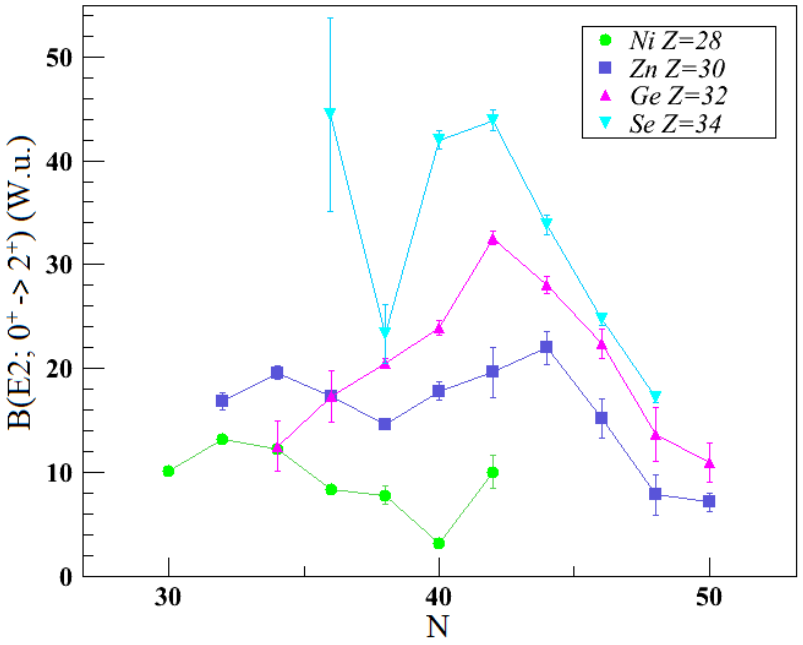
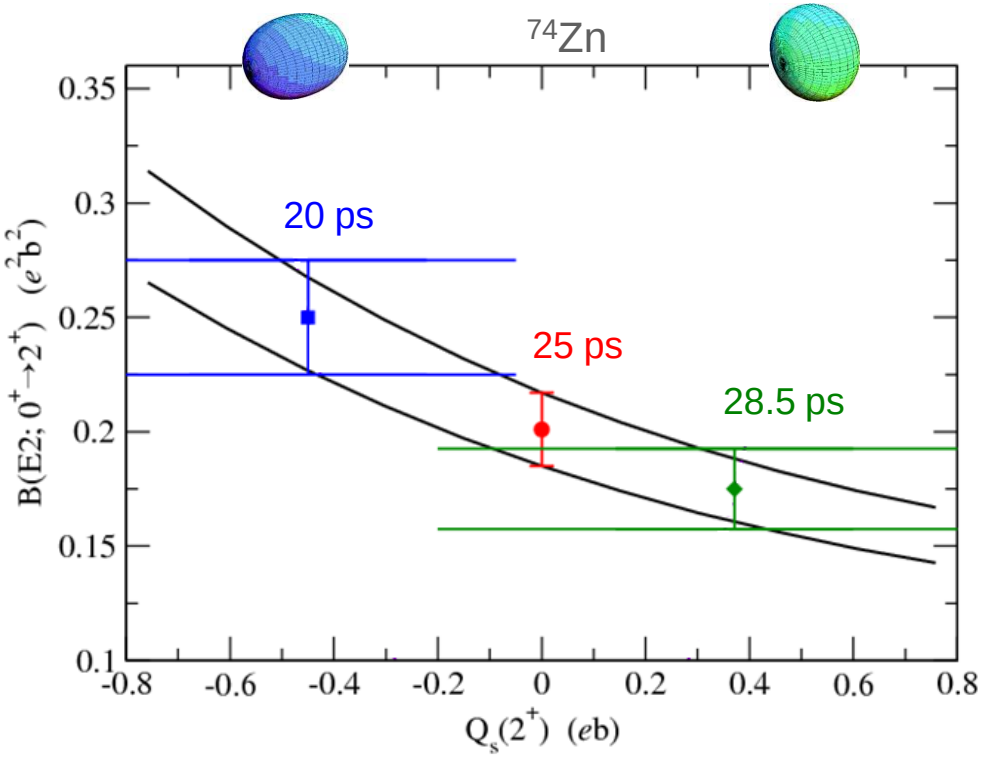
Lifetime of excited states in ^{72}Zn and ^{74}Zn using the AGATA demonstrator and the RDDS technique

EGAN workshop, 2011
Corinne Louchart, CEA Saclay

Onset of collectivity near N=40





Coulomb excitation of $^{74-80}$Zn at CERN
(J. Van de Walle et al., PRL 99, 142501 (2007))

