

# COMBINED $\gamma$ -RAY AND CONVERSION ELECTRON SPECTROSCOPY OF $^{186}\text{PB}$

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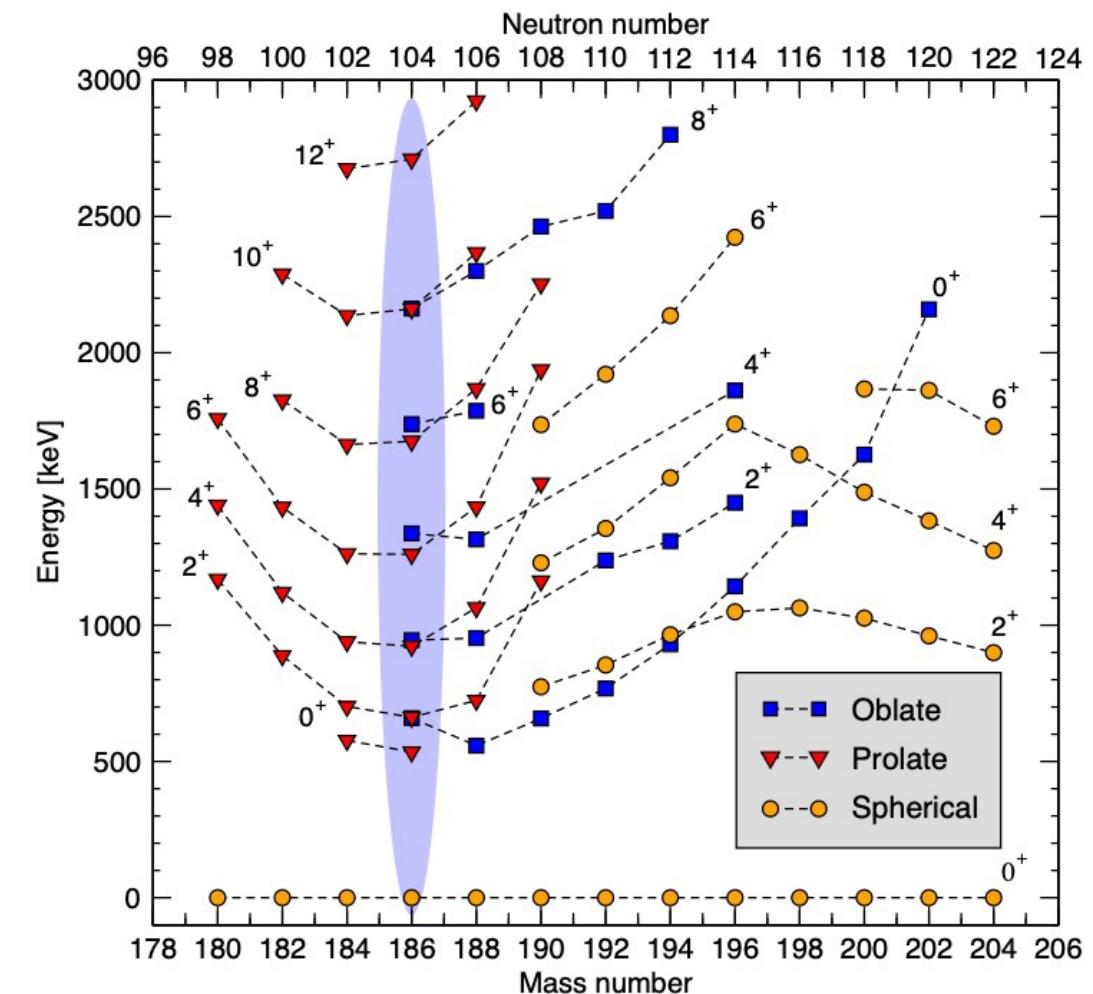
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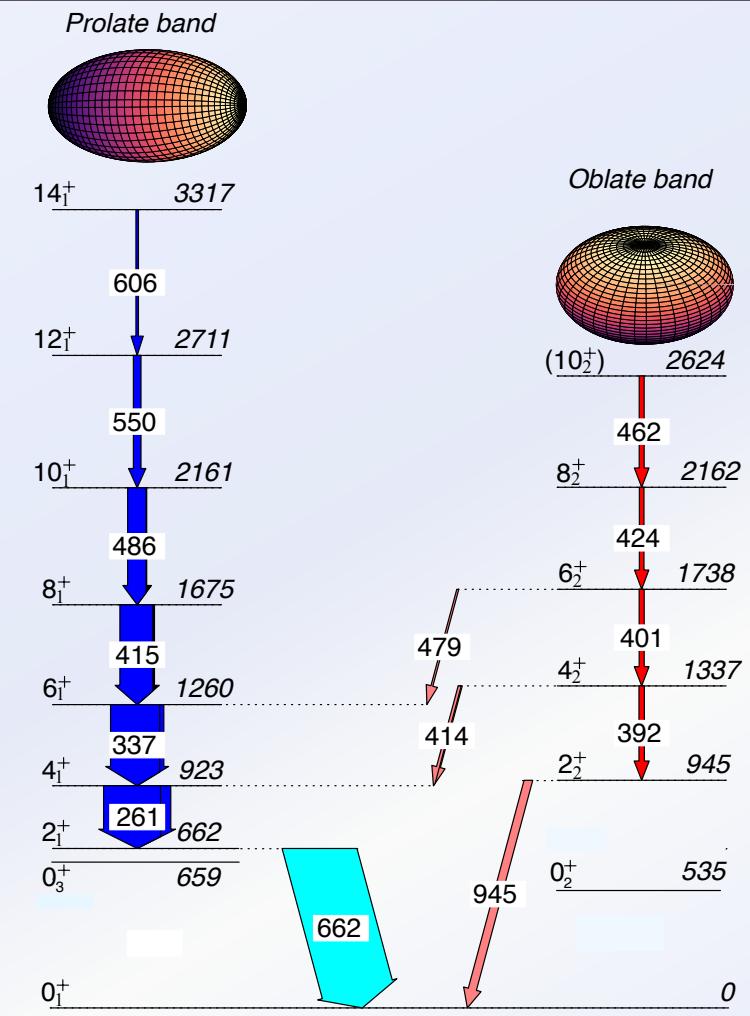
# Shape coexistence in Pb region

