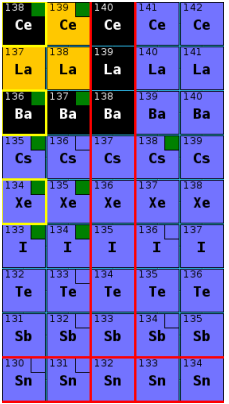
- Dominant fragments of MSS identified in N = 80 isotones
- Valence protons / valence neutron holes + ^{132}Sn core



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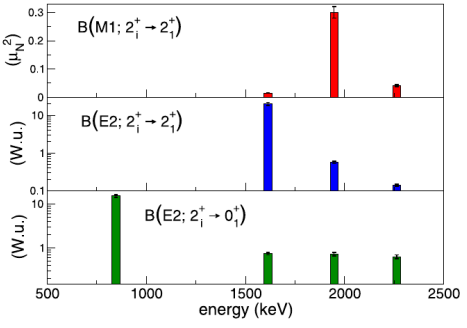
- Nuclei:
  - ^{134}Xe: $B(M1; 2_3^+ \rightarrow 2_1^+) = 0.30\,(2)\,\mu_N{}^2$

    T. Ahn, *et al.*, PLB **679**, 19 (2009).



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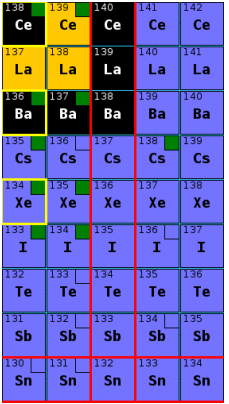

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  - ^{136}Ba: $B(M1; 2_3^+ \rightarrow 2_1^+) = 0.26\,(3)\,\mu_N{}^2$

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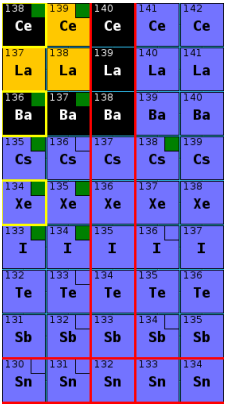

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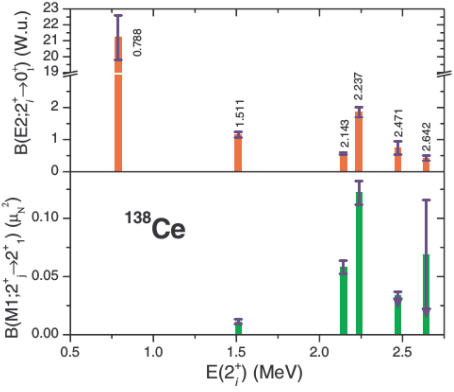
    N. Pietralla, *et al.*, PRC **58**, 796 (1998).
  - ^{138}Ce: $B(M1; 2_4^+ \rightarrow 2_1^+) = 0.122\,(10)\,\mu_N{}^2$

    G. Rainovski, *et al.*, PRL **96**, 122501 (2006).



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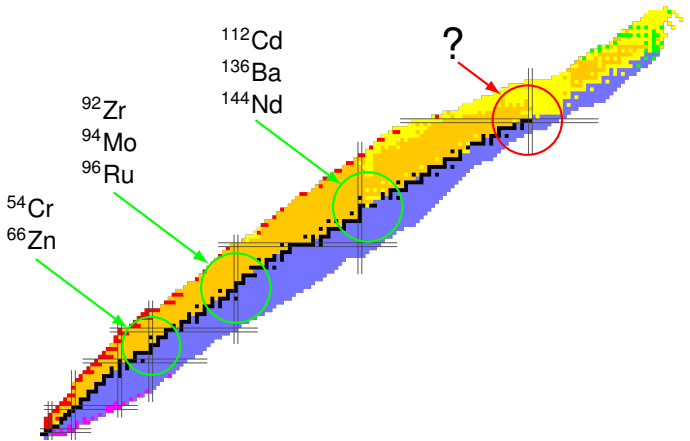

Experiment

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Gammasphere/Atlas @ ANL

- Coulomb excitation in inverse kinematics
  - ^{12}C(^{202}Hg, ^{202}Hg*)^{12}C
  - ^{12}C(^{204}Hg, ^{204}Hg*)^{12}C
- Beam: E_{kin} = 890 MeV
- Target: ^{12}C (1 mg/cm^2)
  1 mm thick Al
- Detector: GAMMASPHERE array
  - 100 HPGe detectors in 16 rings
  - Quasi 4π configuration
- γ-singles mode

