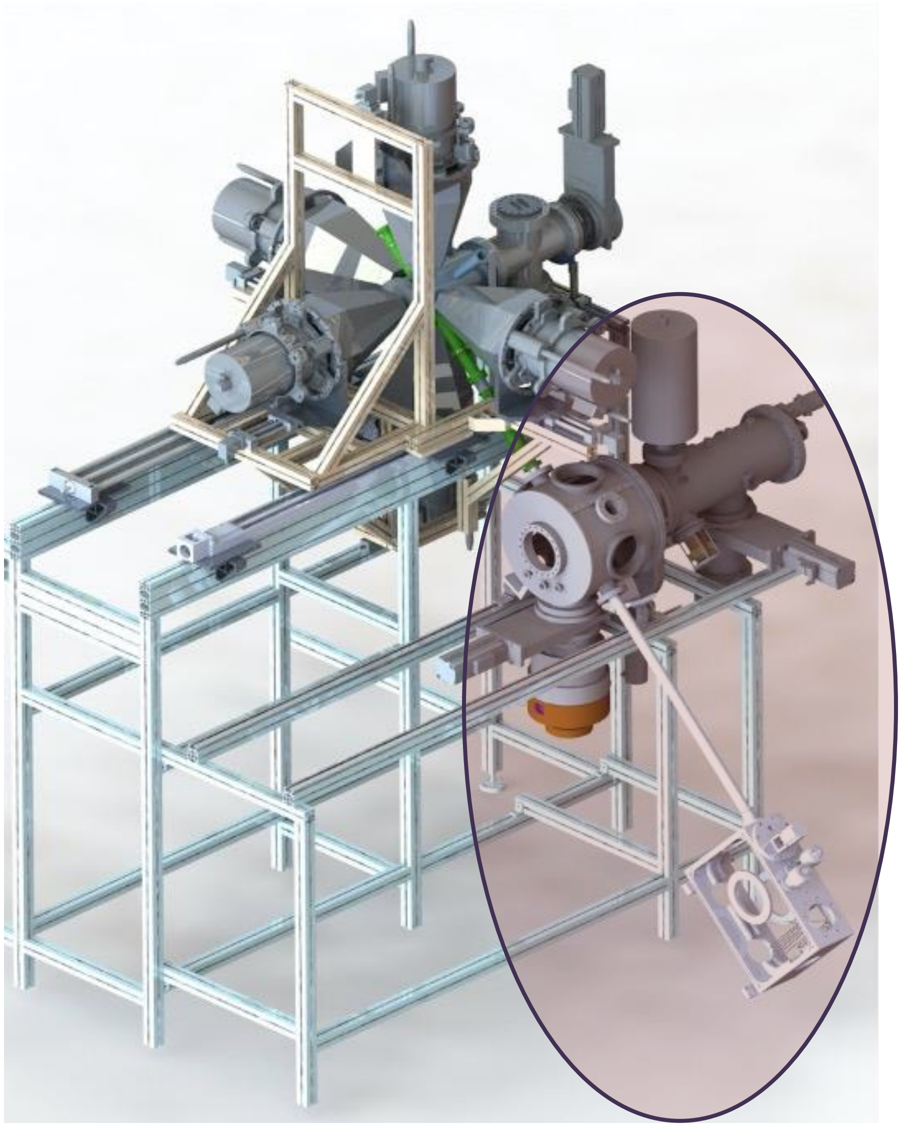
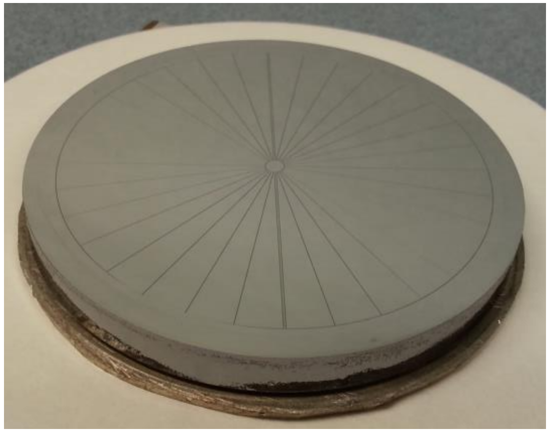
