A $K^{\pi} = 8^{+}$ isomer in ^{162}Dy, and the relative importance of competing K-mixing mechanisms for 2-quasiparticle isomer decays in the $82 \leq N \leq 126$ region.

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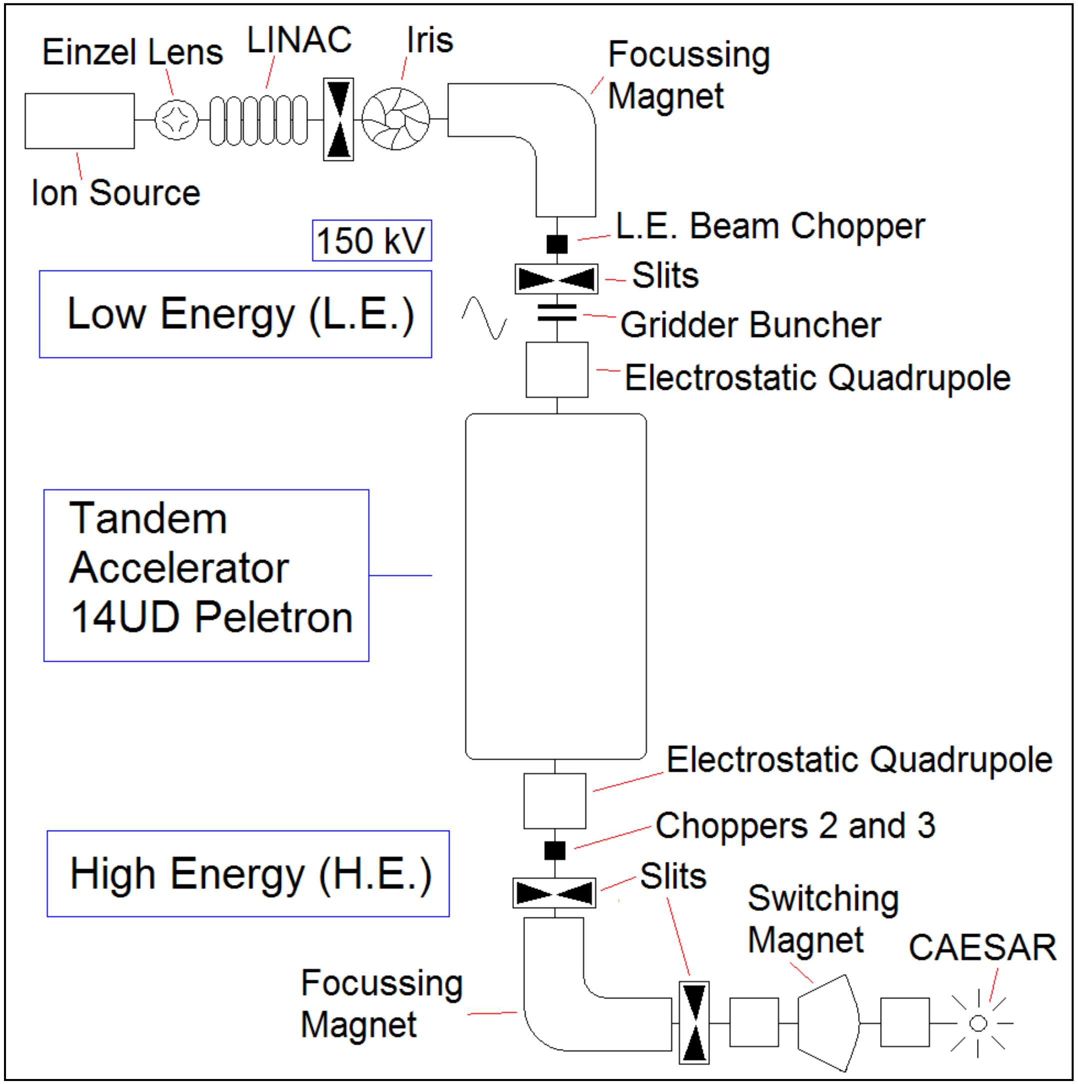
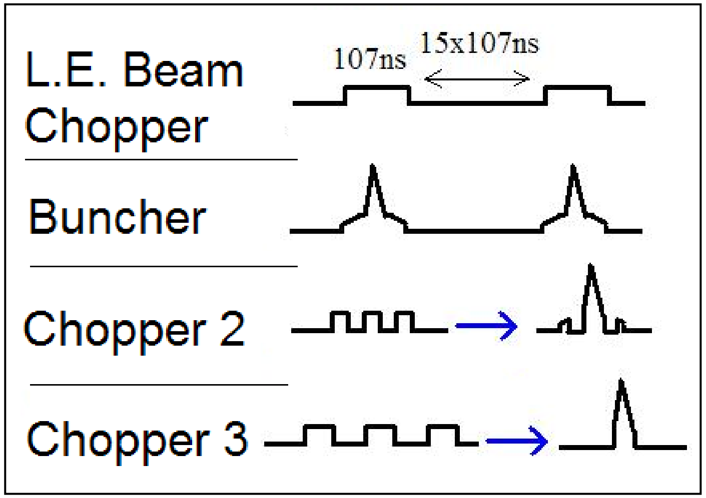
- Experimental details of a gamma-spectroscopy experiment to look at ^{162}Dy.
- Discovery of a new isomer in ^{162}Dy.
- Half-life and intensity measurements for the isomer.
- Discussion and justification for the spin-parity assignment of the isomer.
- Plotting the reduced hindrance of the isomer as a function of variables that quantify the three types of K-mixing that commonly affect the hindrance of isomers.
- The relative importance of K-mixing mechanisms for nuclei in the region.