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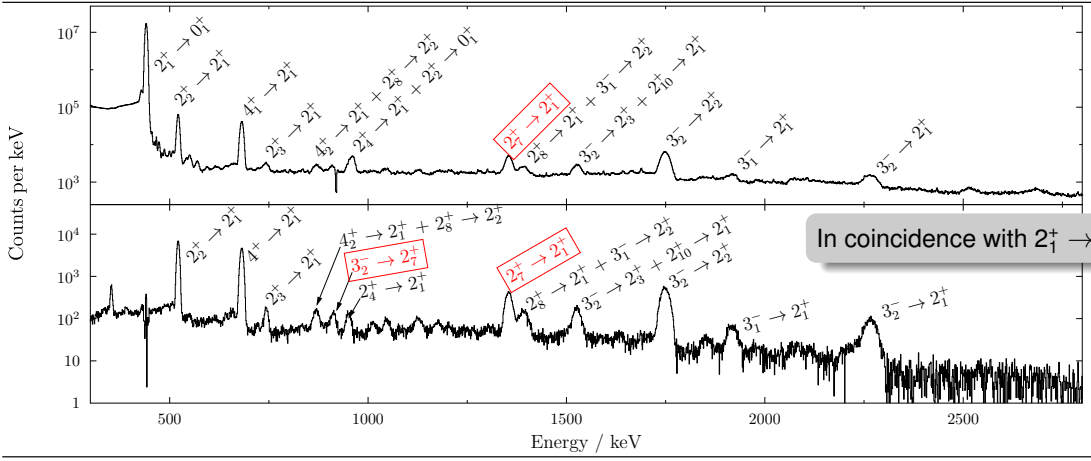
FN tandem @ U of Cologne

- α-transfer reaction
  ^{208}Pb(^{12}C, ^{8}Be)^{212}Po*
- Beam: E_{kin} = 62 MeV
- Target: ^{12}C (10 mg/cm^2)
- Detectors:
  - 12 HPGe detectors at 3 different angles
  - Array of 6 solar cells
- Master trigger: γ-α or γ-γ coincidences

Experiment

γ-ray spectra & level scheme – ^{202}Hg



In coincidence with $2_1^+ \to 0^+$

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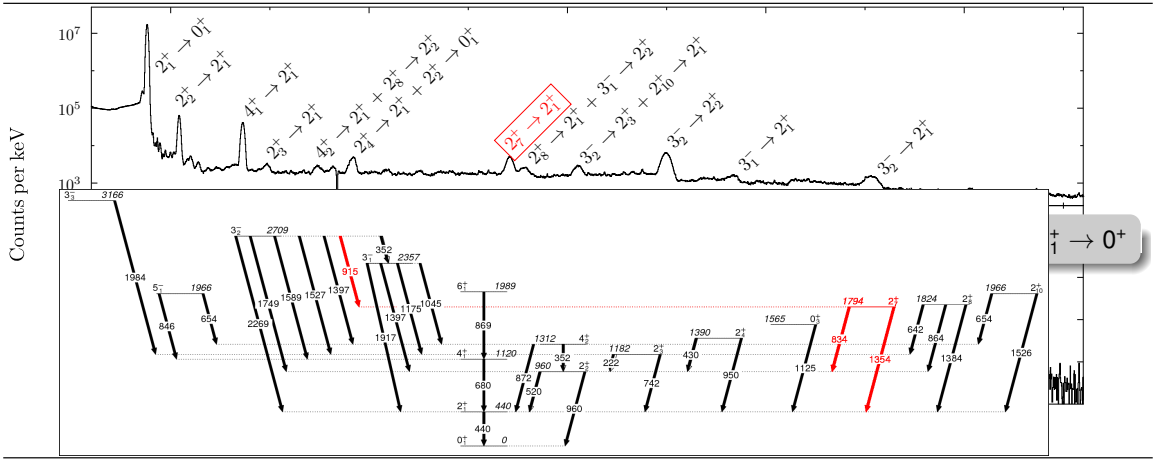