- Lifetime measurement to determine the B(E2) value

Experiment

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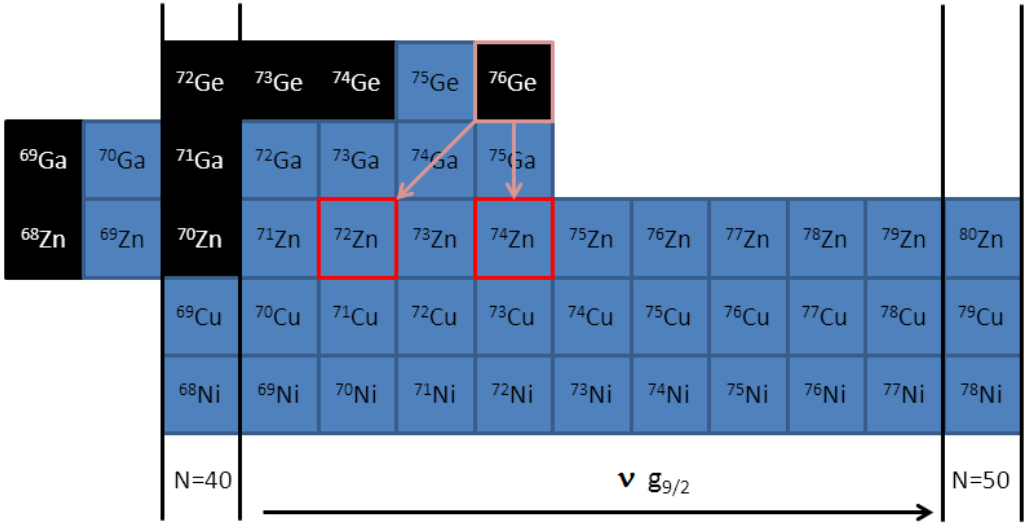
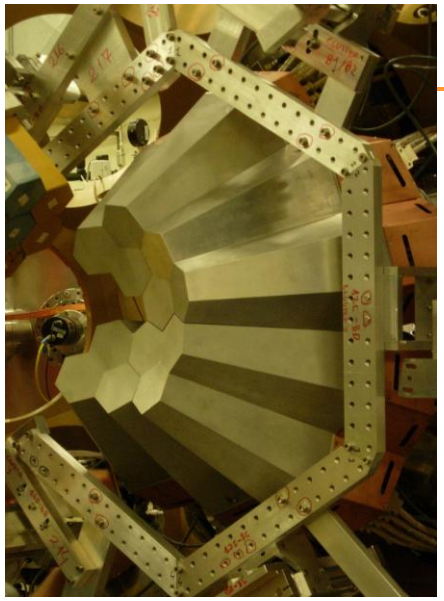
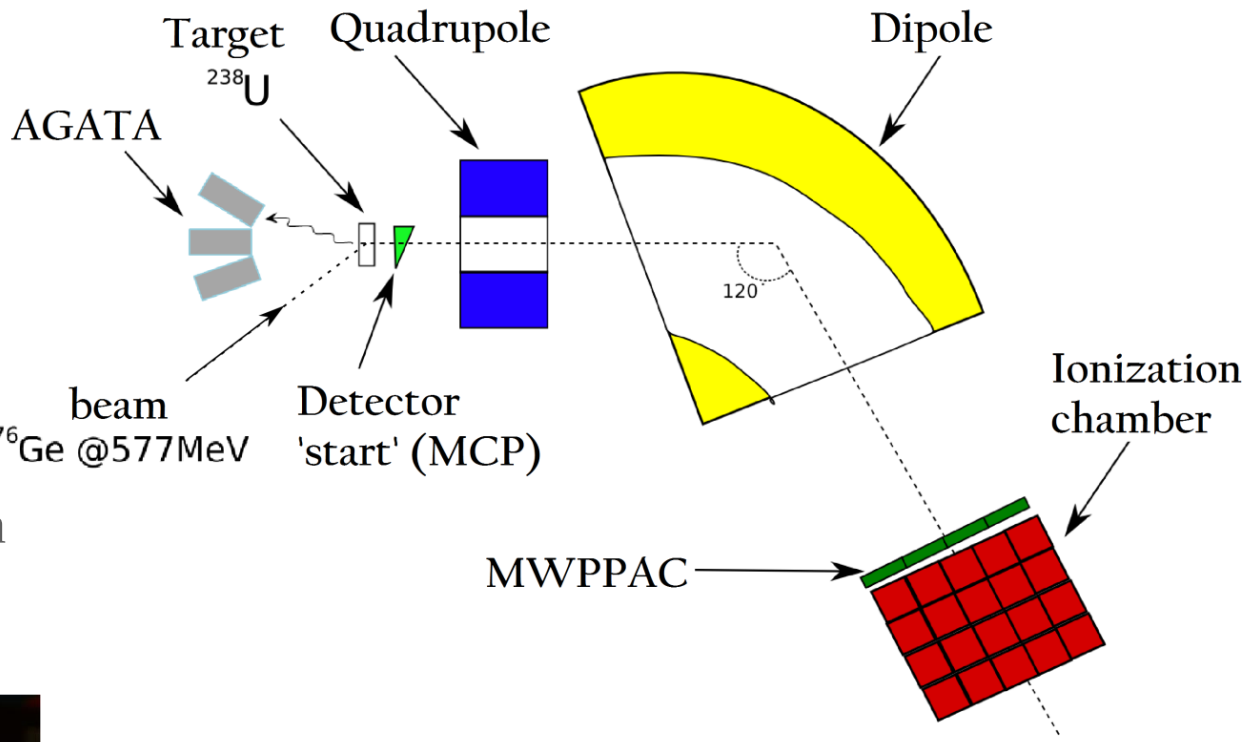


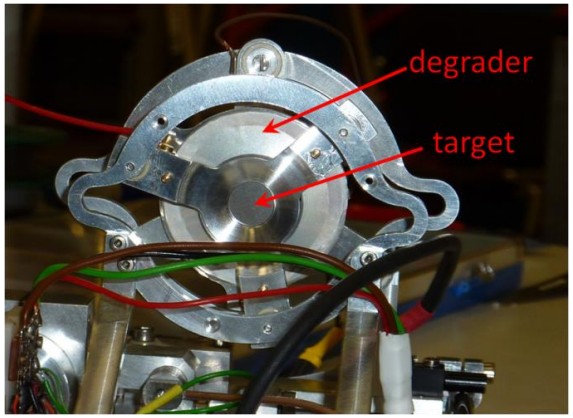
- Lifetimes in odd copper (next talk by Maria Doncel)
- Lifetimes in ^{72,74}Zn

Experimental set-up





- four clusters placed at 18 cm
- γ rate : 50 kHz per crystal



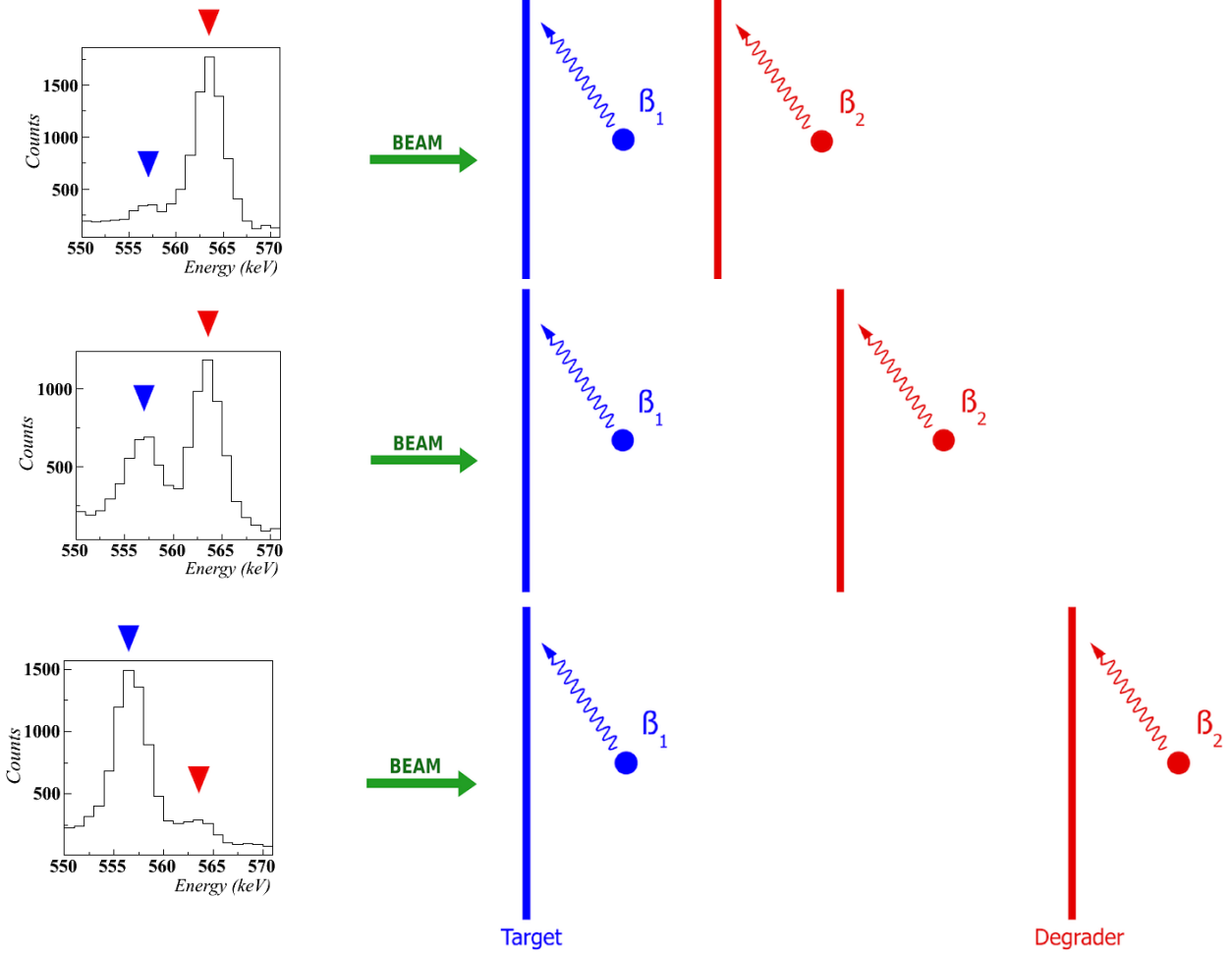
- target: ^{238}U of 1.4 mg/cm^2 thickness
- degrader: Nb of 4.2 mg/cm^2 thickness