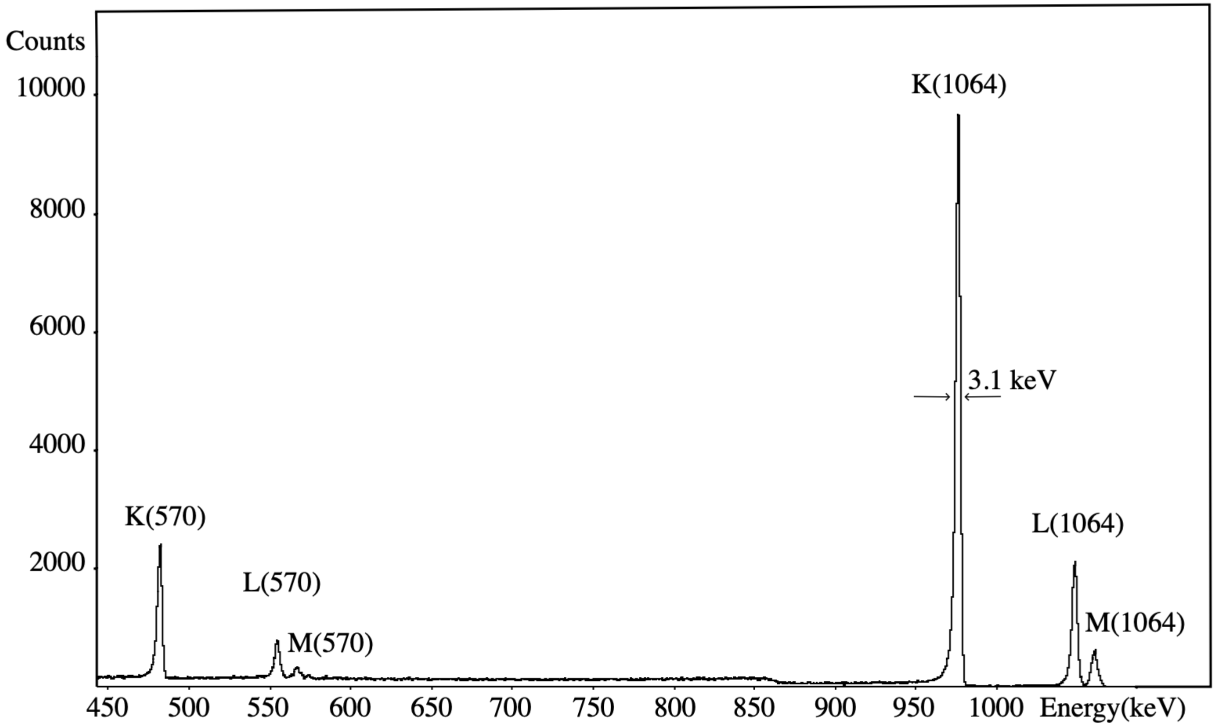
Electron Spectroscopy with the SLICES setup