ANU Experiment: $^{160}Gd(^{9}Be,\alpha 3n)^{162}Dy$





Discovery of an isomer in ^{162}Dy

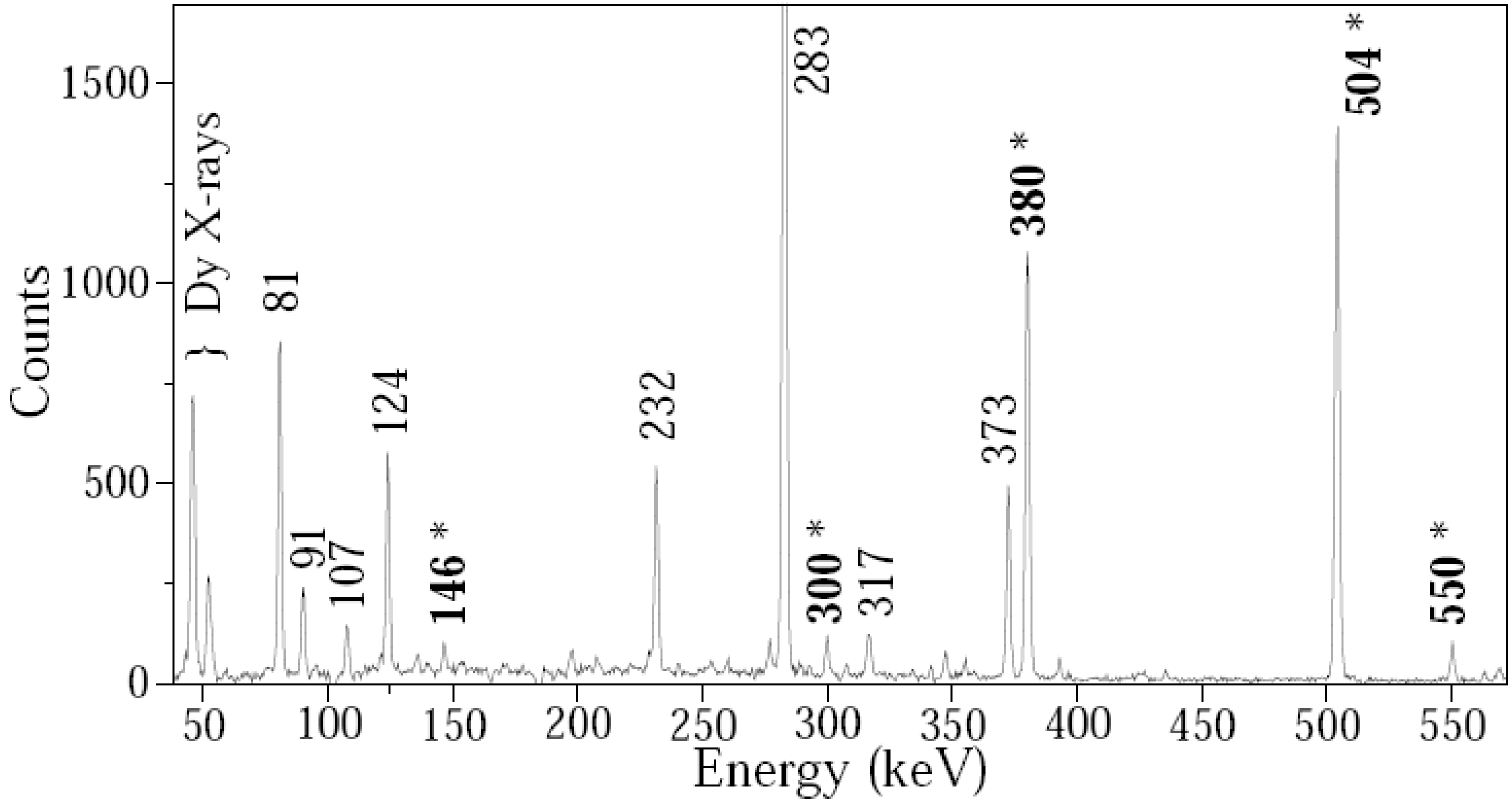
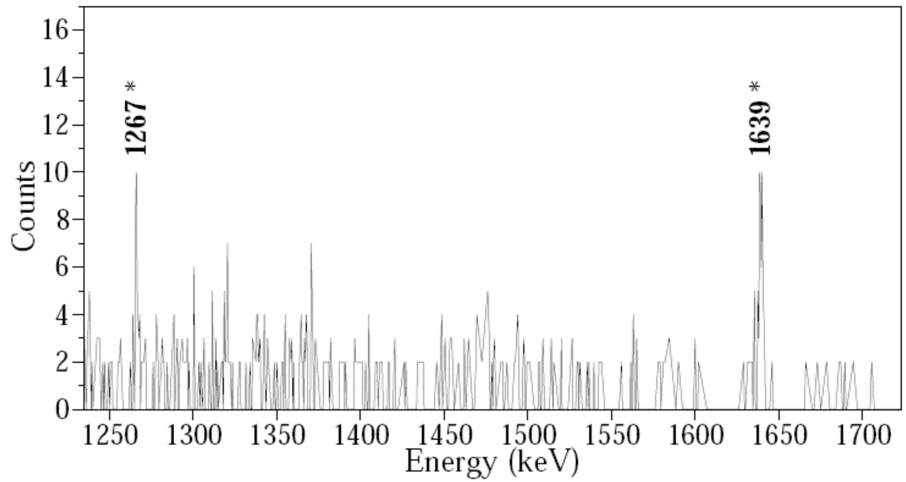
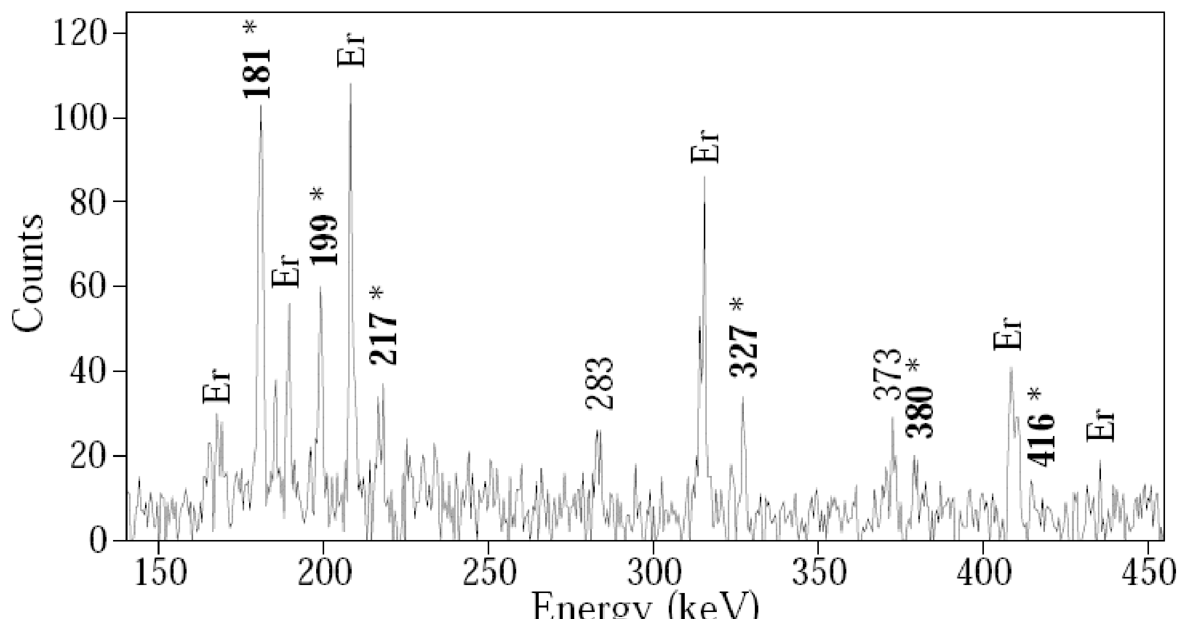