Plunger device

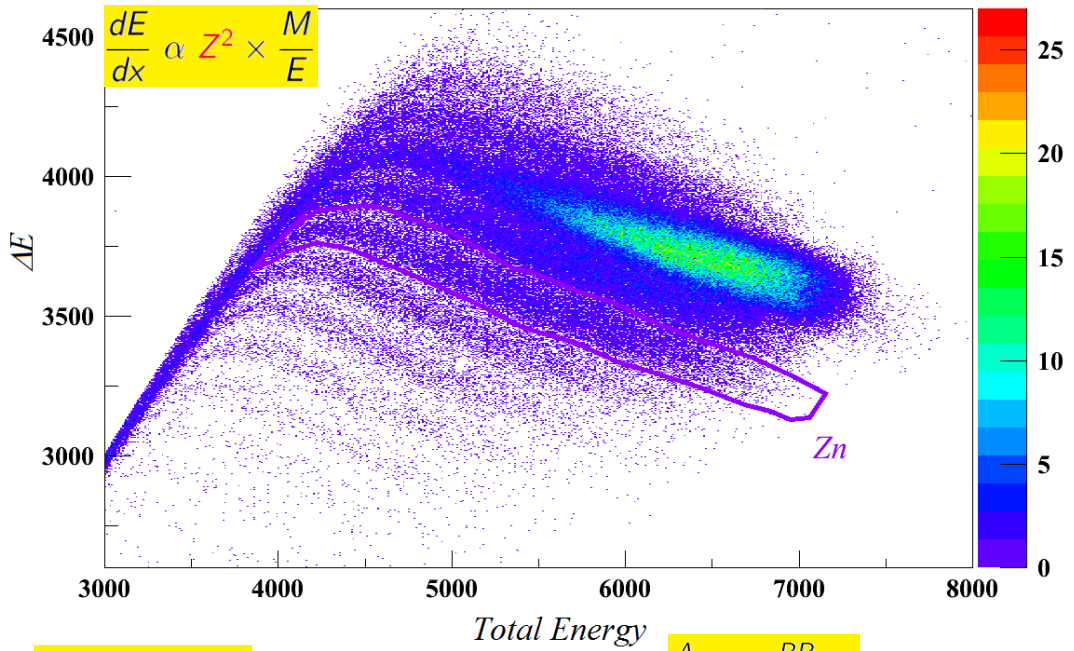
Doppler shift : $E_\gamma = \frac{\sqrt{1-\beta^2}E_0}{1-\beta\cos(\theta)}$

$\beta_1 \simeq 0.1$

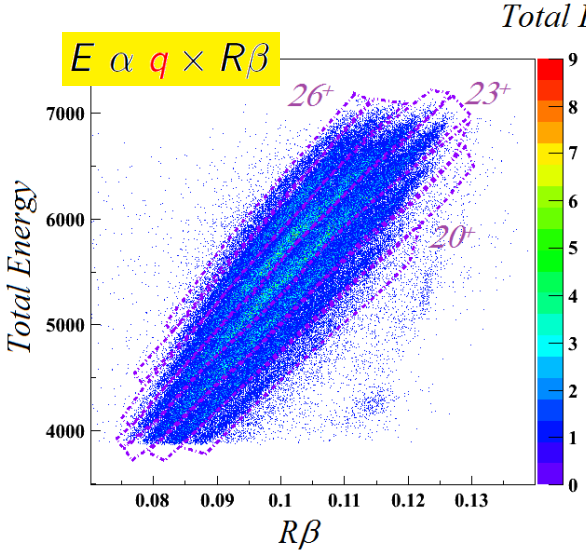
$\beta_2 \simeq 0.08$

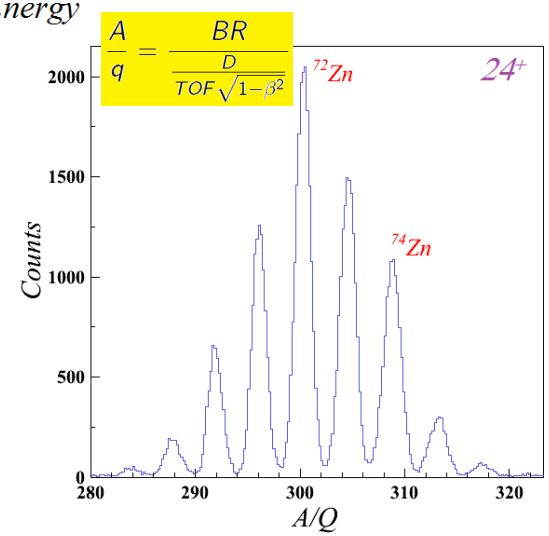


Identification with PRISMA



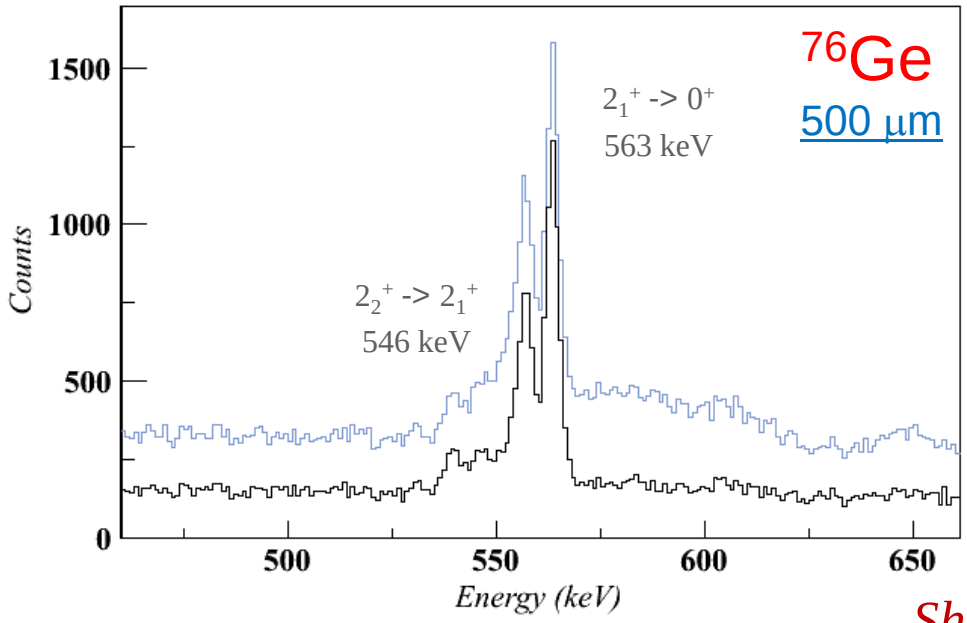
- ΔE in the two first ionization chamber sections
- total energy lost in the 4 ionization chamber sections