SLICES

- SLICES (Spes Low-energy Internal Conversion Electron Spectrometer)
  - Large area (~ 3900 mm^2) Si(Li) detector 6.8 mm thick segmented in 32 sectors

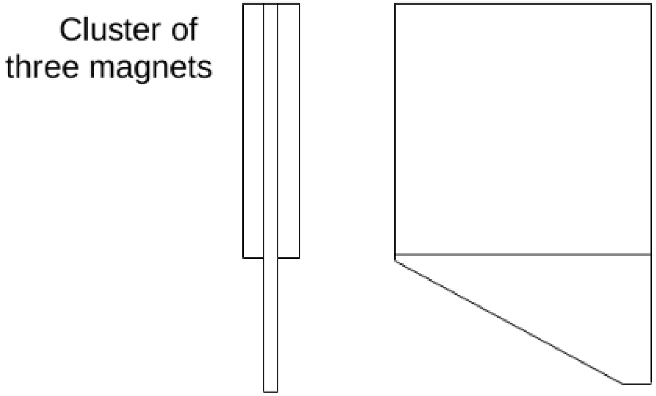


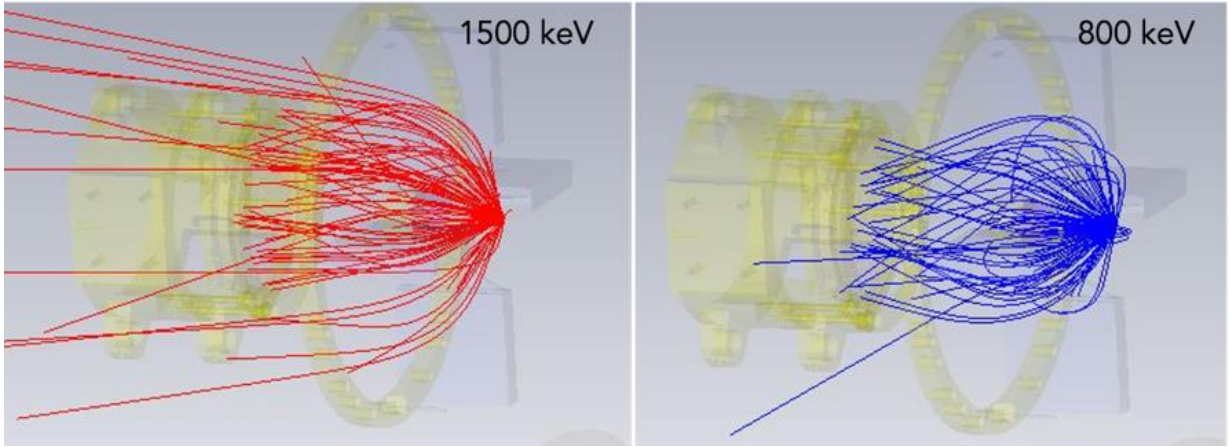


N. Marchini et al.: Nucl. Inst. Meth. A 1020 (2021) 165860

SLICES

- SLICES (Spes Low-energy Internal Conversion Electron Spectrometer)
  - Large area (~ 3900 mm^2) Si(Li) detector 6.8 mm thick segmented in 32 sectors
  - Four truncate wedge shaped permanent magnets around a lead absorber

