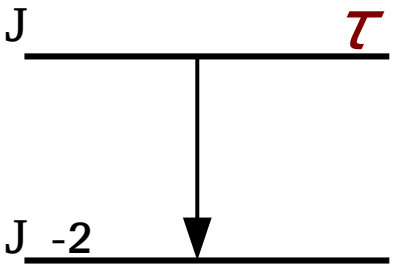
Lifetime measurements in the ground-state band of ^{114}Pd

Eugenio R. Gamba[1,2]
A. M. Bruce[3]
S. Lalkovski[4]
M. Rudigier[5]
S. Bottoni[6]
G. Benzoni[2]

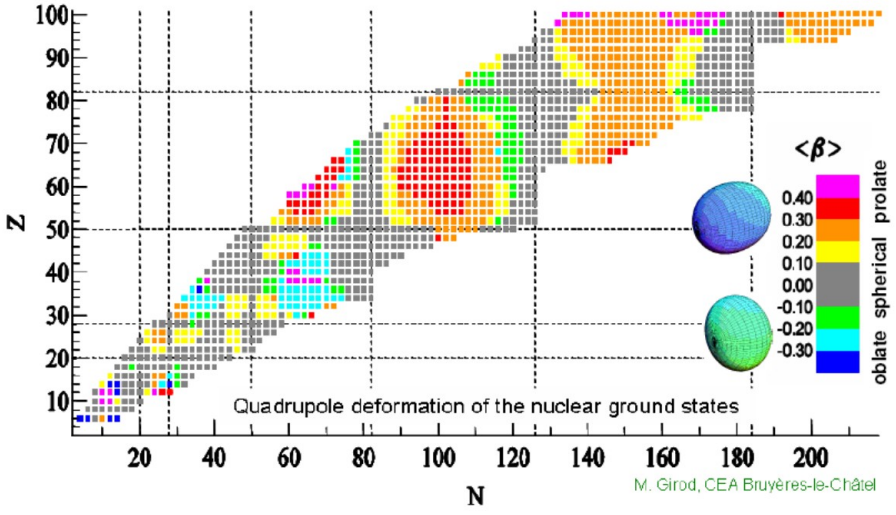
106° Congresso Nazionale - Società Italiana di Fisica
Sezione 1: Fisica Nucleare e Subnucleare
14-18 Settembre 2020

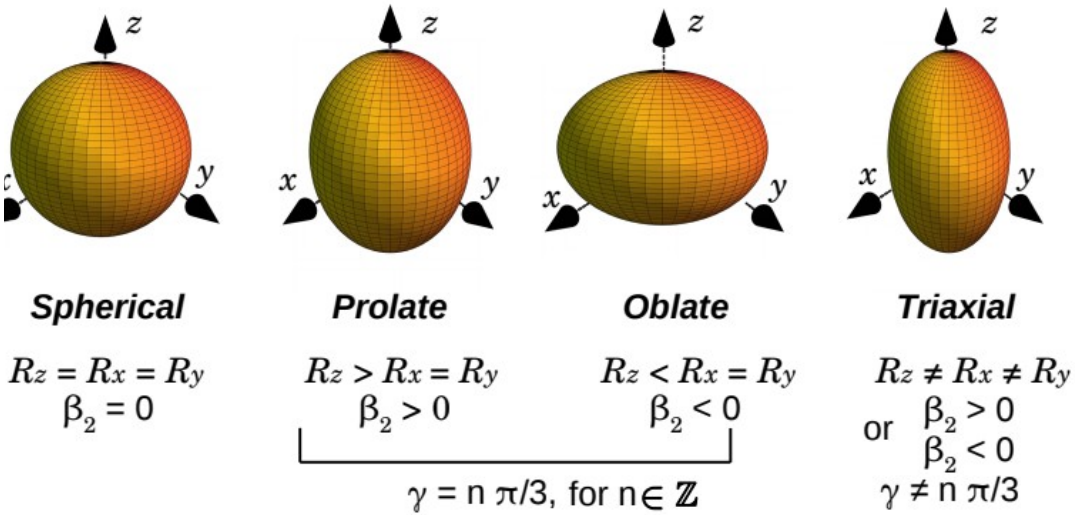
1 - Centro Fermi – Museo Storico della Fisica e Centro Studi e Ricerche "Enrico Fermi", Roma
2 - INFN sezione di Milano
3 - School of Computing, Engineering and Mathematics, University of Brighton, UK
4 - Department of Nuclear Engineering, Faculty of Physics, University of Sofia, Sofia, Bulgaria
5 – Institut für Kernphysik, TU Darmstadt, Darmstadt, Germany
6 - Dipartimento di Fisica, Università degli Studi di Milano