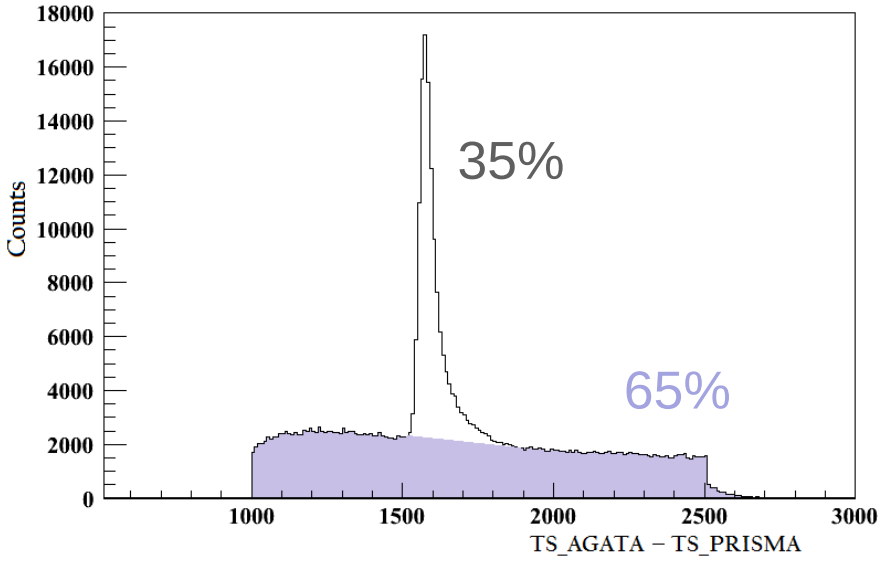


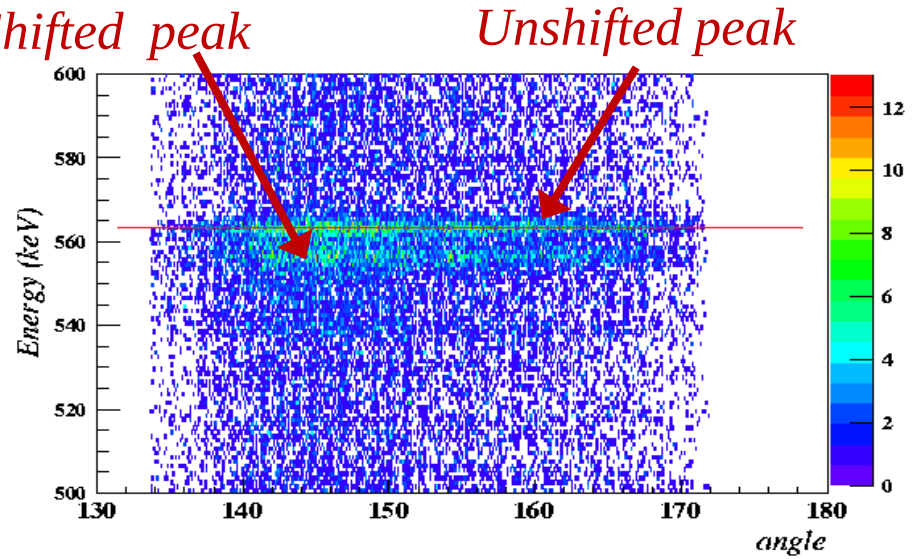


- β = Path/(TOF*c)
- x in focal plane by PPAC

De-excitation gamma spectrum of ^{76}Ge



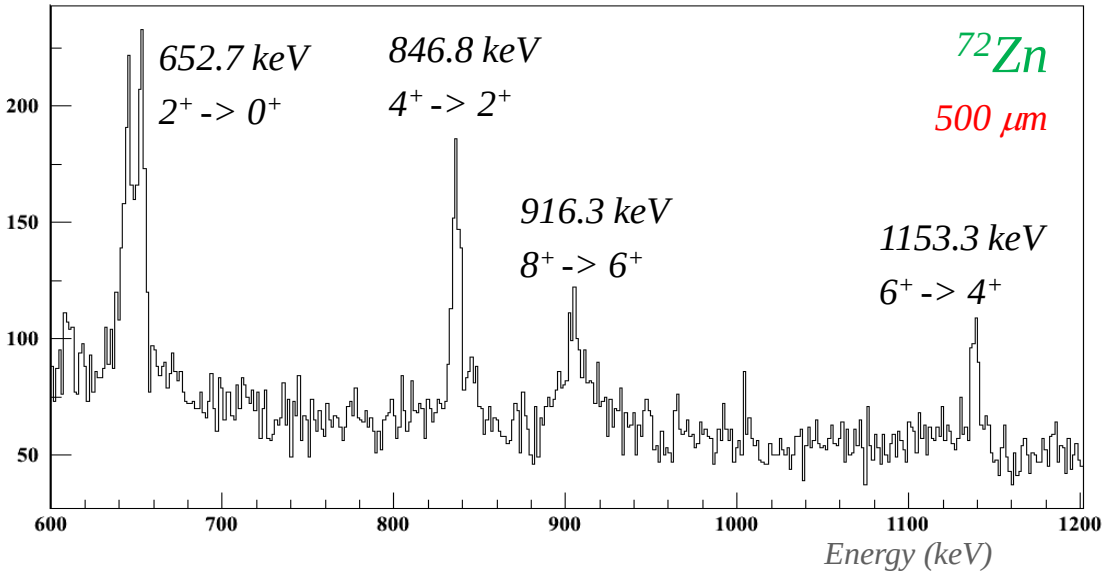


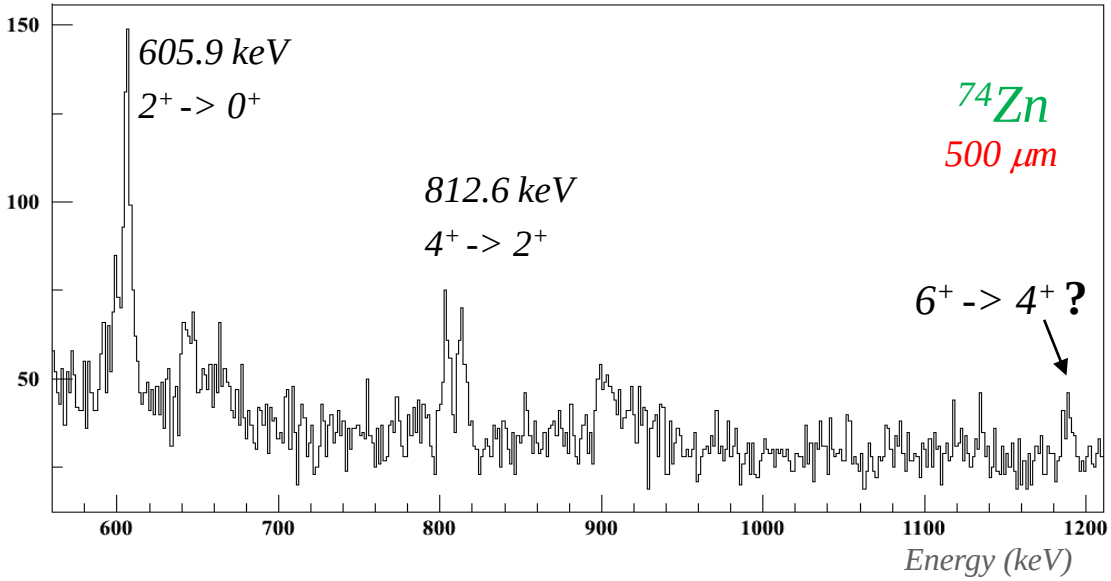


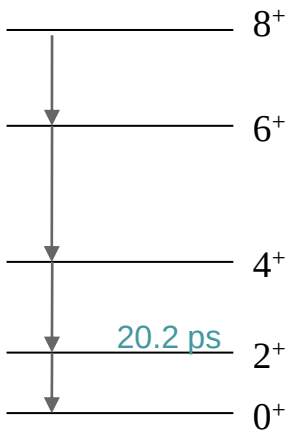
Energy resolution:

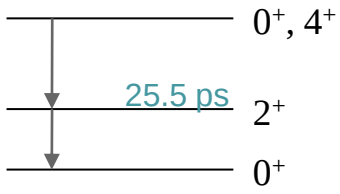
- Unshifted peak : 3.5 keV
- Shifted peak : 4.5 keV

^{72,74}Zn spectra



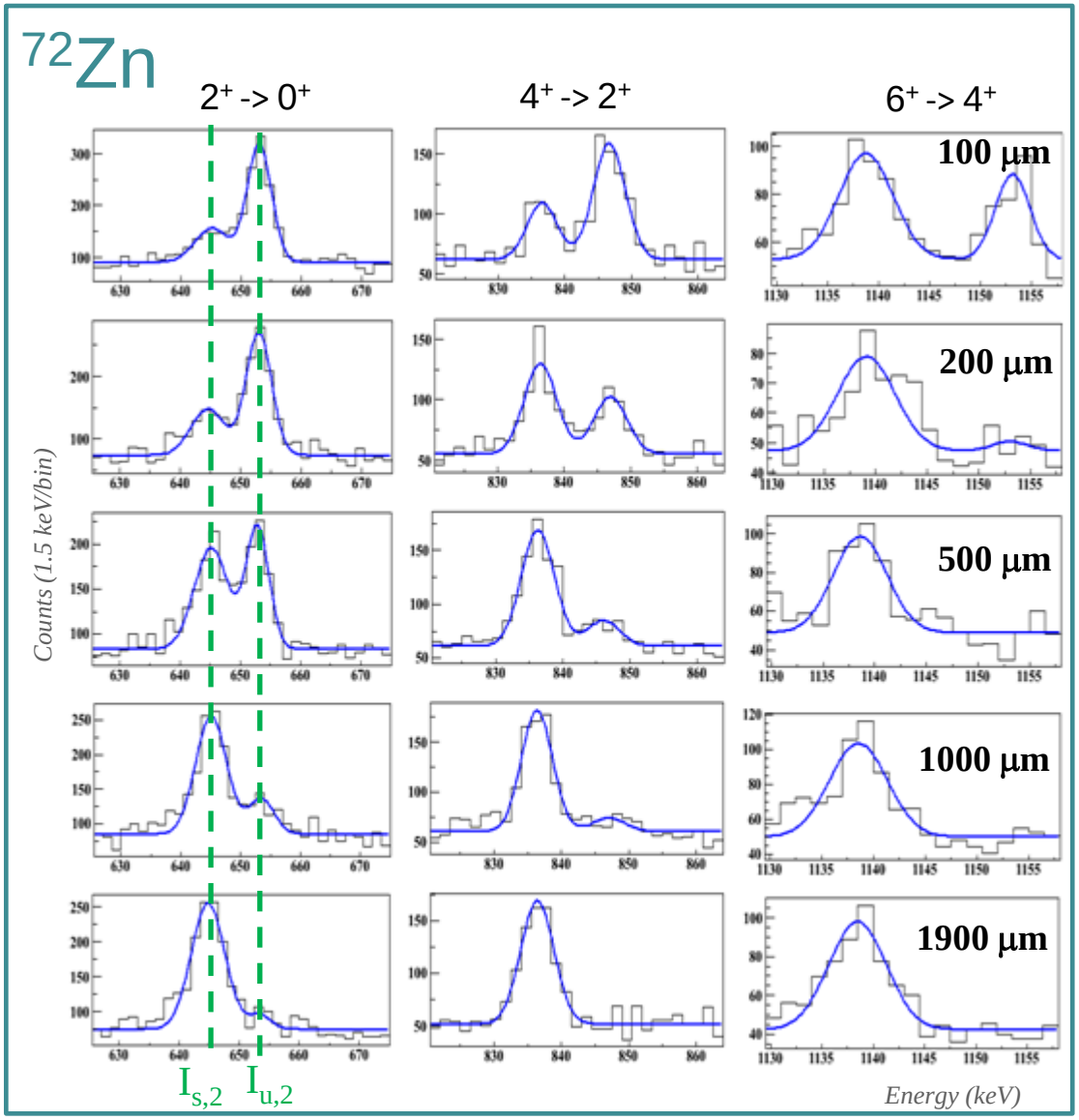


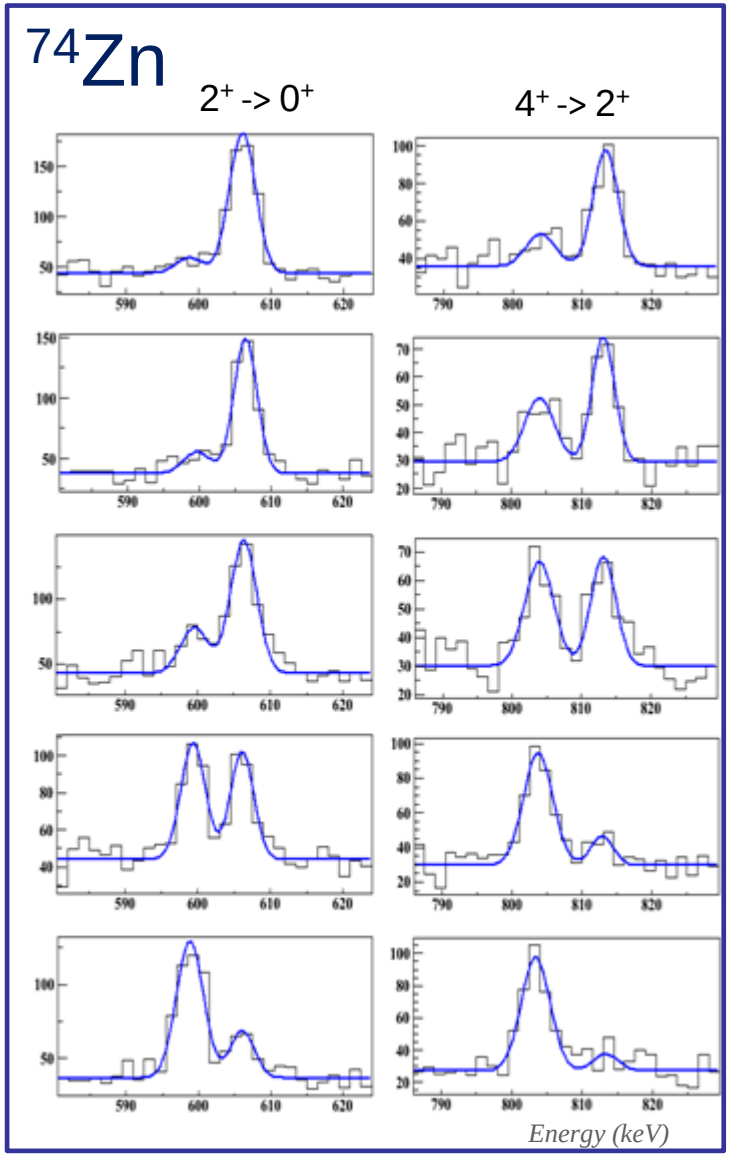




Data taken from NNDC

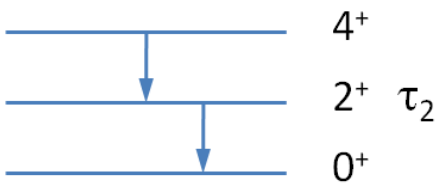
Energy distribution for ^{72,74}Zn





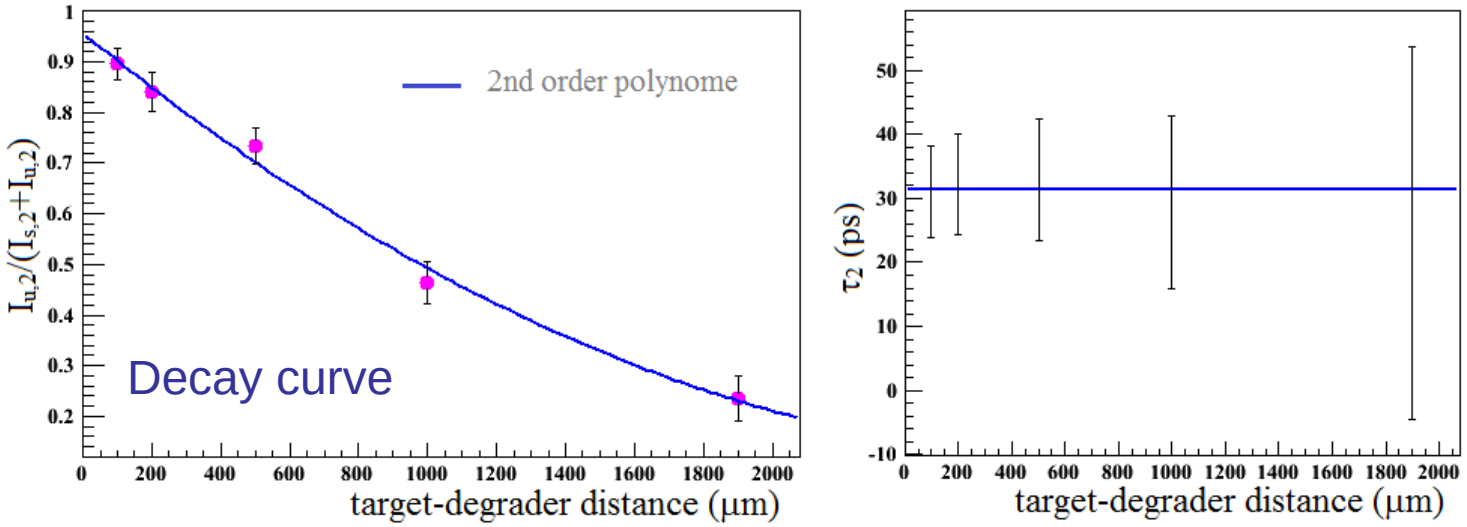
Differential Decay Curve method

$$\tau_2(x) = \frac{-\left(I_{u,2}(x) - I_{u,4}(x)\right)}{v * \frac{d}{dx}\left(I_{u,2}\right)}$$



Ref: A. Dewald *et al.*, Z. Phys. A – Atomic Nuclei 334, 163-175 (1989)

$2^+ \rightarrow 0^+$ in ^{74}Zn



⇒ Still in discussion with Köln group

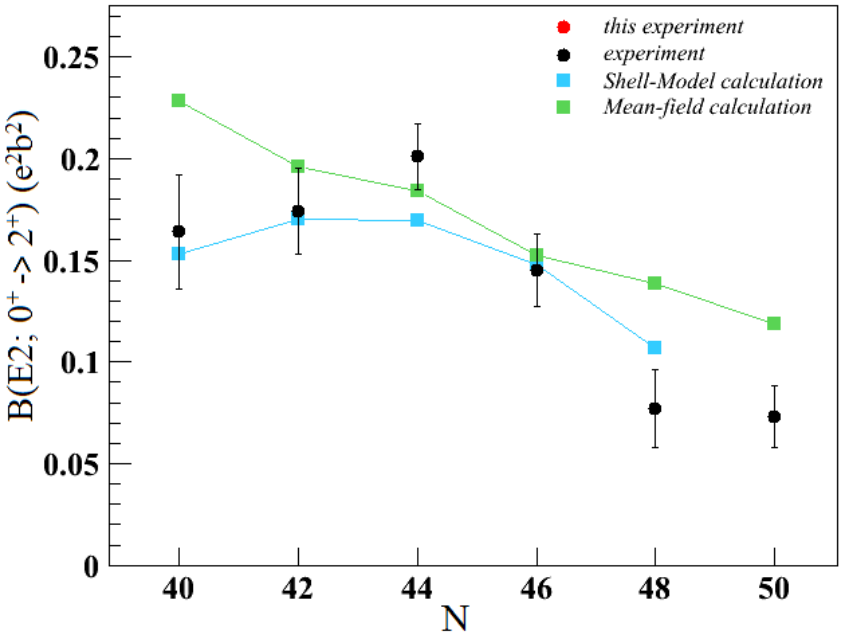
Preliminary lifetimes

^{76}Ge		τ (ps)	B(E2) down (e^2fm^4)
$2^+ \rightarrow 0^+$: 563 keV	this experiment	26.6 ± 0.6	545^{+12}_{-11}