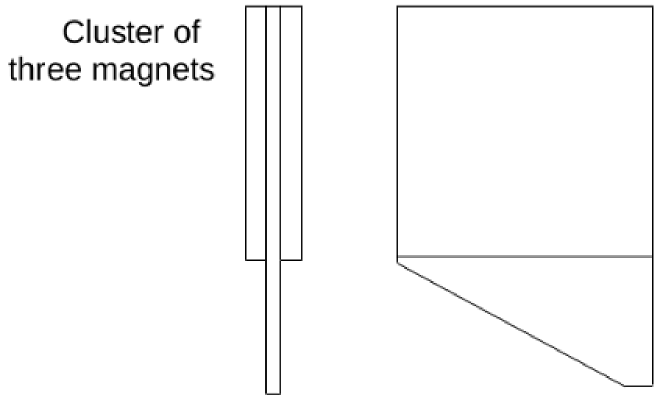


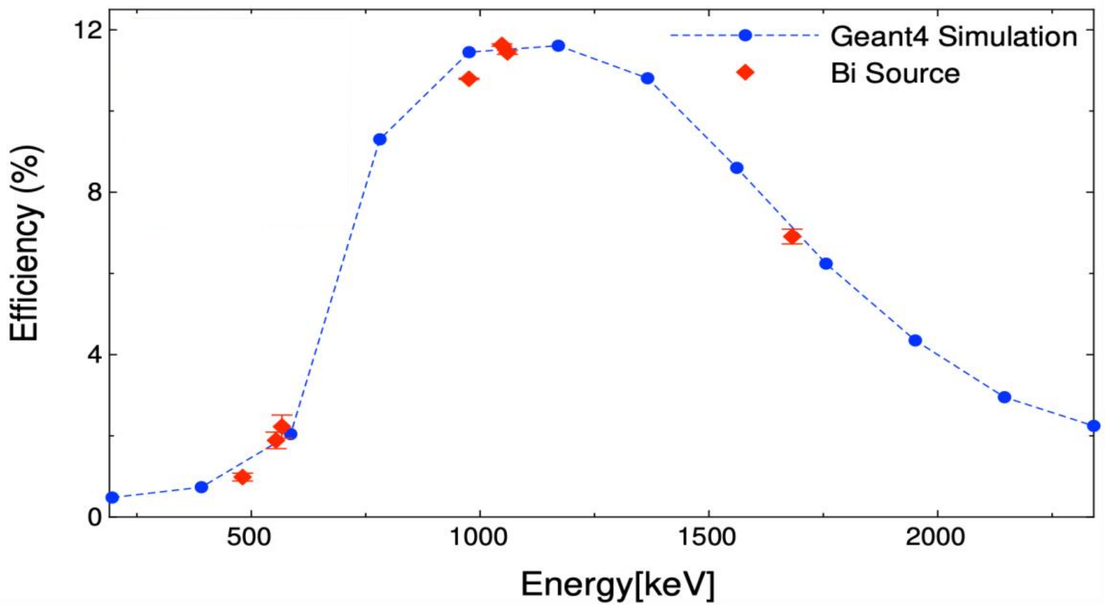


N. Marchini et al.: Nucl. Inst. Meth. A 1020 (2021) 165860

SLICES

- SLICES (Spes Low-energy Internal Conversion Electron Spectrometer)
  - Large area (~ 3900 mm^2) Si(Li) detector 6.8 mm thick segmented in 32 sectors
  - Four truncate wedge shaped permanent magnets around a lead absorber
  - Efficiency above 10% in the 800-1300 keV energy range

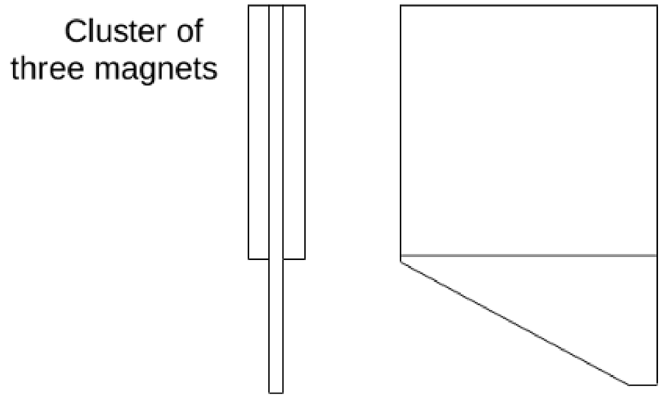


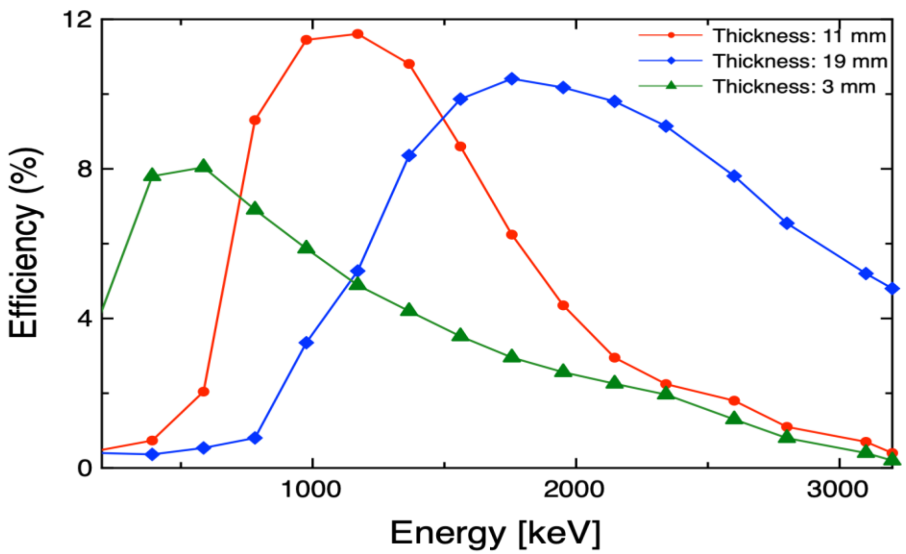


N. Marchini et al.: Nucl. Inst. Meth. A 1020 (2021) 165860

SLICES

- SLICES (Spes Low-energy Internal Conversion Electron Spectrometer)
  - Large area (~ 3900 mm^2) Si(Li) detector 6.8 mm thick segmented in 32 sectors
  - Four truncate wedge shaped permanent magnets around a lead absorber
  - Efficiency above 10% in the 800-1300 keV energy range