Introduction

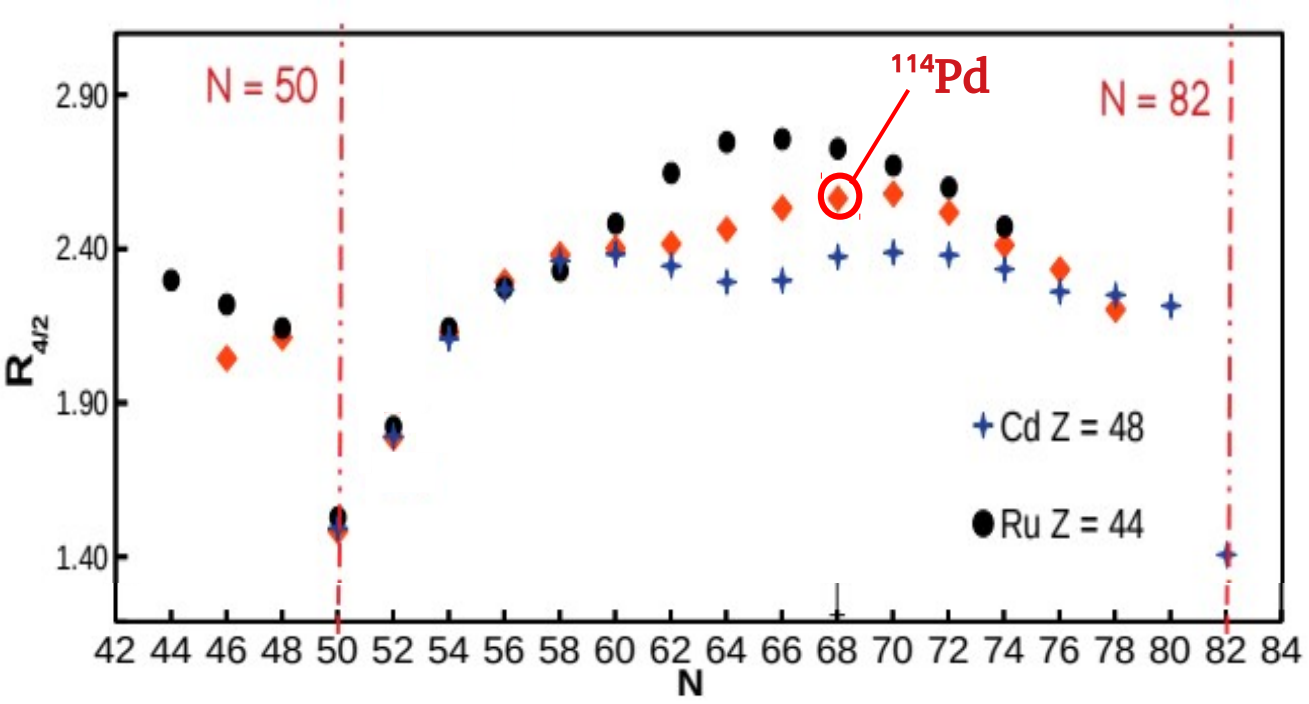


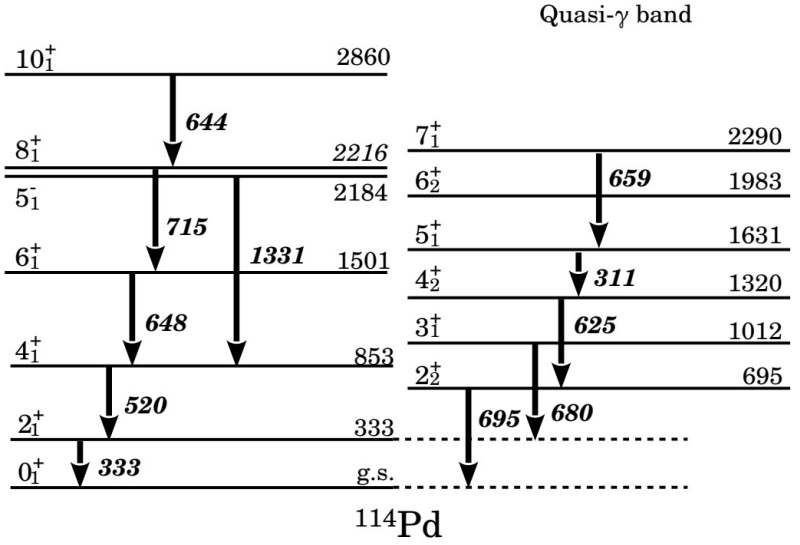
τ ⇒ B(E2; J → J-2) ⇒ Q_0 ⇒ β_2





The physics case: ^{114}Pd - 1





$R_{4/2} = E(4^+_1)/E(2^+_1) = 2.6$

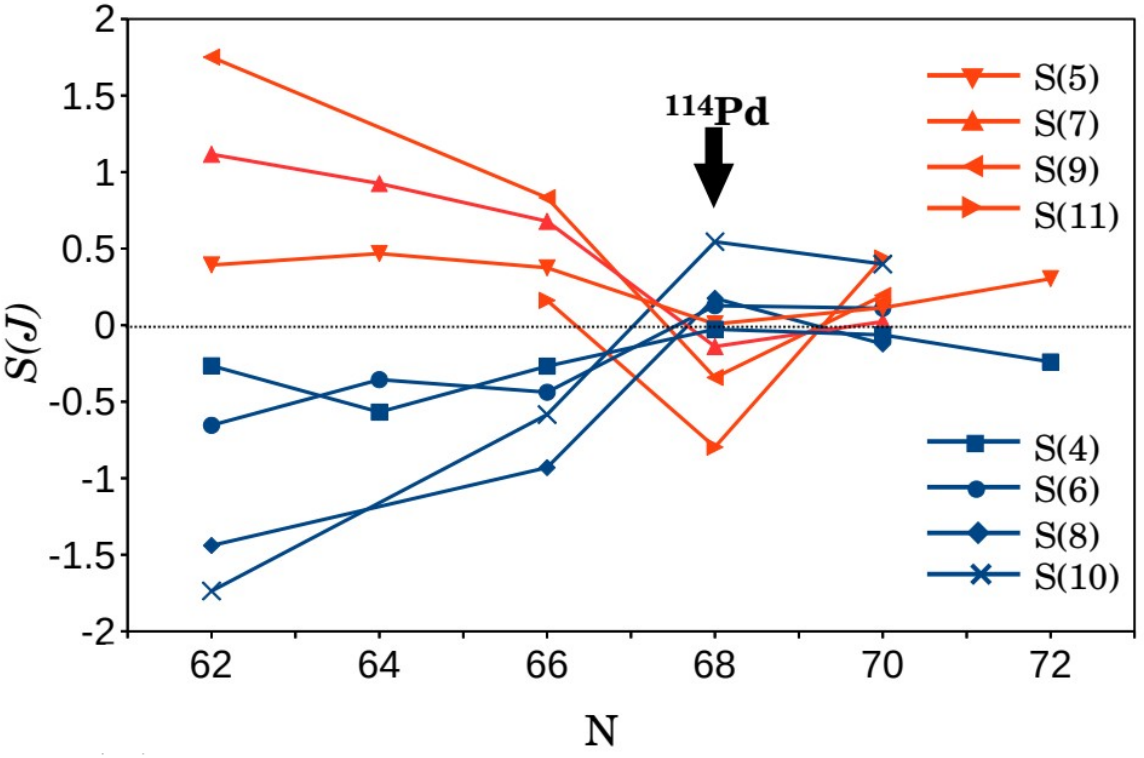
Rotational limit = 3.33

$R_{2/2} = E(2^+_2)/E(2^+_1) = 2.1$ → $\gamma = 27.5°$

Energy spacing yrast band ~ J(J+6)

Typical of triaxially deformed nuclei