Figure 1.1: Coincidence spectrum for the 185 keV transition in the out-of-beam $\gamma-\gamma$ matrix. The strongest direct decays from the isomer are denoted by an asterisk.

Further γ-transitions related to the isomer

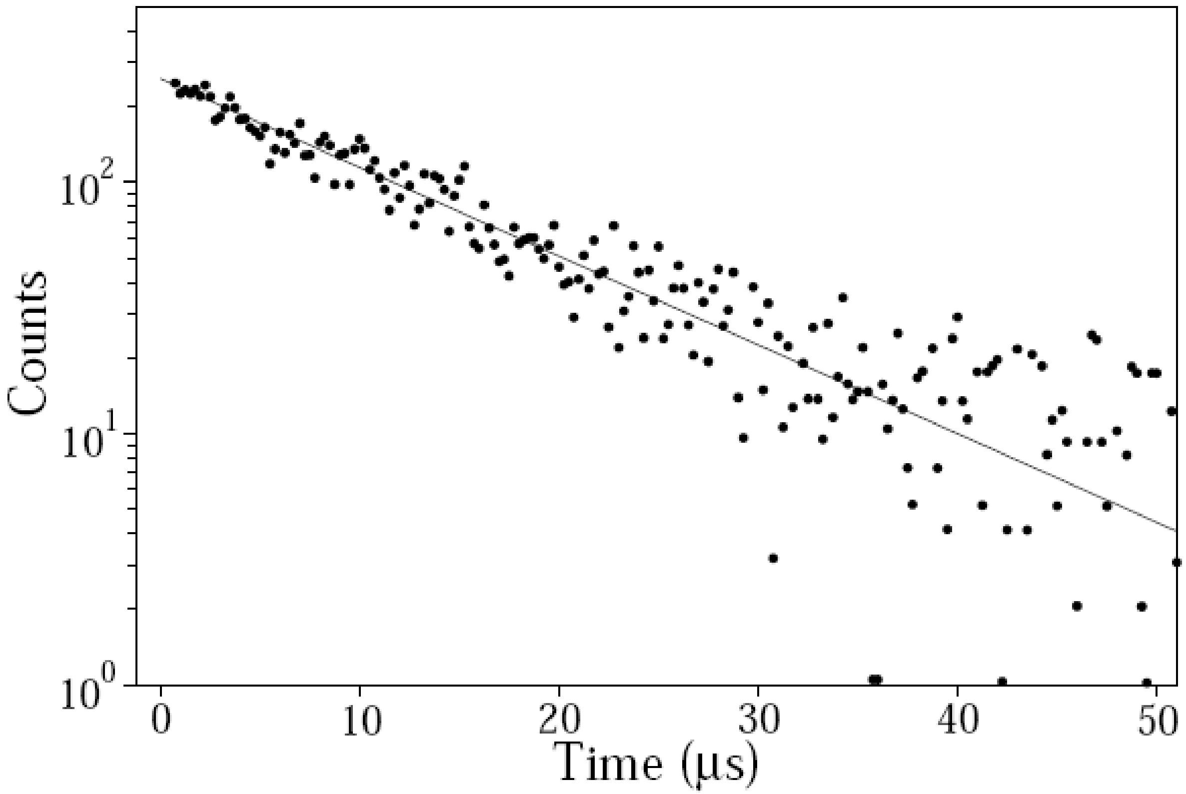


The strong 504 and 380 keV transitions and their coincidences indicate the energy of the isomer, allowing one to search for weaker transitions at expected energies. High energy transitions from the isomer to the ground state band were identified.