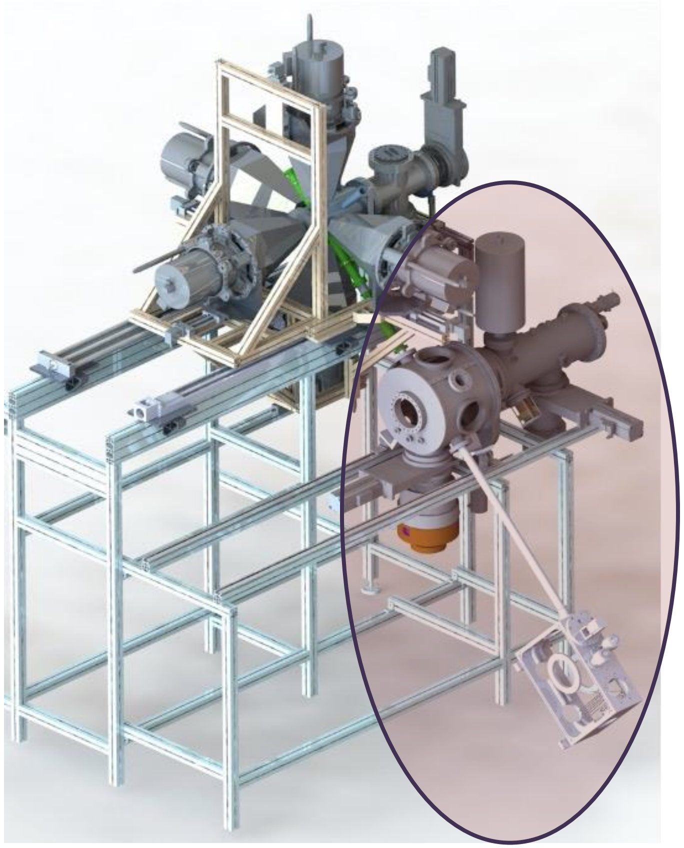




N. Marchini et al.: Nucl. Inst. Meth. A 1020 (2021) 165860

SLICES

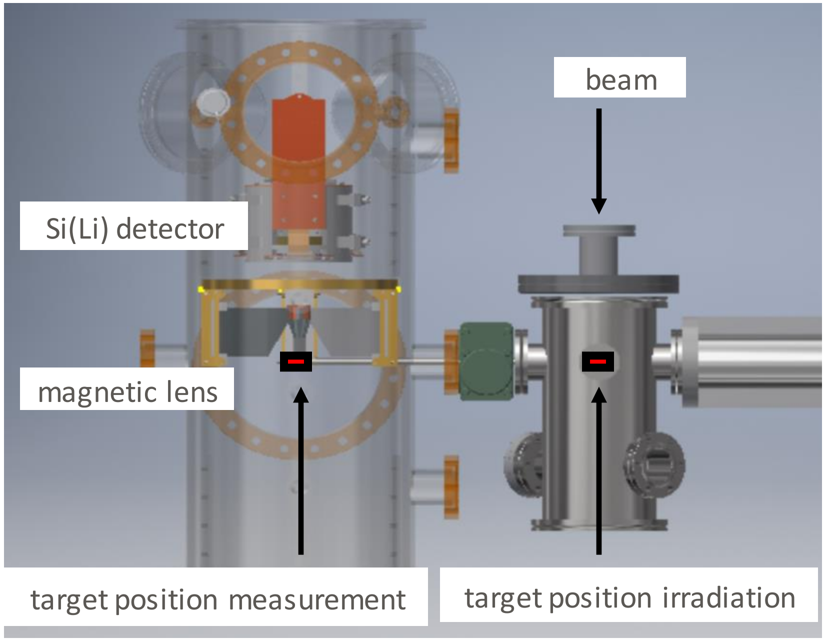
- [SLICES (Spes Low-energy Internal Conversion Electron Spectrometer)]
  - Large area (~ 3900 mm^2) Si(Li) detector 6.8 mm thick segmented in 32 sectors
  - Four truncate wedge shaped permanent magnets around a lead absorber
  - Efficiency above 10% in the 800-1300 keV energy range
  - Movable tape at the β decay station