The physics case: ^{114}Pd - 2



$$S(J) = \frac{[E(J) - 2E(J-1) + E(J-2)]}{E(2_1^+)}$$

γ-soft triaxiality: positive values for the odd-spin levels and negative values for the even-spin ones

rigid triaxiality: negative values for the odd-spin levels and positive values for the even-spin ones

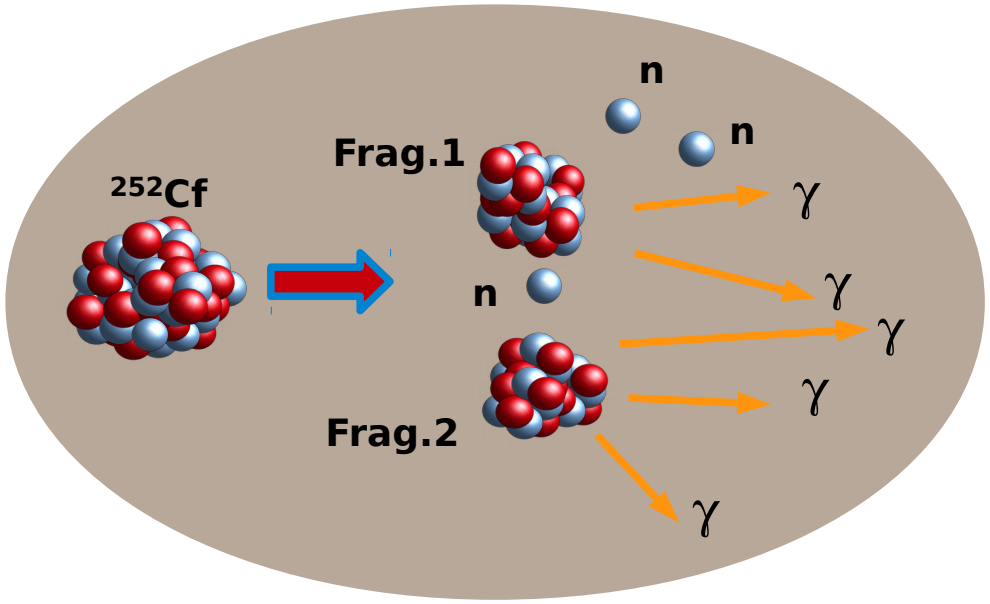
Switch from **γ-soft** to **rigid triaxiality** at **N = 68!**