- The shape coexistence phenomenon has been under study for several decades in Pb-region
- Shape coexistence appears close to  $Z \approx 82$  and  $N \approx 104$
- Prolate and oblate deformation are associated with  $\pi(4p - 4h)$  and  $\pi(2p - 2h)$ , respectively



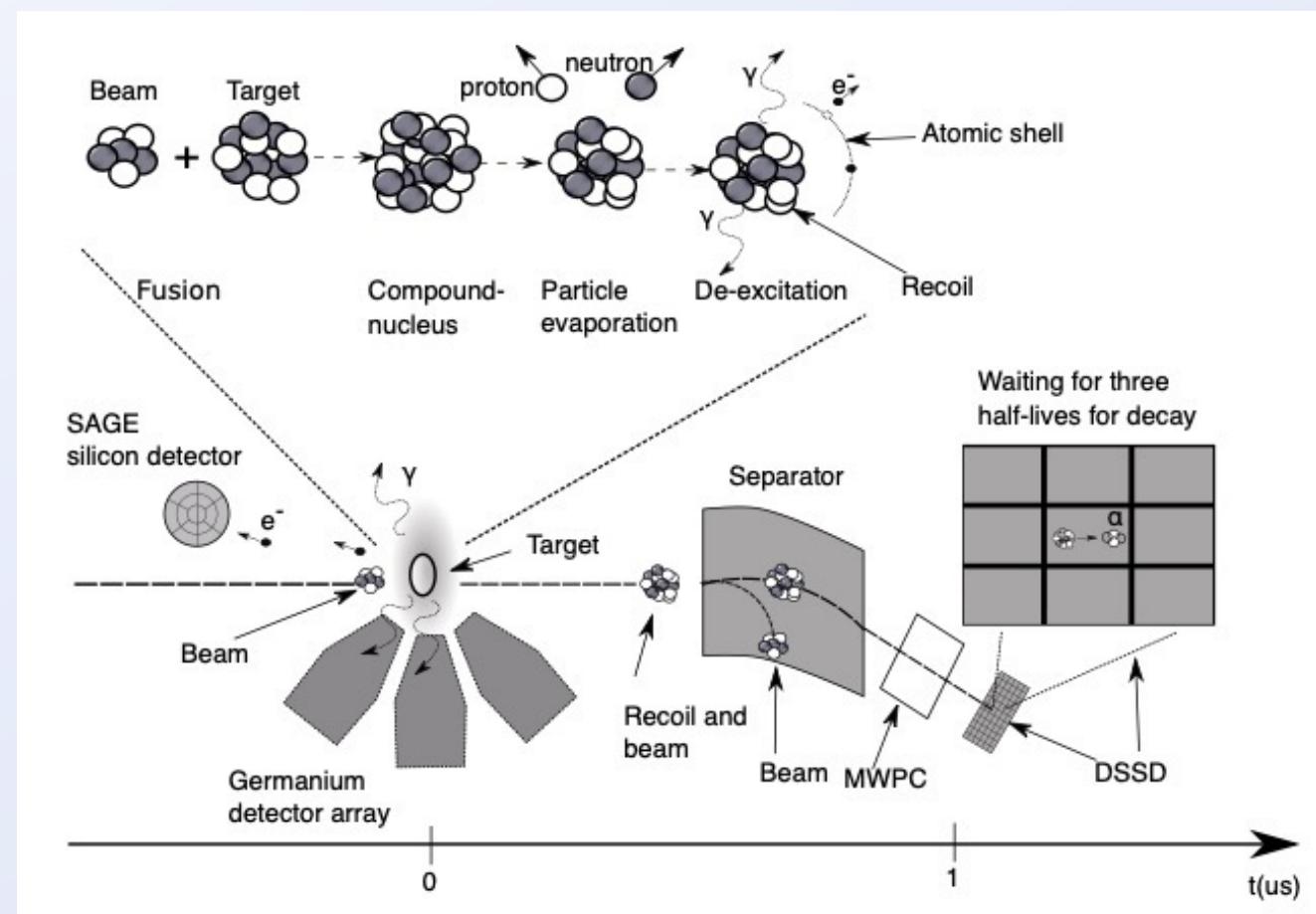
# Previously known for $^{186}\text{Pb}$

- The excited  $0^+$  states were observed for the first time at  $\alpha$ -decay study of  $^{190}\text{Po}$
- Several  $\gamma$ -ray spectroscopy study has presented rotational yrast and non-yrast band
- The lifetime measurement has been performed for the yrast band