A gate on the delayed 504 and 380 keV transitions can be used to show transitions in “early” coincidence, i.e. transitions within the rotational band of the isomer (denoted by an asterisk).

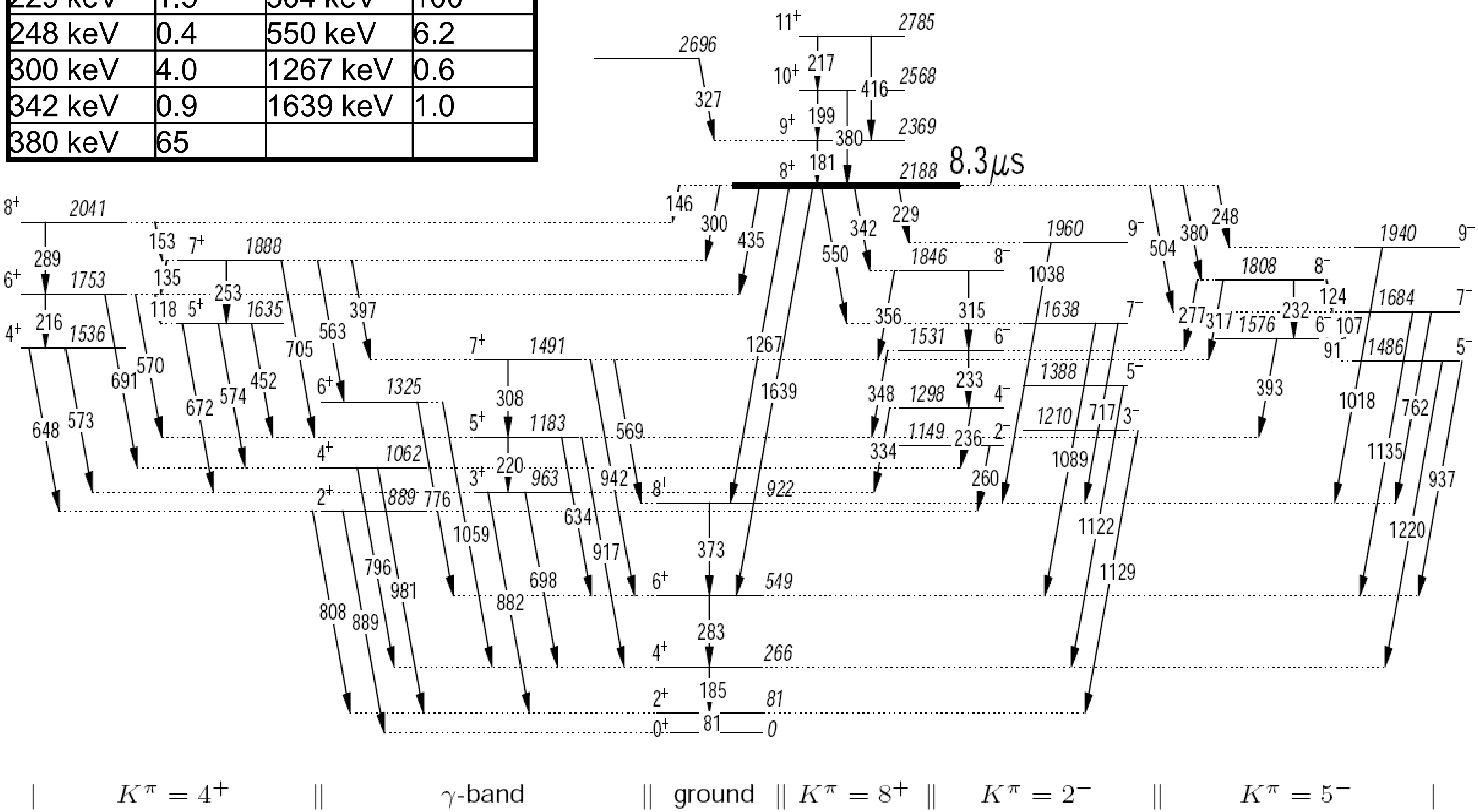
Half-life of the ^{162}Dy isomer



Out of beam time spectrum for 504 keV gamma rays with a longer beam on/off condition of 30 μs / 150 μs. The fitted half-life is 8.3(3) μs.