More stringent test

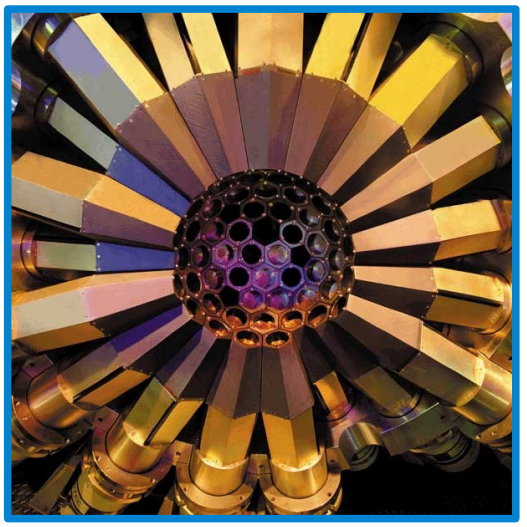
$B_{4/2}$ = B(E2; $4^+_1 \rightarrow 2^+_1$)/B(E2; $2^+_1 \rightarrow 0^+_1$)

To be measured!

Experimental setup @ ANL



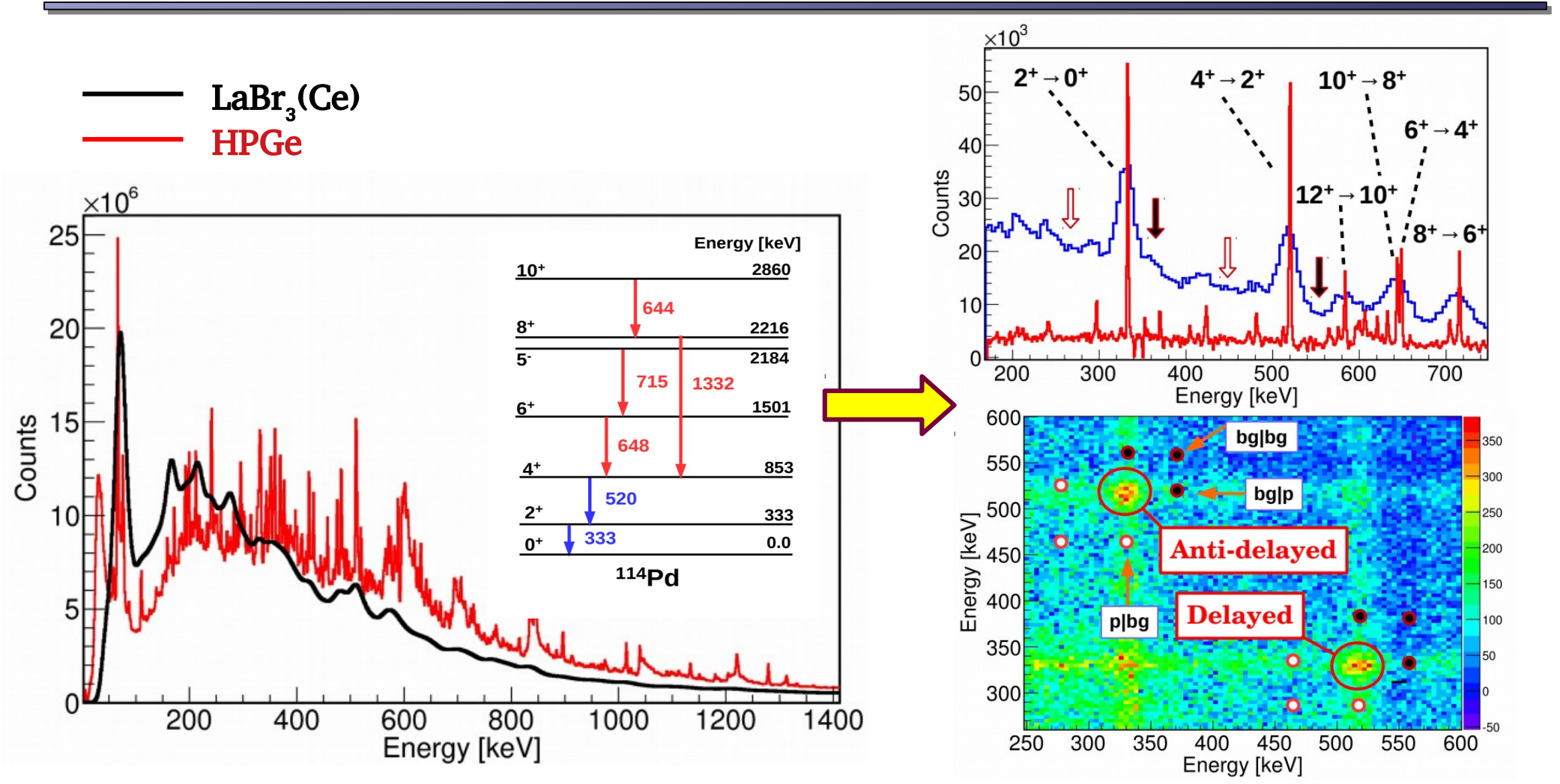
@ Argonne National Laboratory



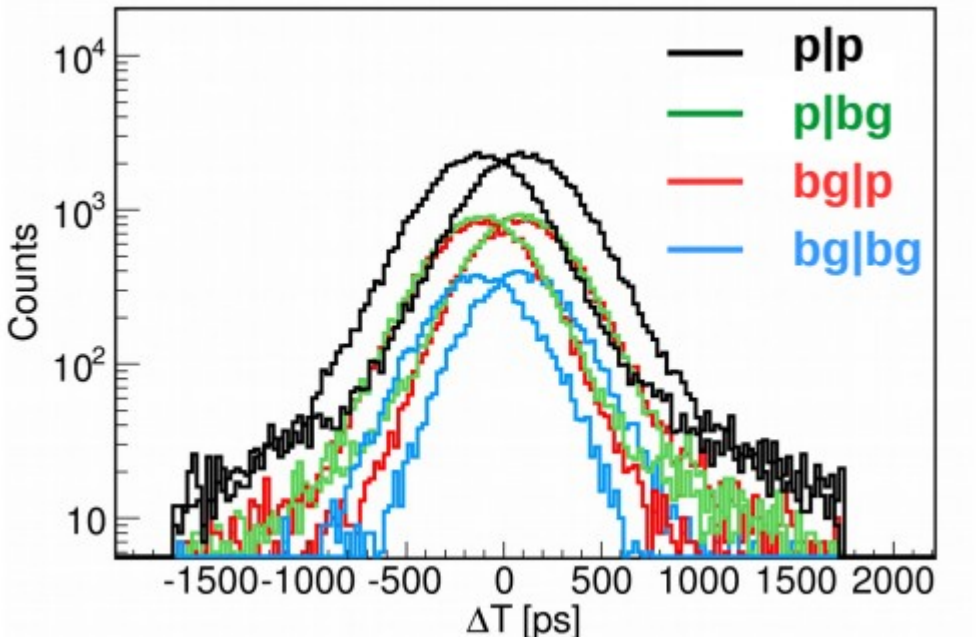
+

- A 34.4 μCi ^{252}Cf source at the focus of the 2 hemispheres ($t_{1/2}$ = 2.645 y, Z = 98 N = 154)
- A scintillator array made of 25 $LaBr_3$(Ce) detectors from the **FATIMA** array
- One hemisphere of **Gammasphere** made of 51 Compton-suppressed HPGe detectors