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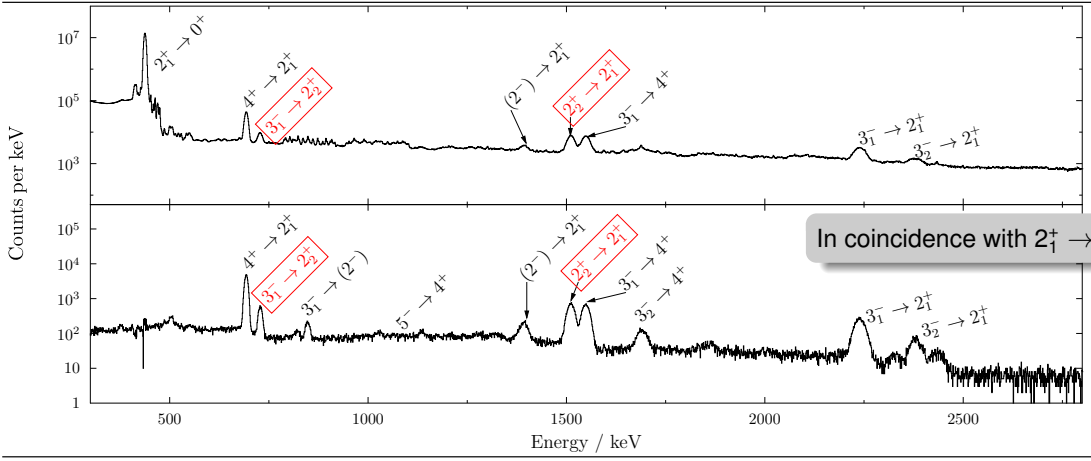

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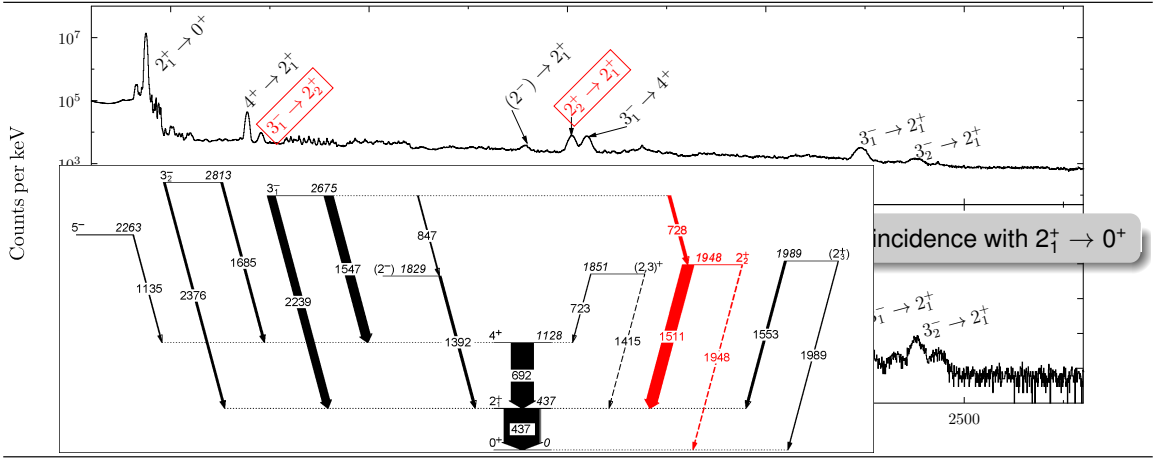

Experiment

γ-ray spectra & level scheme – ^{212}Po

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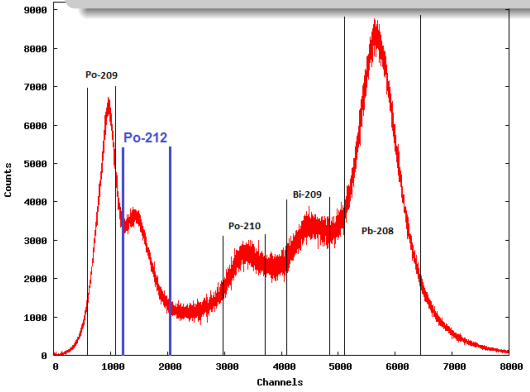
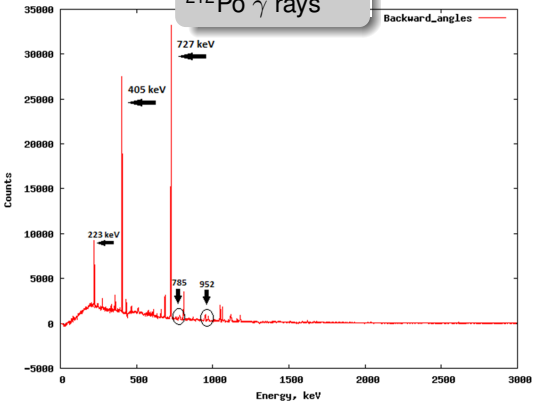
Projection of the particle-γ (at 142°) matrix