Level scheme and branch intensities

Eγ	Iγ	Eγ	Iγ
146 keV	1.6	435 keV	1.3
229 keV	1.5	504 keV	100
248 keV	0.4	550 keV	6.2
300 keV	4.0	1267 keV	0.6
342 keV	0.9	1639 keV	1.0
380 keV	65		

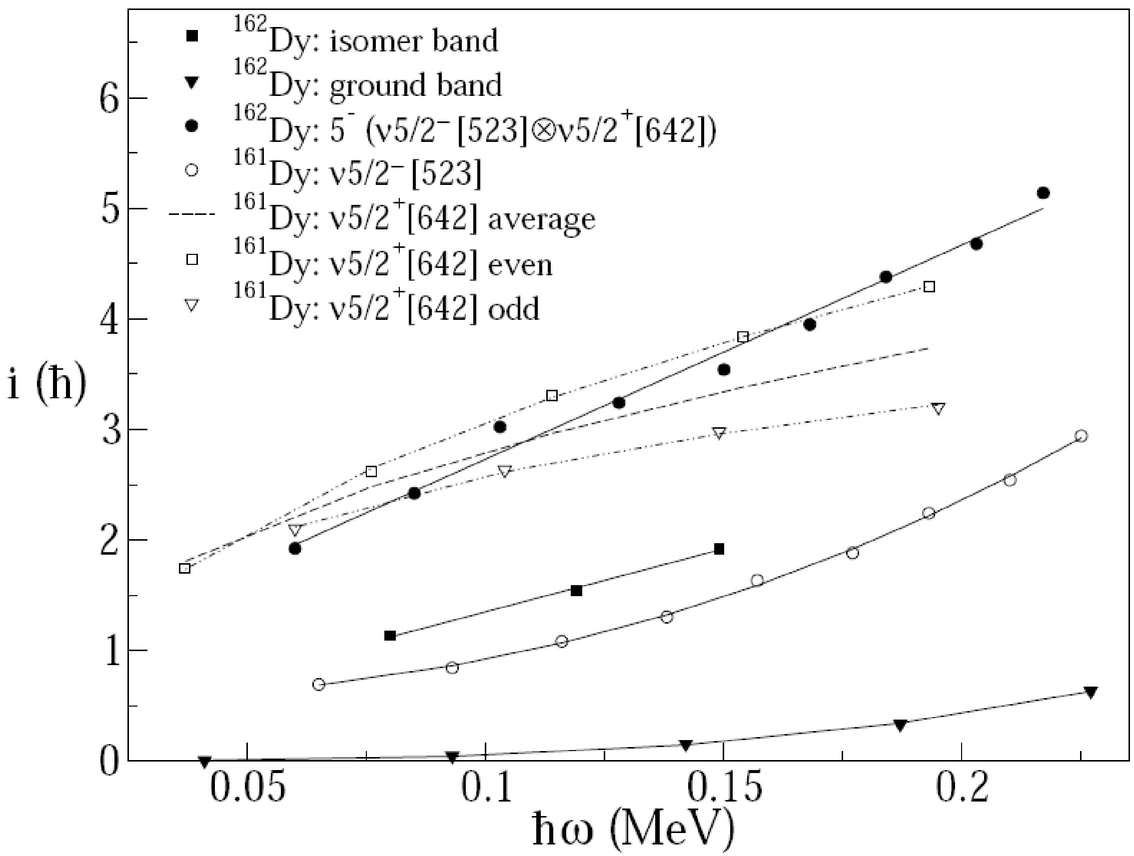


The quasiparticle structure of the isomer

The isomer energy is 2188 keV. Multi-quasiparticle calculations predict an 8^+ ($\nu 5/2^-[523]\nu 11/2^-[505]$) structure at 2200 keV and an 8^- ($\nu 5/2^+[642]\ \nu 11/2^-[505]$) structure at 2414 keV.