- Gammasphere was coupled to 25 $LaBr_3$(Ce) scintillator detectors for the first time

Data analysis: the 2^+ state - 1



Data analysis: the 2^+ state - 2



$$C^t_{cor} = \frac{n^m_{tot}C_{exp} - n^m_{p|bg}C^m_{p|bg} - n^m_{bg|p}C^m_{bg|p} + n^m_{bg|bg}C^m_{bg|bg}}{n^m_{tot} - n^m_{p|bg} - n^m_{bg|p} + n^m_{bg|bg}}.$$

Where n_i are the number of counts and C_i are the centroid positions

Generalized centroid difference method

$$\Delta C^t = C^{t,\mathrm{del}}_{p|p} - C^{t,\mathrm{antidel}}_{p|p}$$

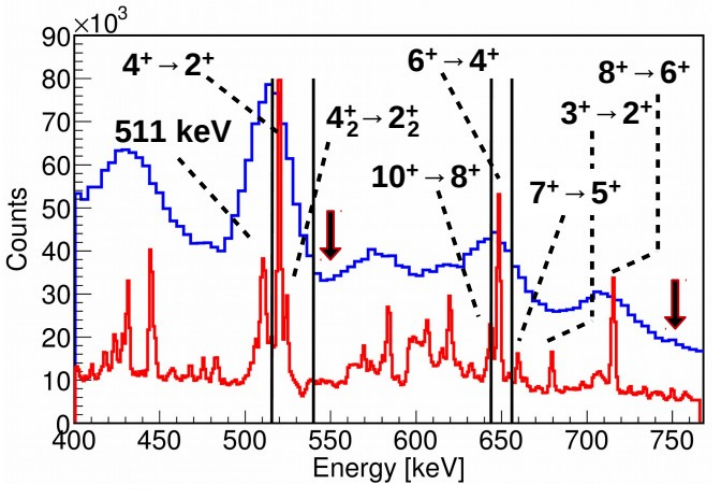
$$\tau = \frac{\Delta C^t - \mathrm{PRD}(E_f, E_d)}{2}$$