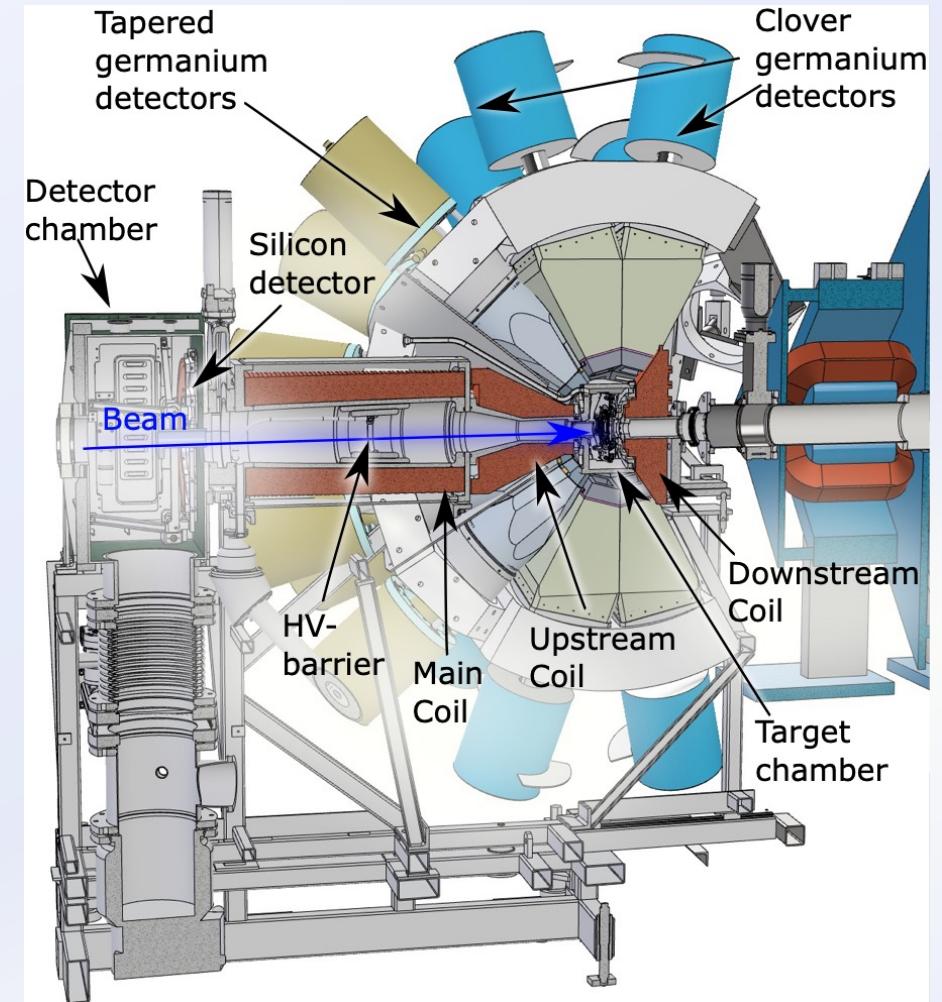
# Experimental methods

- Performed in the Accelerator laboratory of Jyväskylä
- SAGE+RITU+GREAT+TDR
- $^{106}\text{Pd}(^{83}\text{Kr}, 3\text{n}) ^{186}\text{Pb}$
- $^{186}\text{Pb}$  nuclei were identified using recoil-decay tagging method