^{212}Po γ rays



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γ-ray spectra & level scheme – ^{212}Po

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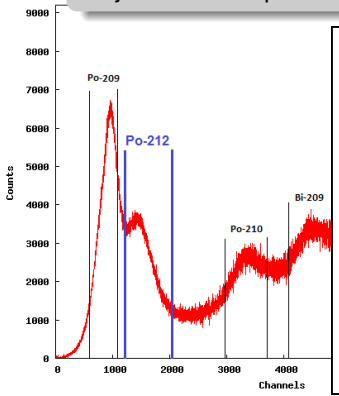
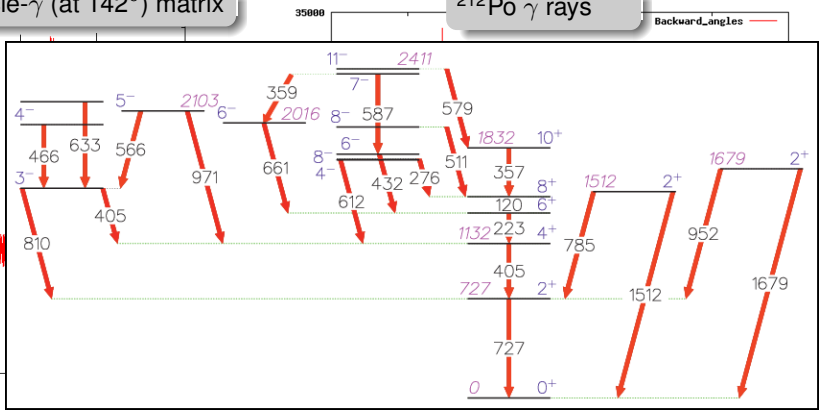


^{212}Po γ rays



Results

^{204}Hg

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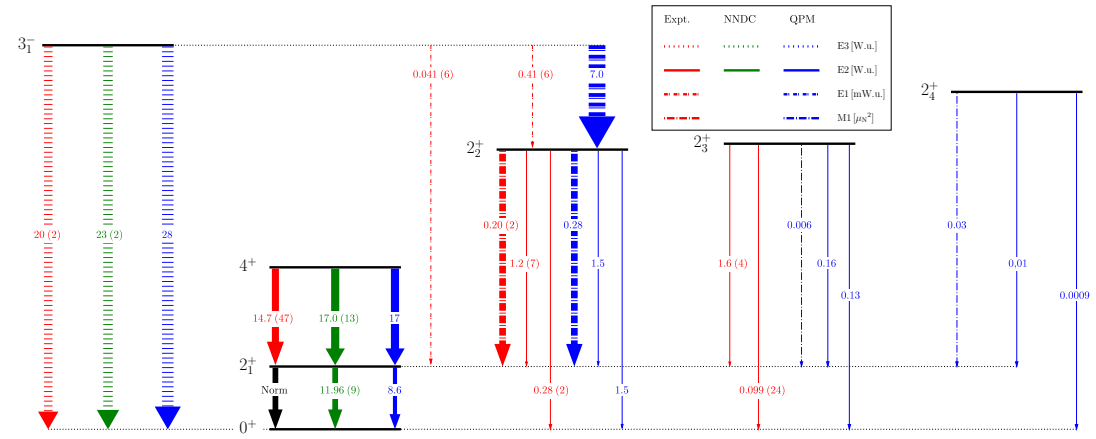

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^{212}Po

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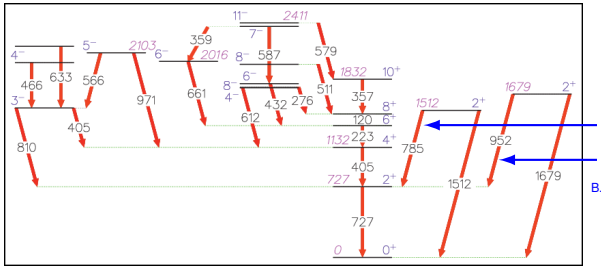