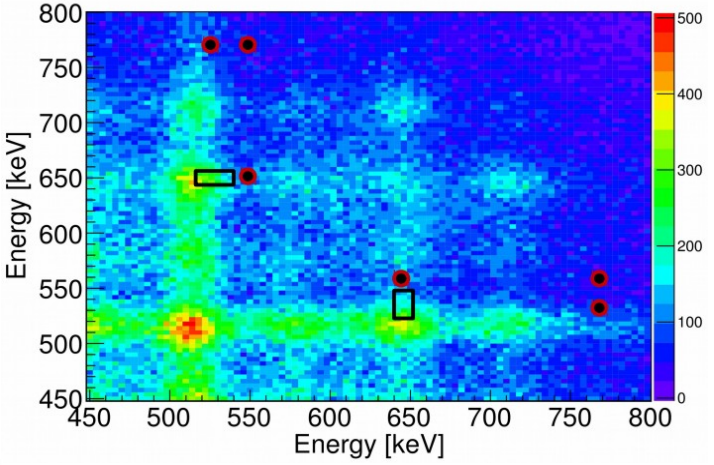
τ_{2+} = 113(5) ps

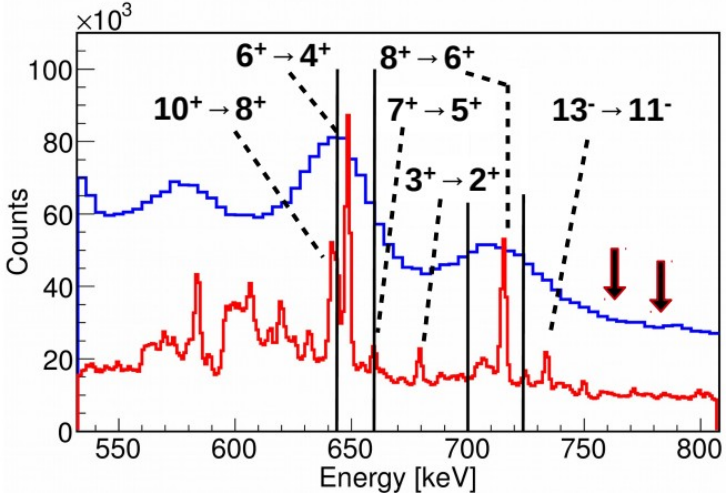
vs literature value of

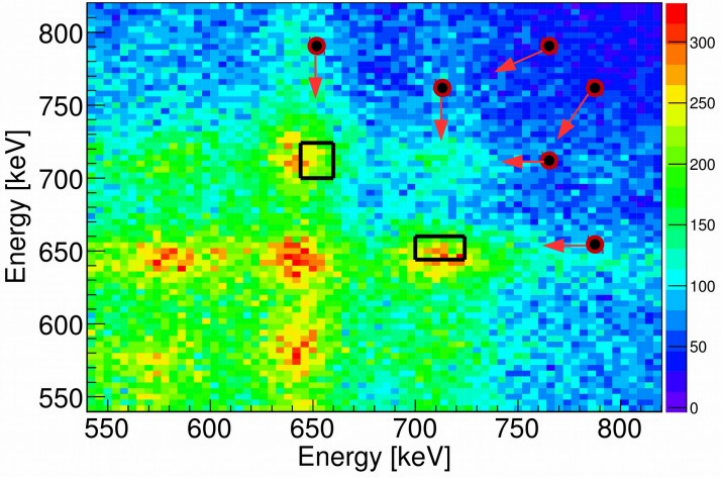
$$\tau = 118(20)$$

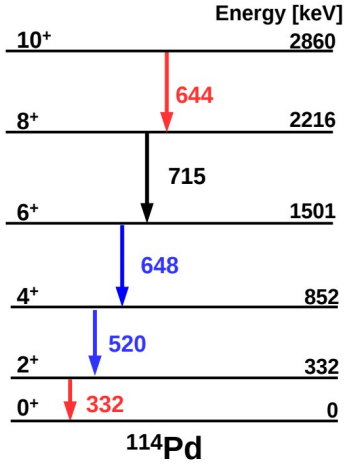
Data analysis: The 4+ and 6⁺ states



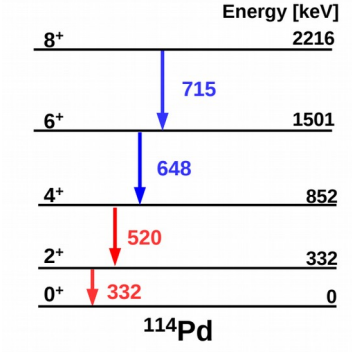






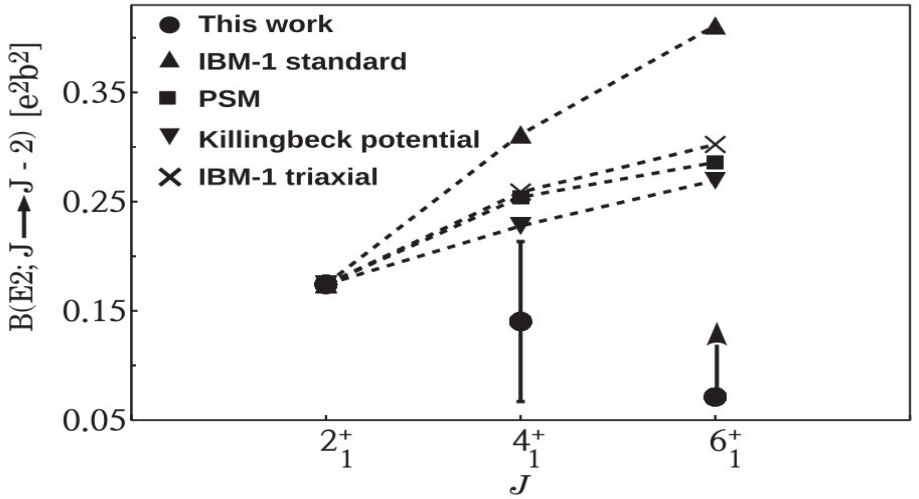


τ_{4+} = 21(11) ps

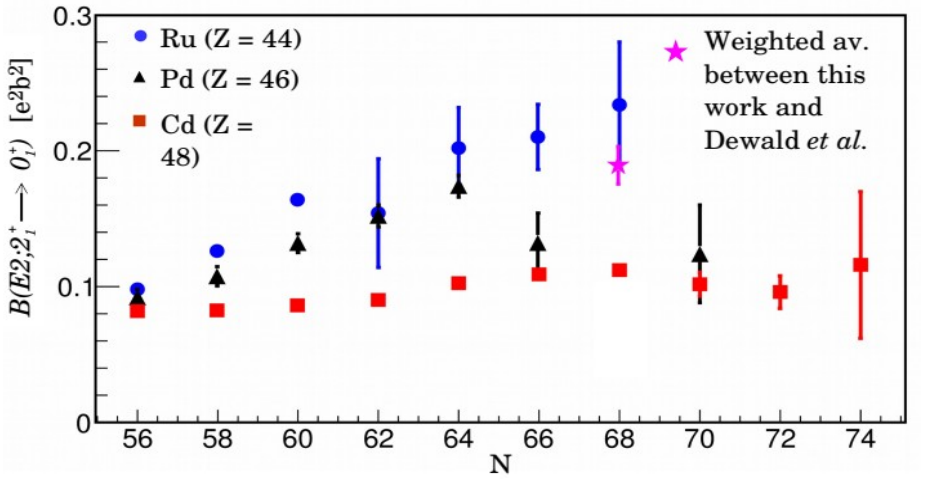


τ_{6+} = ≤10 ps

Results and interpretation



1)