	R. Lecomte *et al.* (coulomb excitation)		556 ± 6
$4^+ \rightarrow 2^+$: 847 keV	this experiment	2.5 ± 0.4	750^{+140}_{-100}
	R. Lecomte *et al.* (coulomb excitation)		730 ± 13
^{72}Zn		τ (ps)	B(E2) down (e^2fm^4)
$2^+ \rightarrow 0^+$: 653 keV	this experiment	16.8 ± 1.7	411^{+46}_{-38}
	S. Leenhardt *et al.* (coulomb excitation)		348 ± 42
$4^+ \rightarrow 2^+$: 847 keV	this experiment	8.2 ± 1.1	229^{+36}_{-27}
^{74}Zn		τ (ps)	B(E2) (e^2fm^4)
$2^+ \rightarrow 0^+$: 606 keV	this experiment	30.5 ± 3.3	329^{+40}_{-32}
	O. Perru *et al.* (coulomb excitation)		408 ± 30
	J. Van de Walle *et al.* (coulomb excitation)		401 ± 32
	M. Niikura *et al.* (plunger experiment)	27.2 ± 1.9	367 ± 26
$4^+ \rightarrow 2^+$: 813 keV	this experiment	25.7 ± 2.2	90^{+8}_{-7}
	J. Van de Walle *et al.* (coulomb excitation)		507 ± 74