δ = +0.09 (3)

δ = +0.65 (50)

B. Bengston, *et al.*, NPA 378, 1 (1982)

Results

^{212}Po

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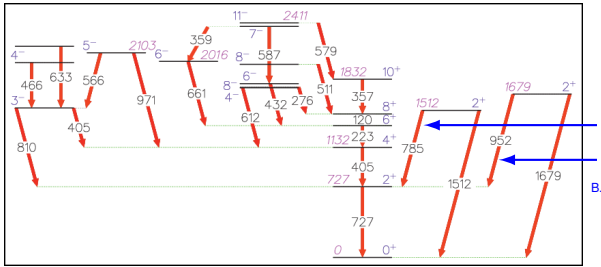

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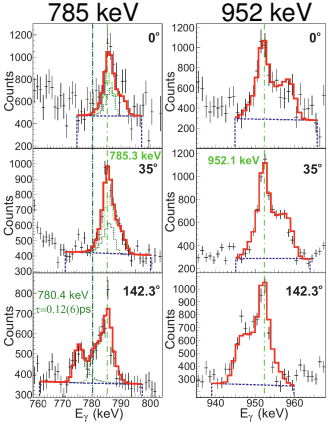

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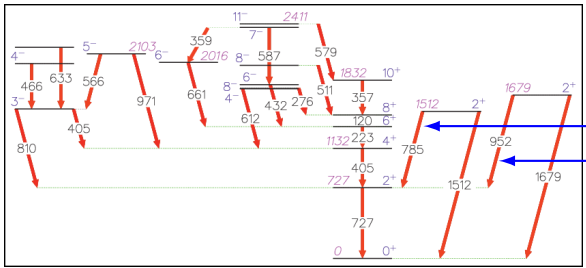
^{212}Po



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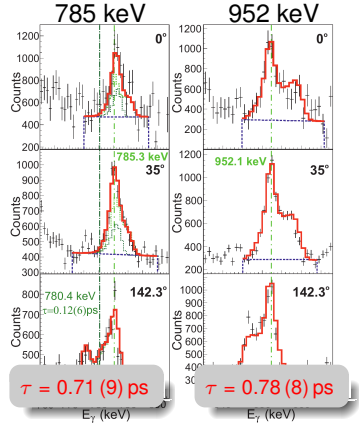

τ = 0.71 (9) ps

τ = 0.78 (8) ps

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^{212}Po

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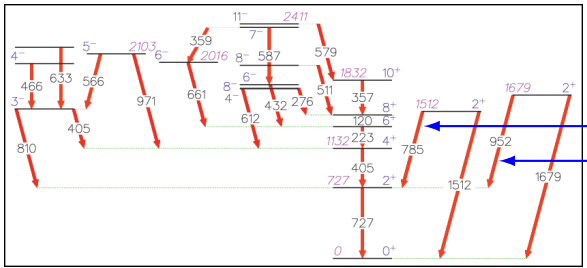

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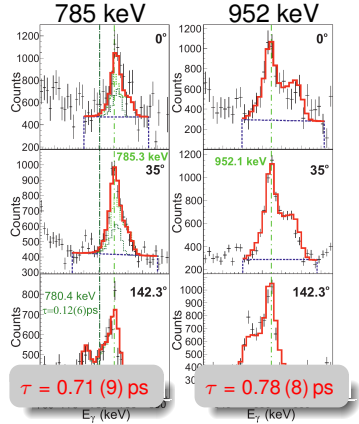

E_{level} / keV	J^π	J^π_{final}	$B(\pi\lambda)\downarrow$
1512	2^+_2	2^+_1	$B(M1)$ = 0.126 (16) $\mu_N{}^2$
			$B(E2)$ = 0.32 (21) W.u.
		0^+_1	$B(E2)$ = 0.39 (5) W.u.
1679	2^+_3	2^+_1	$B(M1)$ = 0.042 (20) $\mu_N{}^2$
			$B(E2)$ = 3.9 (36) W.u.
		0^+_1	$B(E2)$ = 0.27 (7) W.u.

Results

Summary

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- Mixed-symmetry states expected in vibrational nuclei around shell closures

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- Candidate for $2^+_{1,ms}$ state identified in ^{202}Hg

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Thank you for your attention