Experimental g-factors for the isomer band

I_i, K	$E_\gamma^{\Delta I=1}$	$E_\gamma^{\Delta I=2}$	$I_\gamma^{\Delta I=1}$	$I_\gamma^{\Delta I=2}$	$\lvert g_K - g_R \rvert$
10,8	199.0	379.8	1.0(1)	0.51(8)	0.24^{+4}_{-4}
11,8	216.7	415.7	0.36(6)	0.30(7)	0.27^{+8}_{-6}



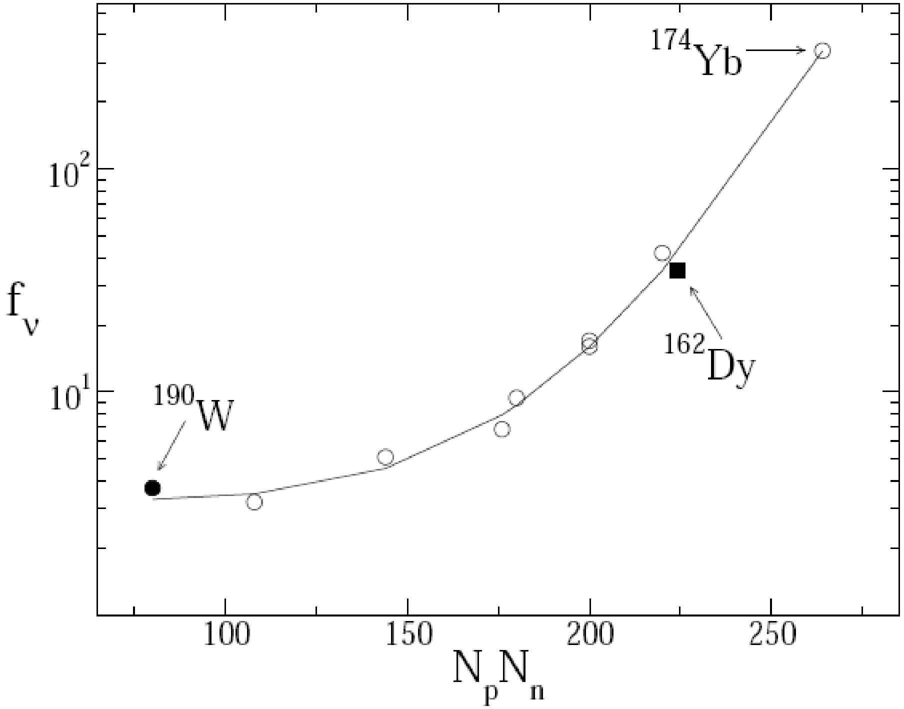
Theoretical g_K-g_R factors for the two candidate structures are:

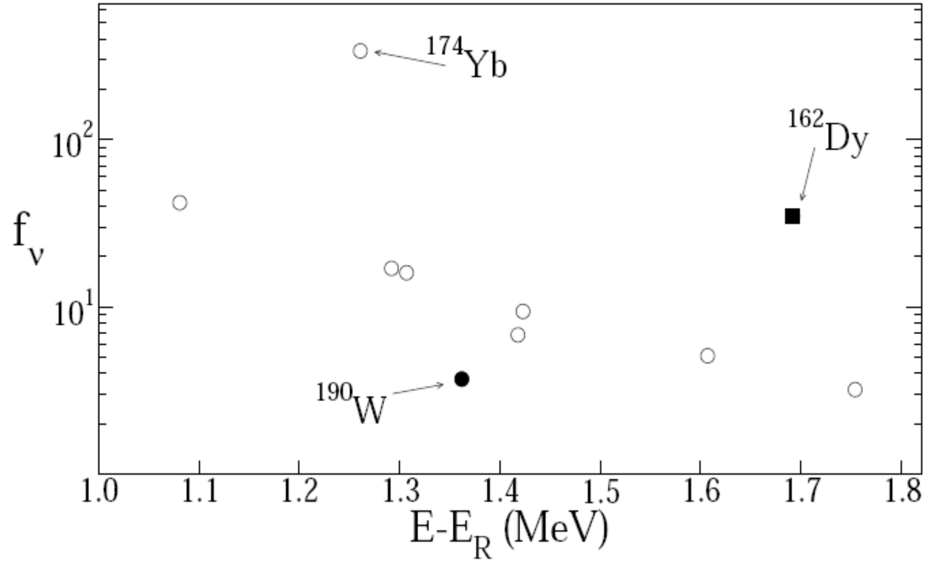
- ❑ $8^+ = 0.30$
- ❑ $8^- = 0.59$

The alignment of the isomer band also favours the 8^+ structure as the alignment of the isomer band is much less than the alignment of the $5/2^+[642]$ orbital in ^{161}Dy.