- $\tau_{2,4}(^{76}Ge)$ in agreement with previous value

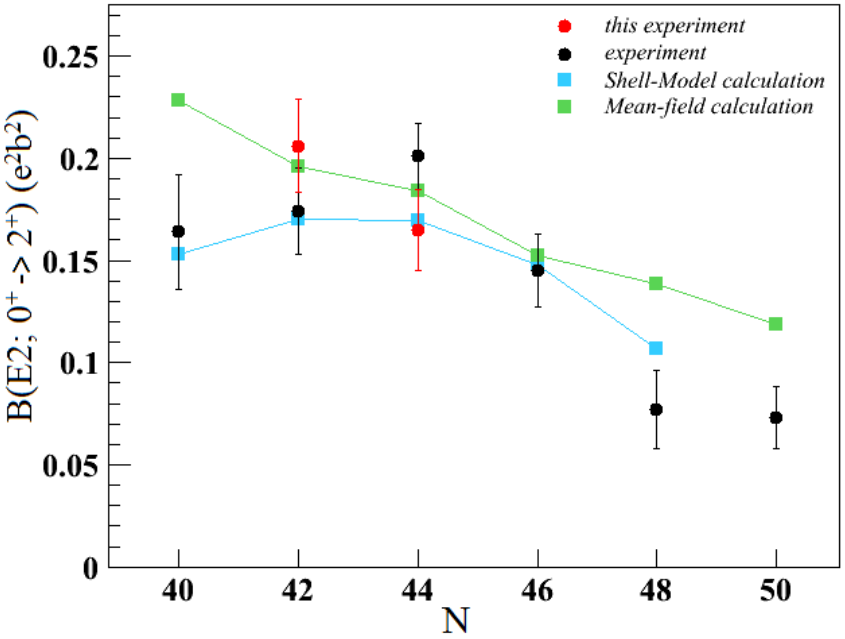
  $\tau_2(^{72}Zn)$ in agreement with previous value

Conclusion


this experiment
experiment
Shell-Model calculation
Mean-field calculation
B(E2; 0⁺ -> 2⁺) (e²b²)
0.25
0.2
0.15
0.1
0.05
0
40
42
44
46
48
50
N

Conclusion

- higher value for $\tau_2(^{74}Zn)$, maximum of collectivity at N=42



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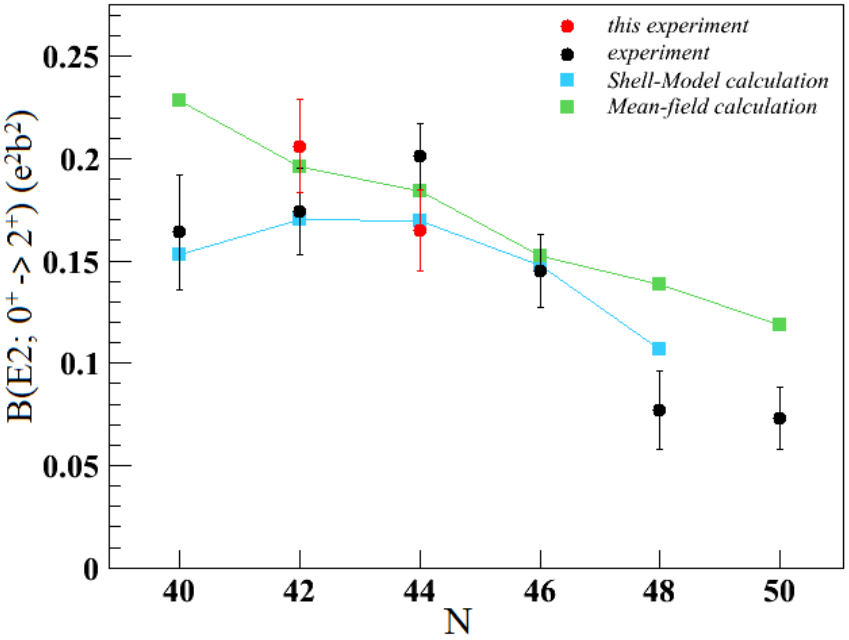
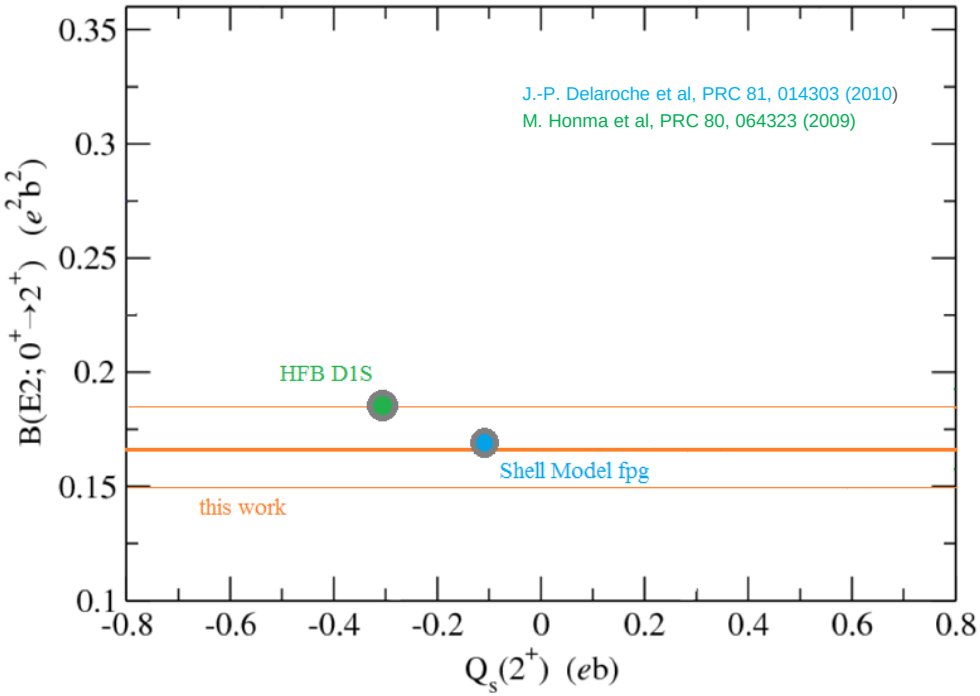
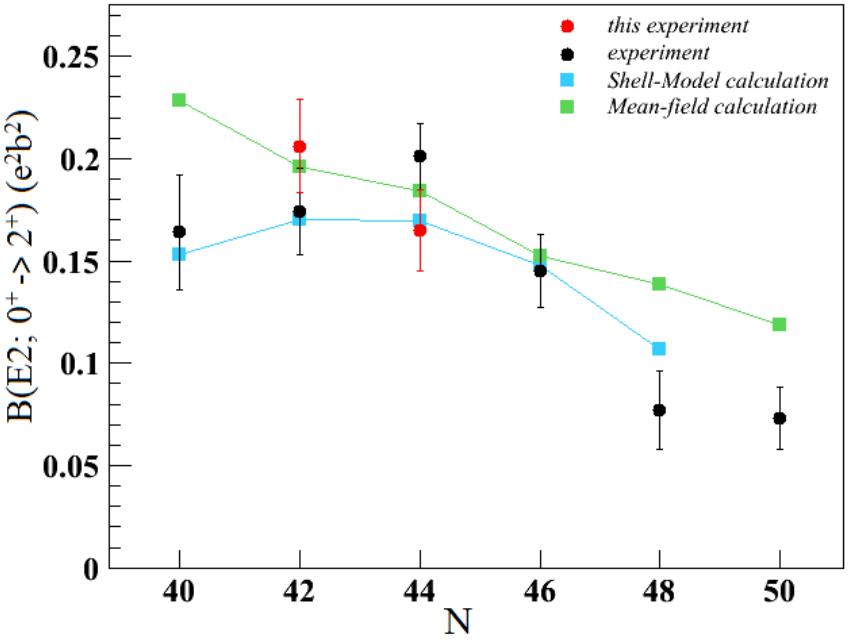
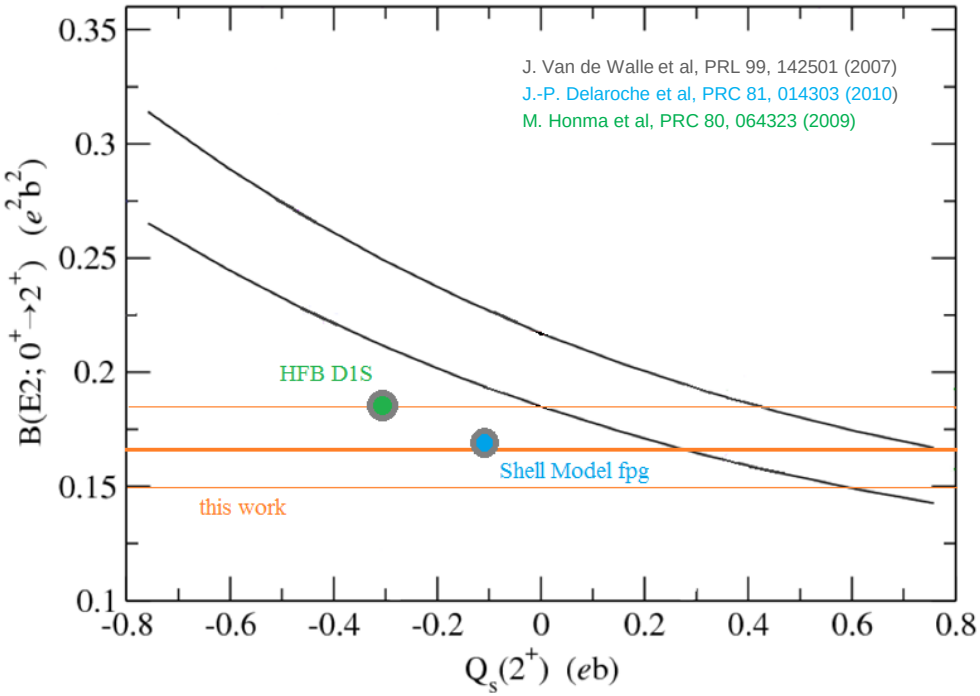