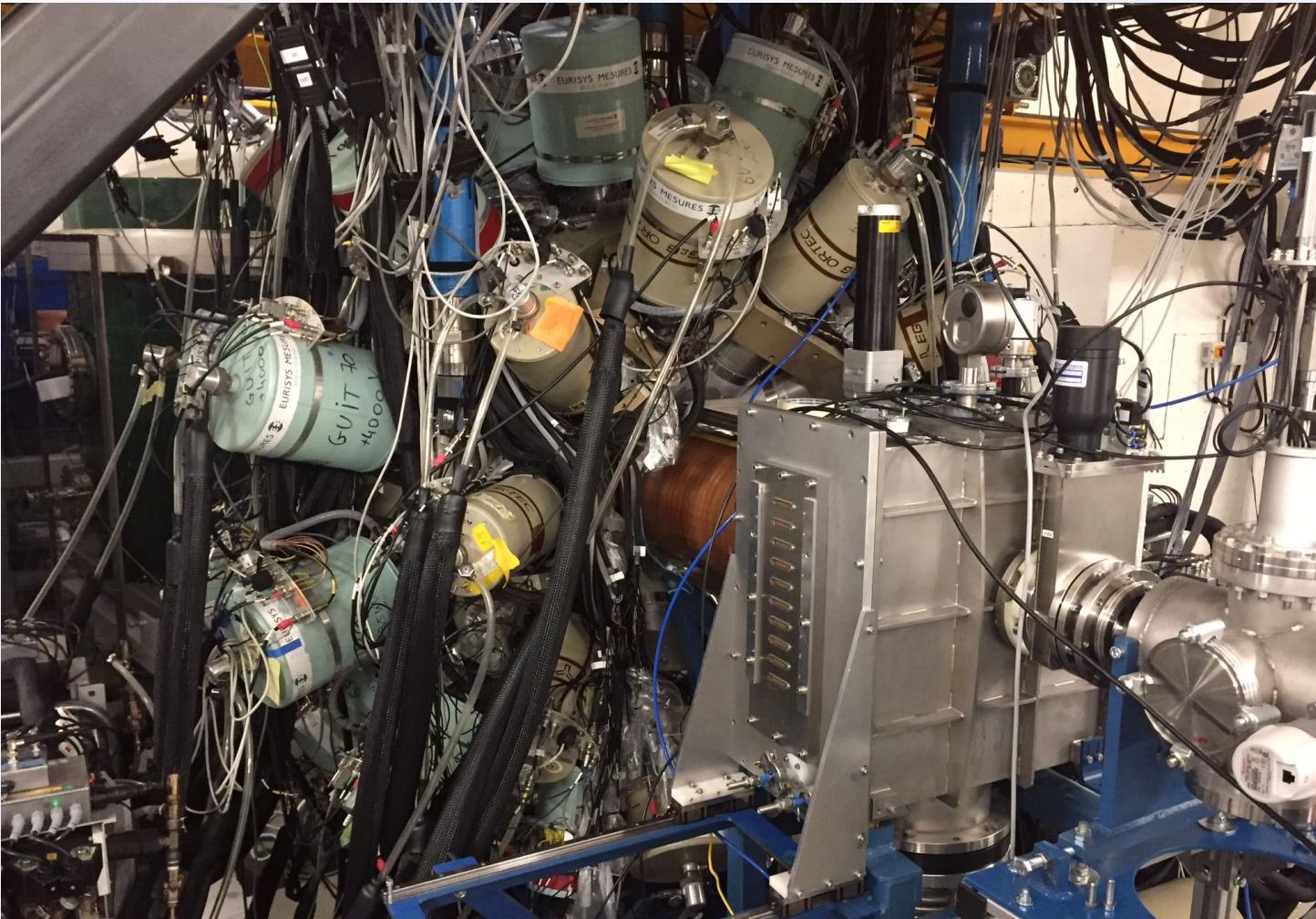


# SAGE

- SAGE consist the germanium detector array surrounded target chamber and the silicon detector in upstream
- Conversion electrons are transported using magnetic fields created by solenoid coils (applied with 800 A )
- $\delta$ -electrons are suppressed with HV-Barrier (-30 KV)