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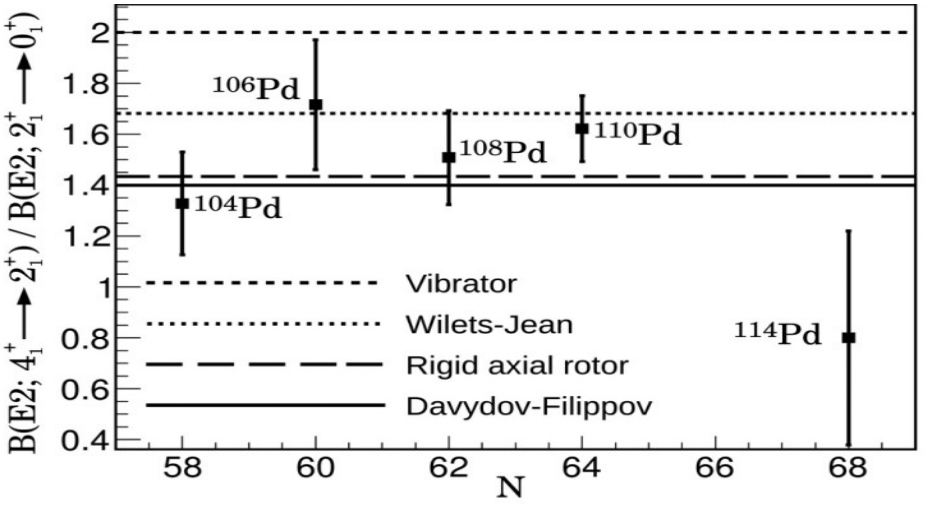

3)

$B_{4/2} = B(E2; 4^+_1 \rightarrow 2^+_1)/B(E2; 2^+_1 \rightarrow 0^+_1) =$ 0.80(42)

Inversion of the type of triaxiality from γ-soft to a more rigid configuration

Summary:

1 – ^{114}Pd nuclei were produced in the spontaneous fission of ^{252}Cf and γ-rays observed using a hybrid Gammasphere-FATIMA array

2 – Lifetimes of the first 2^+, 4^+, 6^+ states in 114Pd were measured and the values of 113(5), 21(11) and ≤10 ps were found respectively.