Conclusion

- higher value for $\tau_2(^{74}Zn)$, maximum of collectivity at N=42
- oblate shape ?





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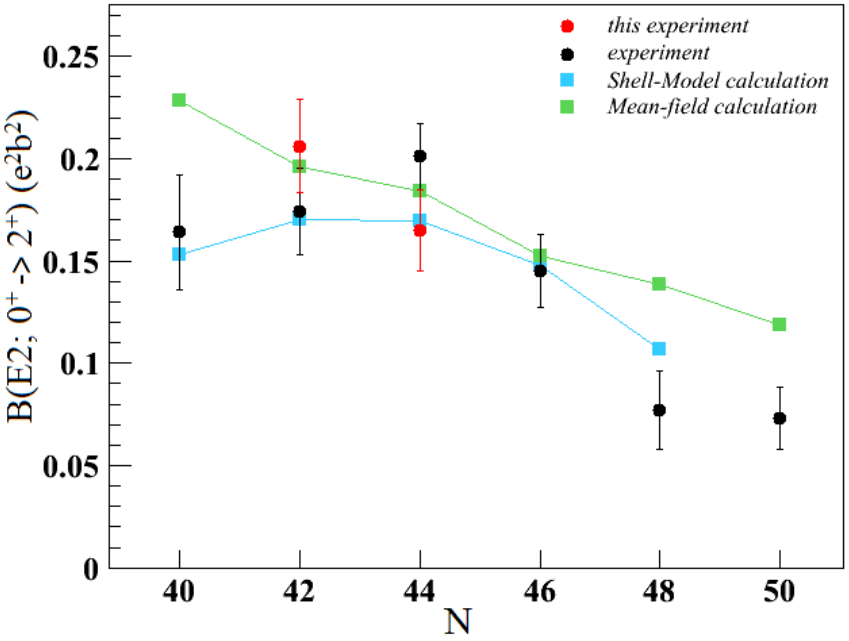

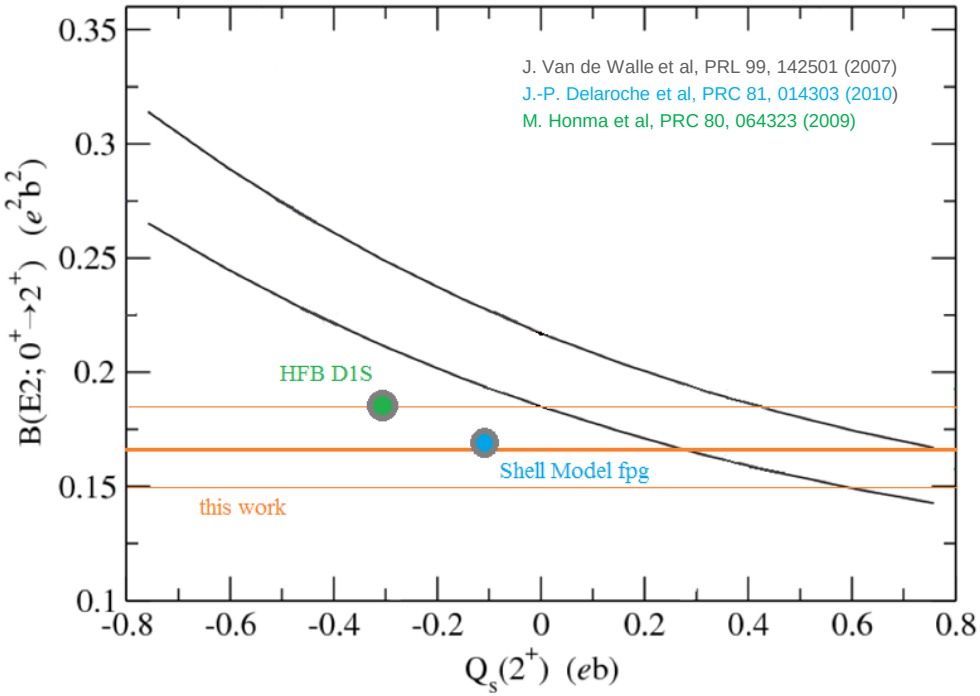

- $\tau_4(^{74}Zn)$: effective lifetime much higher than expected

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Thank you for your attention