N. Marchini et al.: Nucl. Inst. Meth. A 1020 (2021) 165860

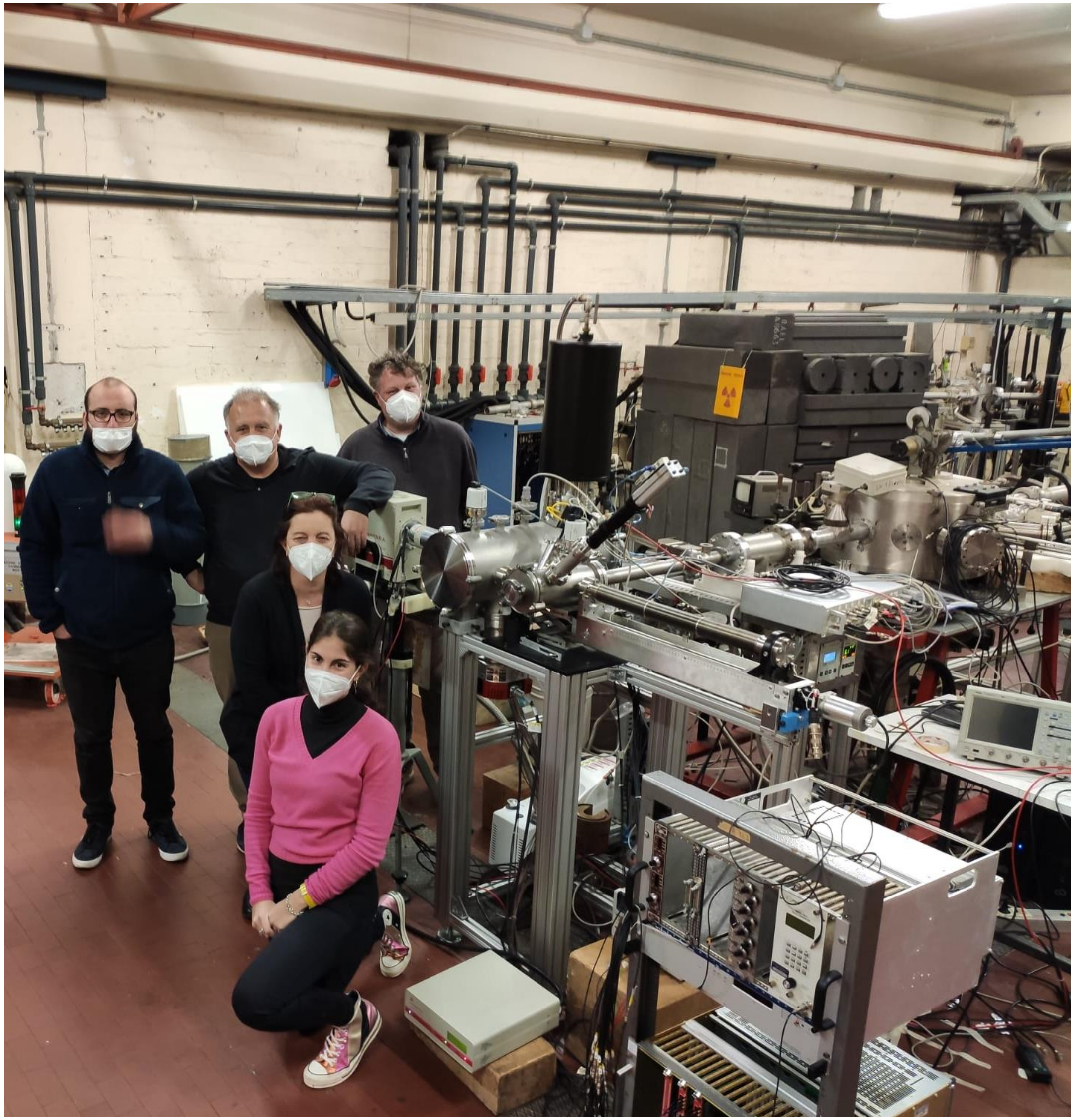
SLICES

- SLICES (Spes Low-energy Internal Conversion Electron Spectrometer)
  - Large area (~ 3900 mm^2) Si(Li) detector 6.8 mm thick segmented in 32 sectors
  - Four truncate wedge shaped permanent magnets around a lead absorber
  - Efficiency above 10% in the 800-1300 keV energy range
  - Movable target remotely controlled