3 – The measured B(E2) values agree with the theoretical models within 2σ. The measured values suggest the ^{114}Pd nucleus to be the most deformed of the isotopic chain.

4 – The measured B(E2) values show an inversion of the type of deformation occurring at N = 68.

Grazie per l'attenzione!

PHYSICAL REVIEW C **100**, 044309 (2019)

Fast-timing measurements in the ground-state band of ^{114}Pd

E. R. Gamba,[1] A. M. Bruce,[1,*] S. Lalkovski,[2,†] M. Rudigier,[2] S. Bottoni,[3,‡] M. P. Carpenter,[3] S. Zhu,[3] J. T. Anderson,[3] A. D. Ayangeakaa,[3,§] T. A. Berry,[2] I. Burrows,[4] M. Carmona Gallardo,[5] R. J. Carroll,[2] P. Copp,[6] D. M. Cullen,[7] T. Daniel,[2,¶] G. Fernández Martínez,[8] J. P. Greene,[3] L. A. Gurgi,[2] D. J. Hartley,[9] R. Ilieva,[2] S. Ilieva,[8] F. G. Kondev,[10] T. Kröll,[8] G. J. Lane,[11] T. Lauritsen,[3] I. Lazarus,[4] G. Lotay,[2] C. R. Niță,[12] Zs. Podolyák,[2] V. Pucknell,[4] M. Reed,[11] P. H. Regan,[2,13] J. Rohrer,[3] J. Sethi,[3] D. Seweryniak,[3] C. M. Shand,[2] J. Simpson,[4] M. Smoleń,[14] E. A. Stefanova,[15] V. Vedia,[5] and O. Yordanov[15]

[1]*School of Computing, Engineering and Mathematics, University of Brighton, Brighton BN2 4GJ, United Kingdom*
[2]*Department of Physics, University of Surrey, Guildford GU2 7XH, United Kingdom*
[3]*Physics Division, Argonne National Laboratory, Argonne, Illinois 60439, USA*
[4]*STFC Daresbury Laboratory, Daresbury, Warrington WA4 4AD, United Kingdom*
[5]*Grupo de Física Nuclear, Universidad Complutense, CEI Moncloa, ES-28040 Madrid, Spain*
[6]*Department of Physics and Applied Physics, University of Massachusetts Lowell, Lowell, Massachusetts 01854, USA*
[7]*School of Physics and Astronomy, University of Manchester, Manchester M13 9PL, United Kingdom*
[8]*Institut für Kernphysik, TU Darmstadt, Schlossgartenstrasse 9, 64289 Darmstadt, Germany*
[9]*Department of Physics, U.S. Naval Academy, Annapolis, Maryland 21402, USA*
[10]*Nuclear Engineering Division, Argonne National Laboratory, Argonne, Illinois 60439, USA*
[11]*Department of Nuclear Physics, R.S.P.E., Australian National University, Canberra 0200, Australia*
[12]*Horia Hulubei National Institute of Physics and Nuclear Engineering, Bucharest-Măgurele, Romania*
[13]*AIR Division, NPL, Teddington TW11 0LW, United Kingdom*
[14]*School of Engineering and Science, University of the West of Scotland, Paisley PA1 2BE, United Kingdom*
[15]*INRNE, Bulgarian Academy of Sciences, 1784 Sofia, Bulgaria*

(Received 29 June 2019; revised manuscript received 31 August 2019; published 11 October 2019)

Using a hybrid Gammasphere array coupled to 25 $LaBr_3(Ce)$ detectors, the lifetimes of the first three levels of the yrast band in ^{114}Pd, populated via ^{252}Cf decay, have been measured. The measured lifetimes are $\tau_{2^+} = 103(10)$ ps, $\tau_{4^+} = 22(13)$ ps, and $\tau_{6^+} \leqslant 10$ ps for the 2_1^+, 4_1^+, and 6_1^+ levels, respectively. Palladium-114 was predicted to be the most deformed isotope of its isotopic chain, and spectroscopic studies have suggested it might also be a candidate nucleus for low-spin stable triaxiality. From the lifetimes measured in this work, reduced transition probabilities $B(E2; J \to J-2)$ are calculated and compared with interacting boson model, projected shell model, and collective model calculations from the literature. The experimental ratio $R_{B(E2)} = B(E2; 4_1^+ \to 2_1^+)/B(E2; 2_1^+ \to 0_1^+) = 0.80(42)$ is measured for the first time in ^{114}Pd and compared with the known values $R_{B(E2)}$ in the palladium isotopic chain: the systematics suggest that, for $N = 68$, a transition from γ-unstable to a more rigid γ-deformed nuclear shape occurs.

DOI: 10.1103/PhysRevC.100.044309