# SAGE



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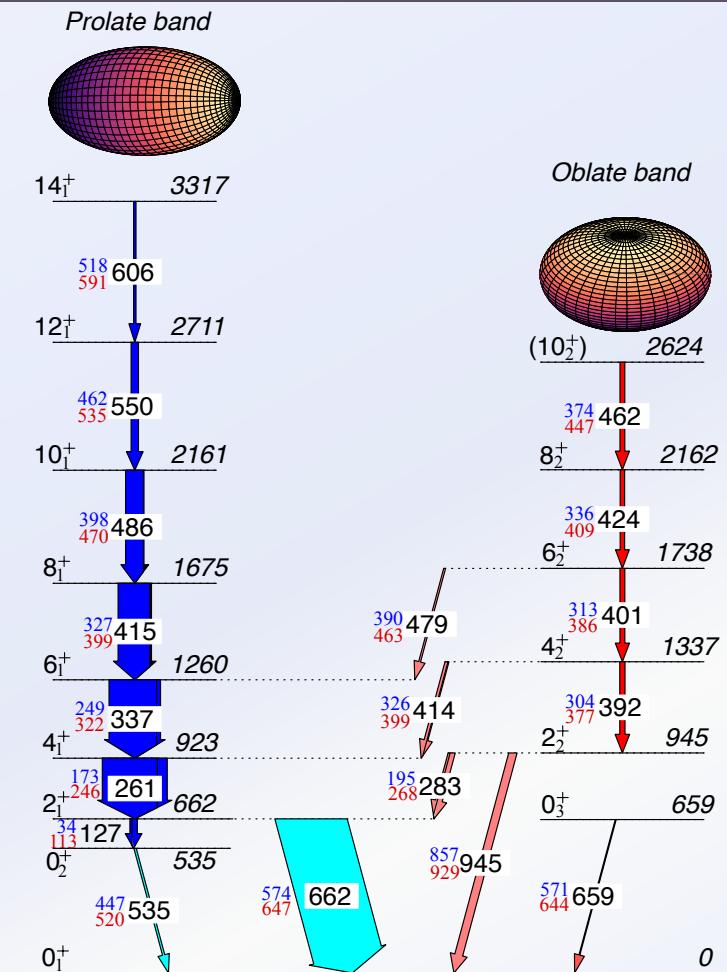
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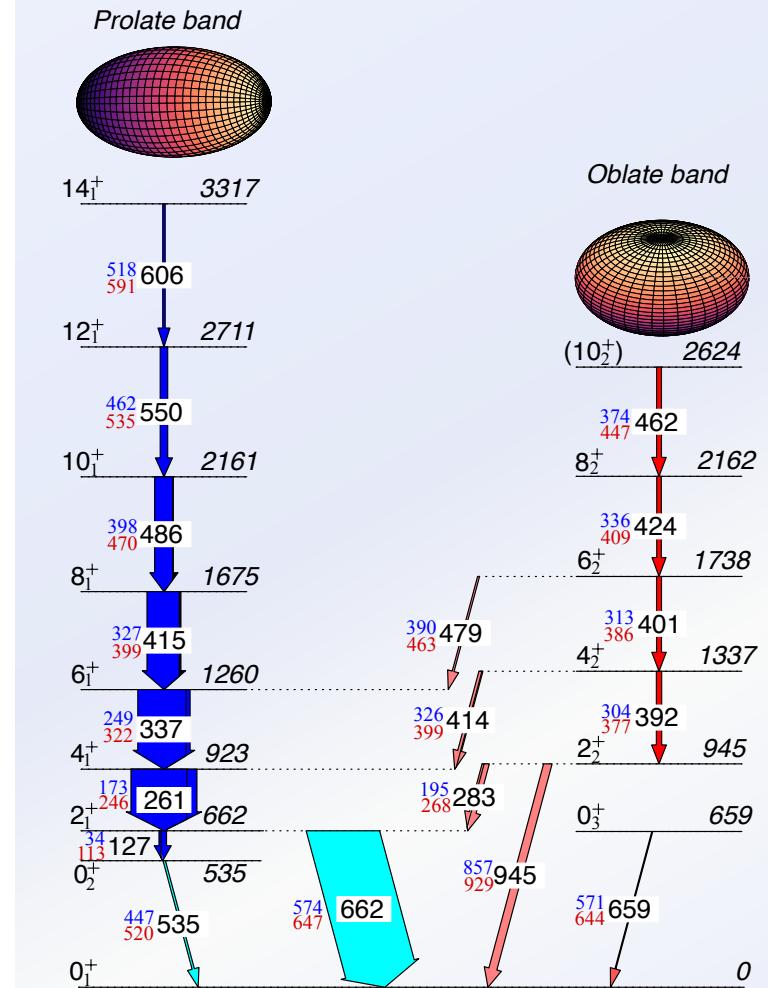
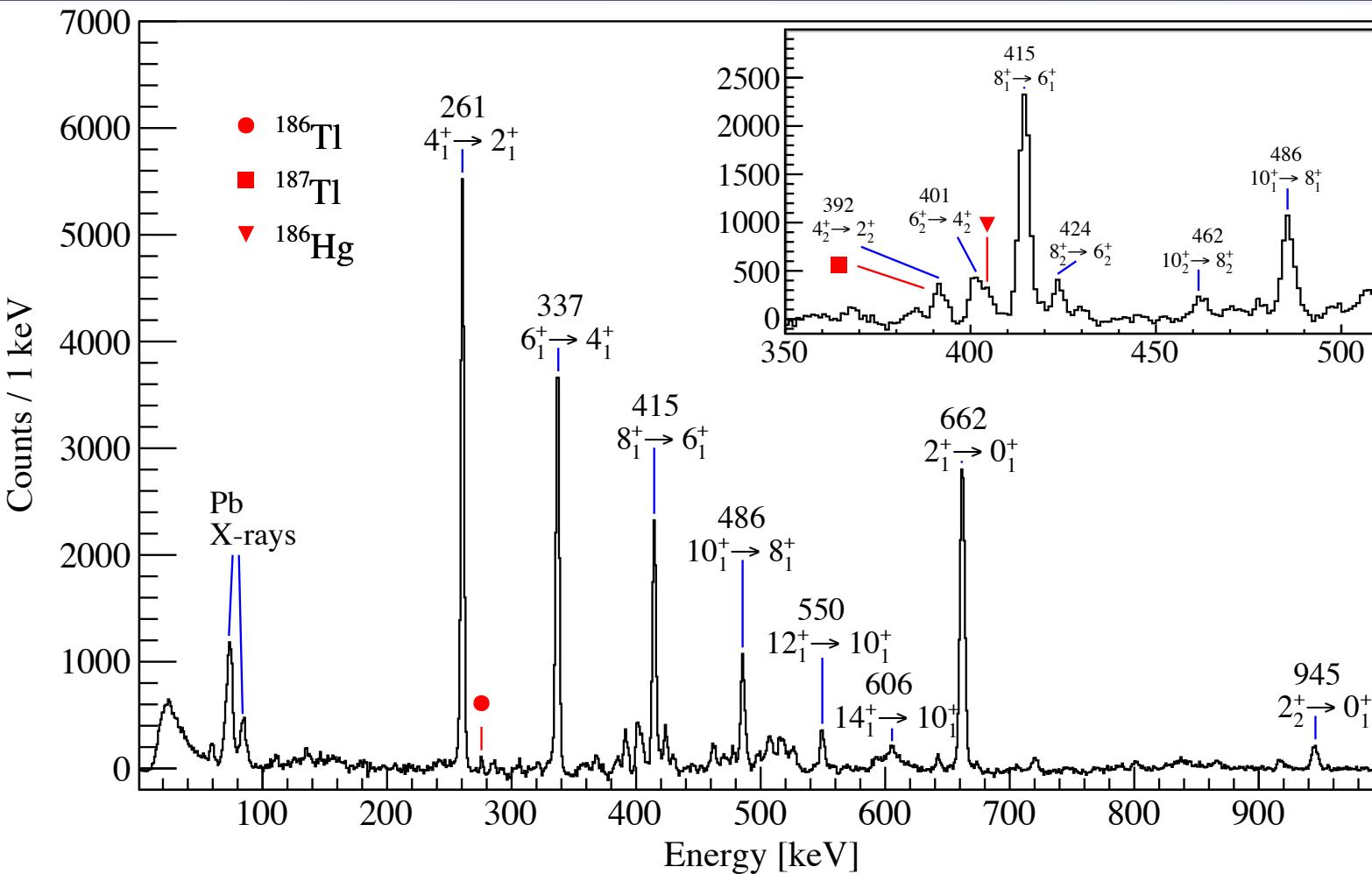
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# $^{186}\text{Pb}$