The reduced hindrance of the isomer

The reduced hindrance, calculated from the highly forbidden 1639 keV, E2 branch to the ground state band, is $f_\nu = 35$.

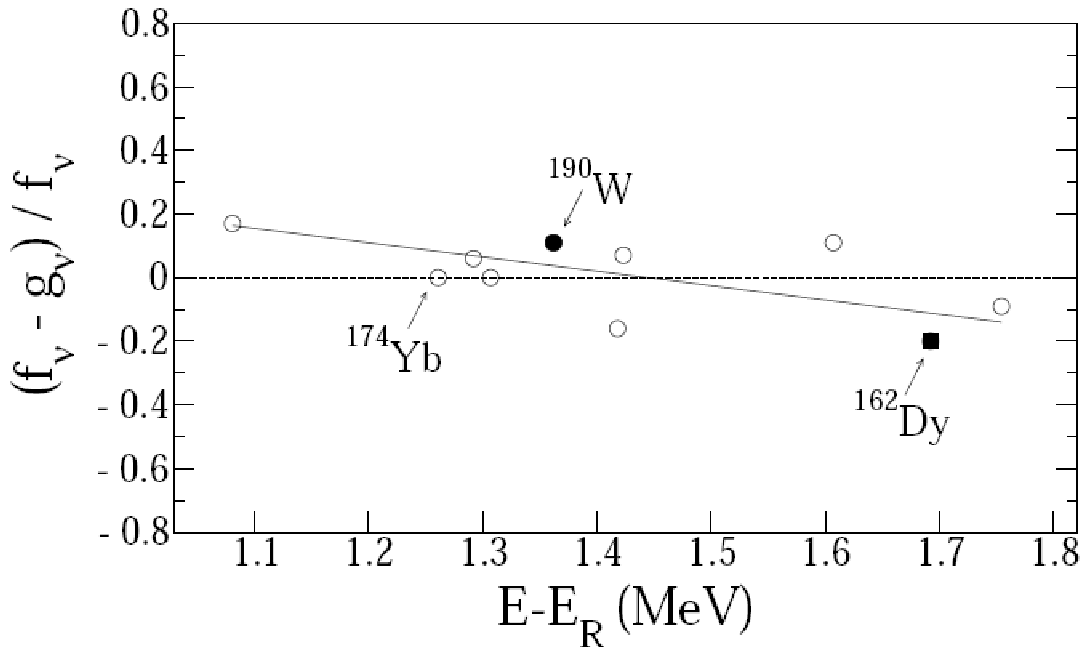




N_pN_n quantifies the effects of Coriolis K-mixing and γ-tunnelling K-mixing

$E\text{-}E_R$ quantifies the effect of level-density K-mixing.

The relative importance of competing K-mixing mechanisms



- g_v is the fit line of f_v with N_pN_n on the previous slide.
- $f_v - g_v$ is the deviation of f_v from this fit.
- $(f_v - g_v)/f_v$ is the fraction of the total reduced hindrance that this deviation represents.

There is a small correlation with $E-E_R$, showing that level density K-mixing is partially responsible for deviations from the correlation of f_v with N_pN_n.

We can therefore conclude that Coriolis K-mixing and γ-tunnelling K-mixing play a major role in determining the reduced hindrance of highly forbidden E2 decays from 2-quasiparticle isomers, while level density K-mixing has a much smaller but non-negligible effect.

Summary

- A new isomer was discovered in ^{162}Dy with a half-life of 8.3(3) μs.
- The isomer was assigned a spin-parity of $K^{\pi}=8^{+}$ on the basis of transition rates, multi-quasiparticle calculations, and the intrinsic g-factor and alignment of its associated rotational band.
- A highly forbidden E2 transition from the isomer to the ground state band was observed to have a reduced hindrance of 35, agreeing well with N_pN_n systematics.
- Small deviations from the N_pN_n dependence were analysed for a range of 2-quasiparticle isomer decays and interpreted as arising from a weak dependence on the isomer excitation energy relative to the yrast line.
- Coriolis and gamma-tunnelling K-mixing have a greater influence on highly forbidden E2 decays in 2-quasiparticle isomers.

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Collaborators

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