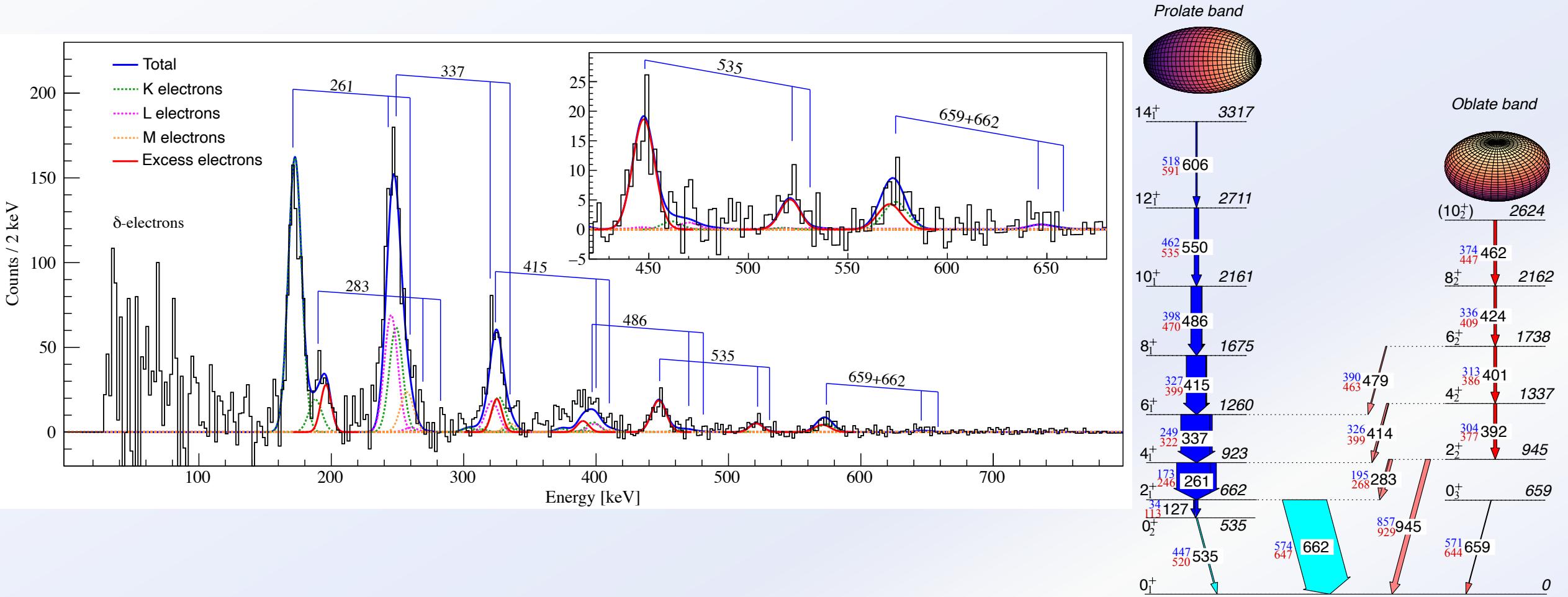
- Three shapes of  $^{186}\text{Pb}$  (spherical, prolate and oblate) have been identified in previous experiments.
- In this experiment
  - Observed feeding of  $0_2^+$  state
  - $0_2^+ \rightarrow 0_1^+$  and  $0_3^+ \rightarrow 0_1^+$  transitions were observed
  - The  $2_2^+ \rightarrow 2_1^+$  and  $4_2^+ \rightarrow 4_1^+$  E0 interband transitions were identified



# Recoil-gated $\alpha$ -tagged singles $\gamma$ rays

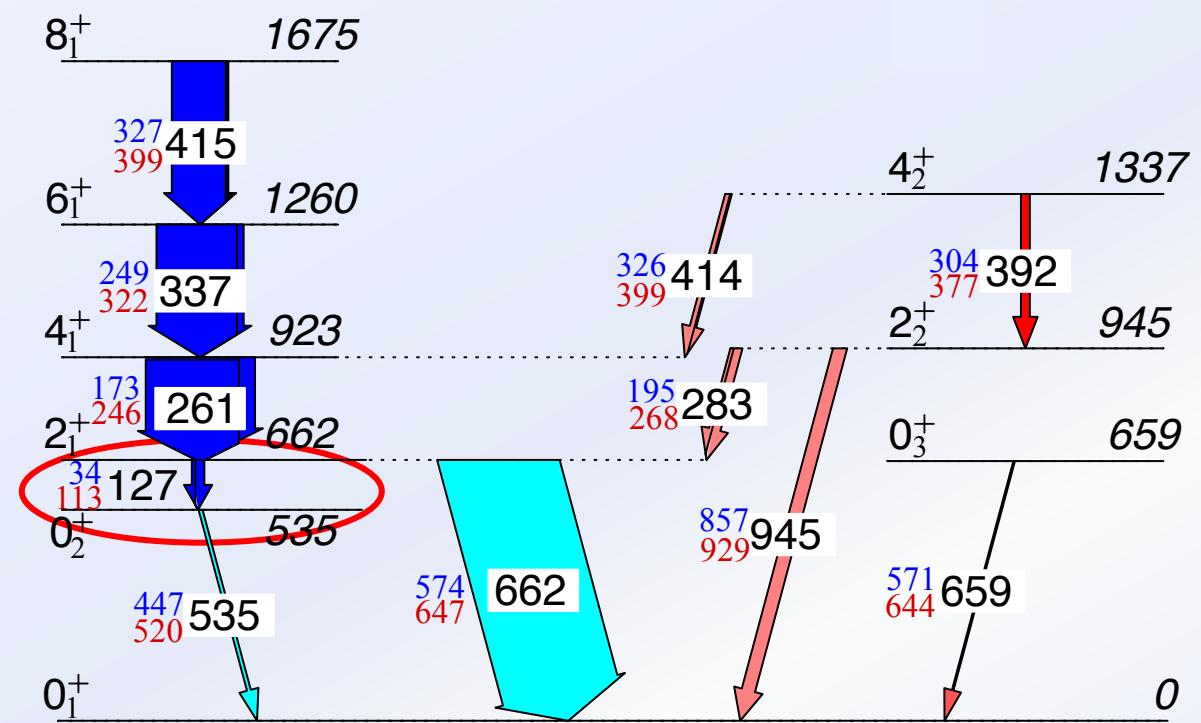


# Recoil-gated $\alpha$ -tagged singles electrons



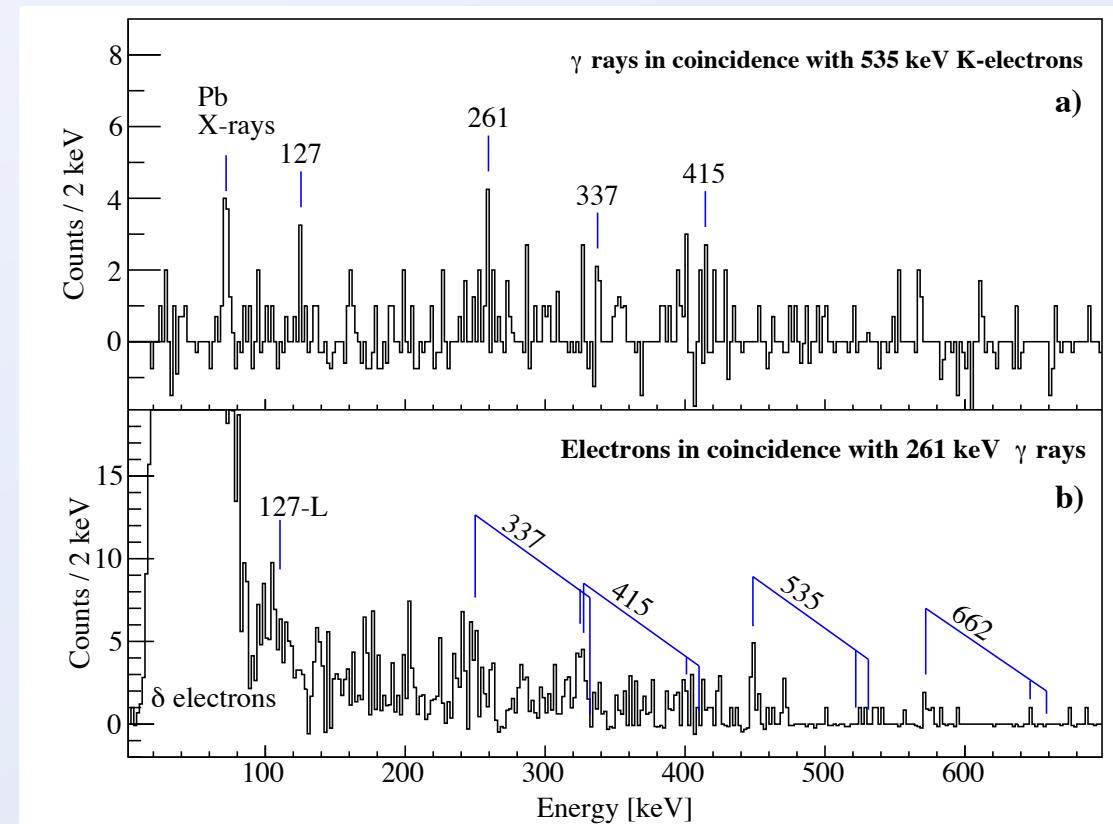
# Reassessing the $0_2^+$ state

- Based on  $\alpha$ -decay studies of  $^{190}\text{Po}$ ,  $0_2^+$  state was associated with the oblate structure
- The yrast band and  $2_1^+ \rightarrow 0_2^+$  transitions were observed in coincidence with the  $0_2^+ \rightarrow 0_1^+$  transition.
- The  $B(E2; 2_1^+ \rightarrow 0_2^+) = 190(80)$  W.u. and  $|Q_t| = 7.7(33)$  eb suggest that the  $0_2^+$  state has a predominant prolate component



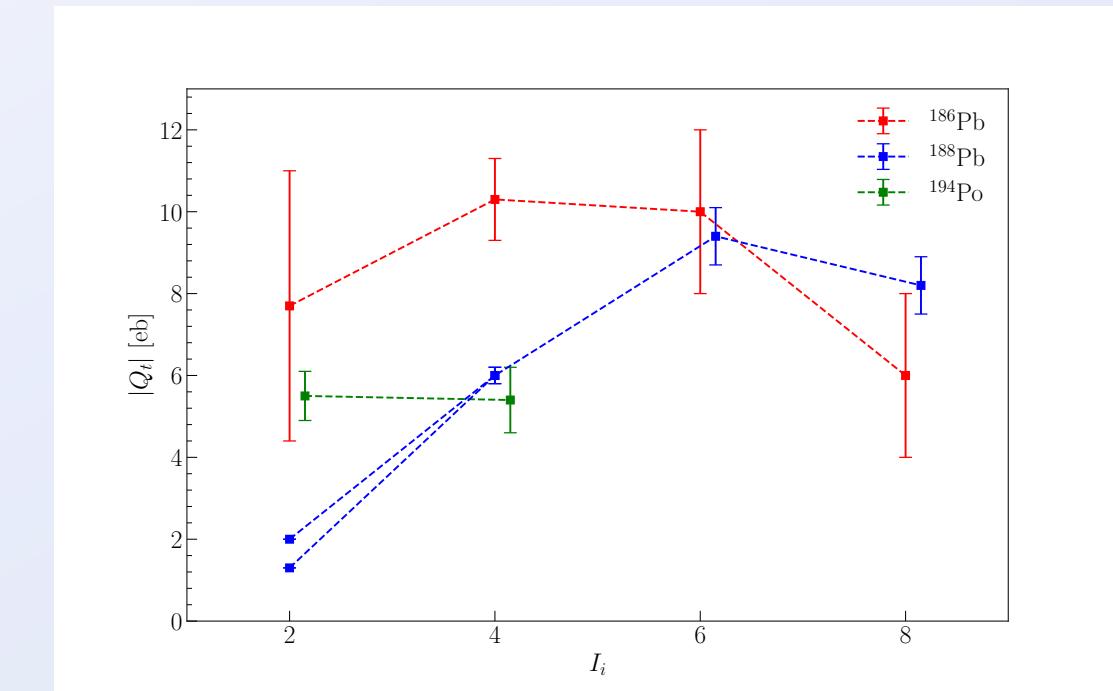
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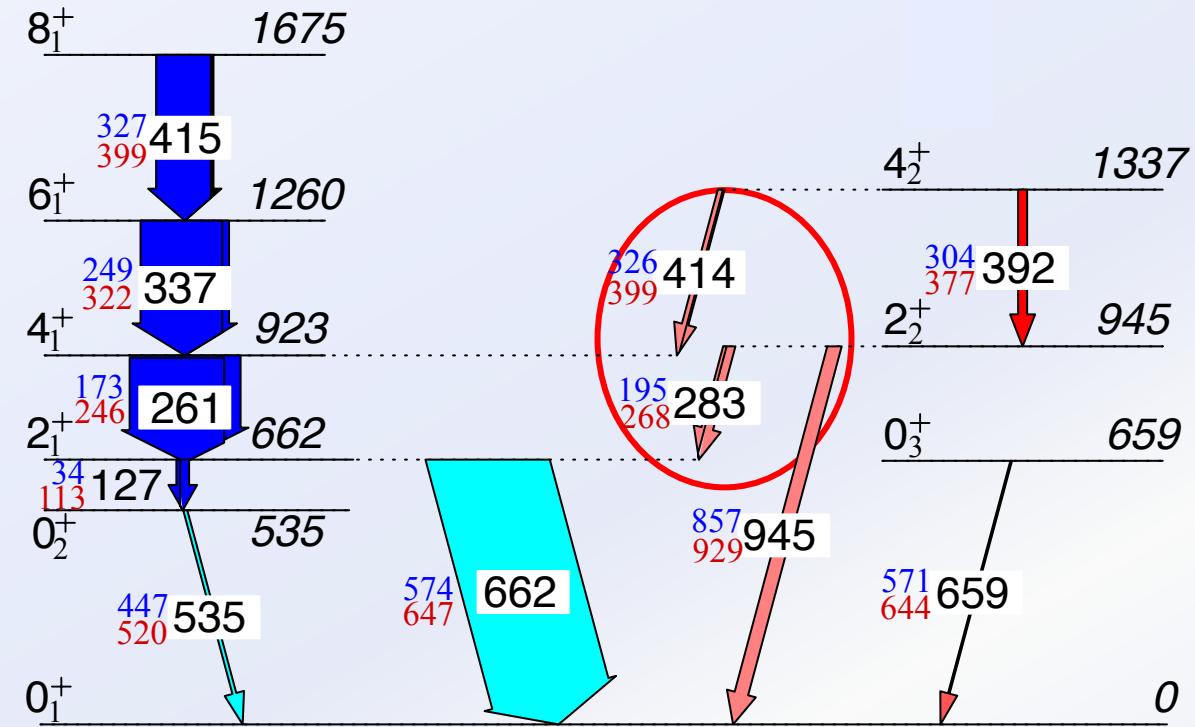
# Estimating shape mixing using E0 transition

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- If large mixing of states between two different configuration is introduced, it will be appeared as large  $\rho(E0)$  transition strength values
- $|\rho(E0)|^2 = \frac{1}{\tau(E0)\Omega(Z,E)}$
- Two-level mixing model:
  - $\rho(E0)^2 = \frac{3}{4\pi} a^2 (1 - a^2) (\beta_1^2 - \beta_2^2)^2$
  - $a$  is the mixing amplitude and  $\beta_n^2$  is the quadrupole deformation parameter

# Configuration mixing based on interband transitions

- $\rho(E0)^2 = \frac{3}{4\pi} a^2 (1 - a^2) (\beta_1^2 - \beta_2^2)^2$
- $\beta_1 = 0.29(5)$  and  $\beta_2 = 0.17(3)$
- The  $2_2^+ \rightarrow 2_1^+$  transition
  - Assuming  $B(E2; 2_2^+ \rightarrow 0_1^+) = 5$  W.u.,
  - $\Rightarrow \rho^2 (2_2^+ \rightarrow 2_1^+) = 100(60) \times 10^{-3}$
  - Mixing amplitude is  $a^2 = 0.9$
- The  $4_2^+ \rightarrow 4_1^+$  transition
  - Assuming  $B(E2; 4_2^+ \rightarrow 2_2^+) = 100$  W.u.
  - $\Rightarrow \rho^2 (4_2^+ \rightarrow 4_1^+) = 40(30) \times 10^{-3}$
  - Mixing amplitude is  $a^2 = 0.96$



# Summary

- First direct observations of several E0 transitions in  $^{186}\text{Pb}$
- Reassigned the  $0_2^+$  state with prolate
- Monopole transition strengths of interband transitions suggest small configuration mixing