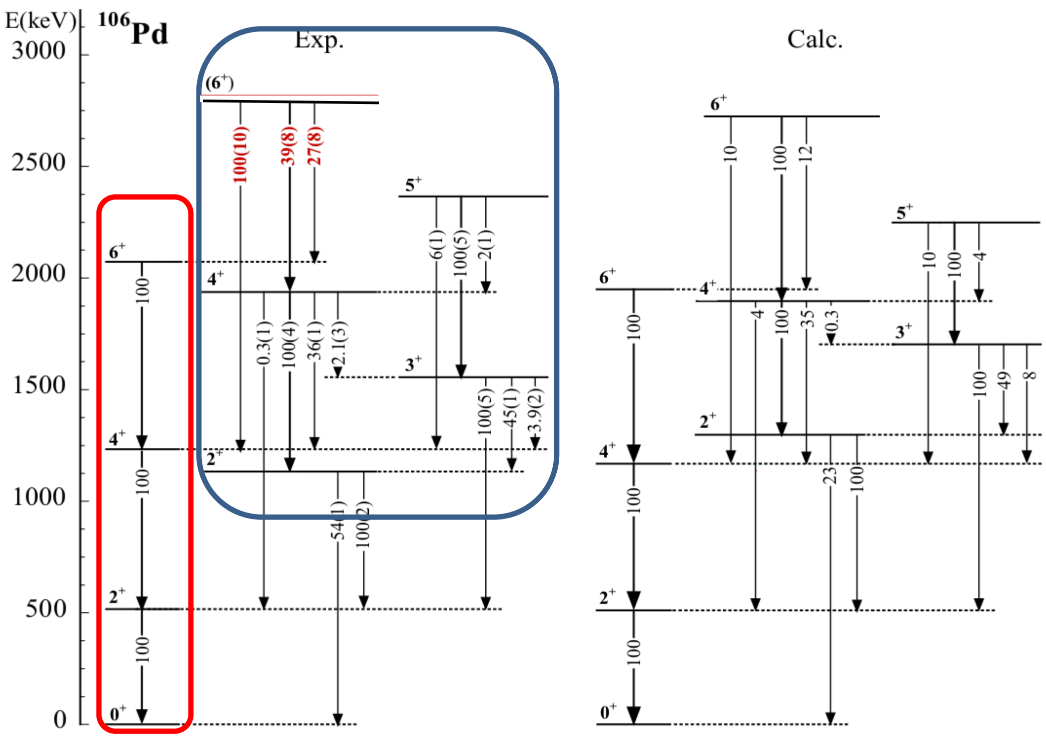
N. Marchini et al.: Nucl. Inst. Meth. A 1020 (2021) 165860

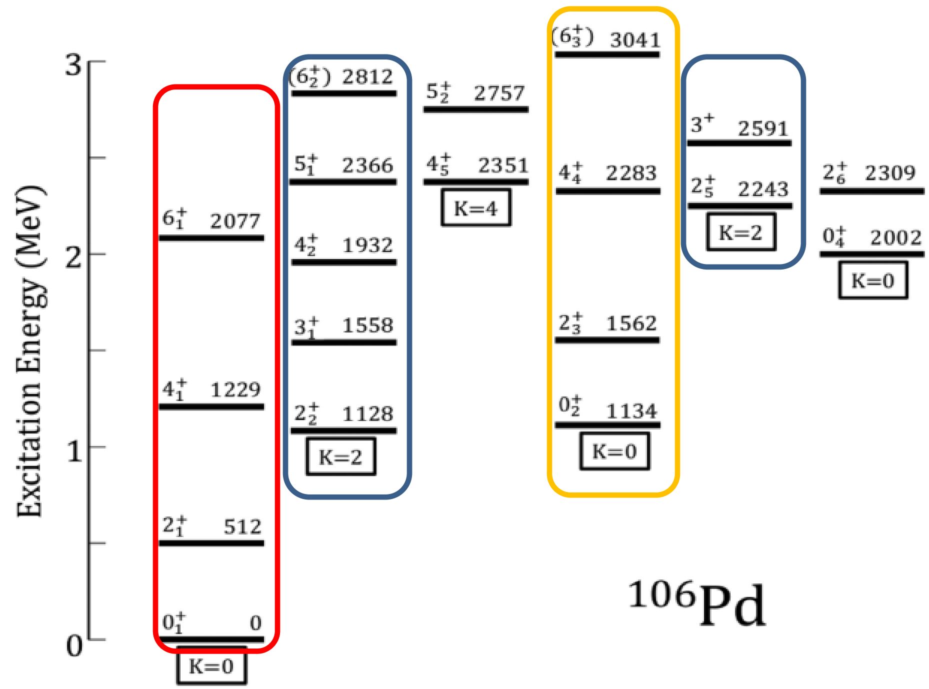
SLICES Commissioning @CN - Electric monopole transitions in ^{106}Pd



^{106}Pd - Physics case

0_3 as Intruder State



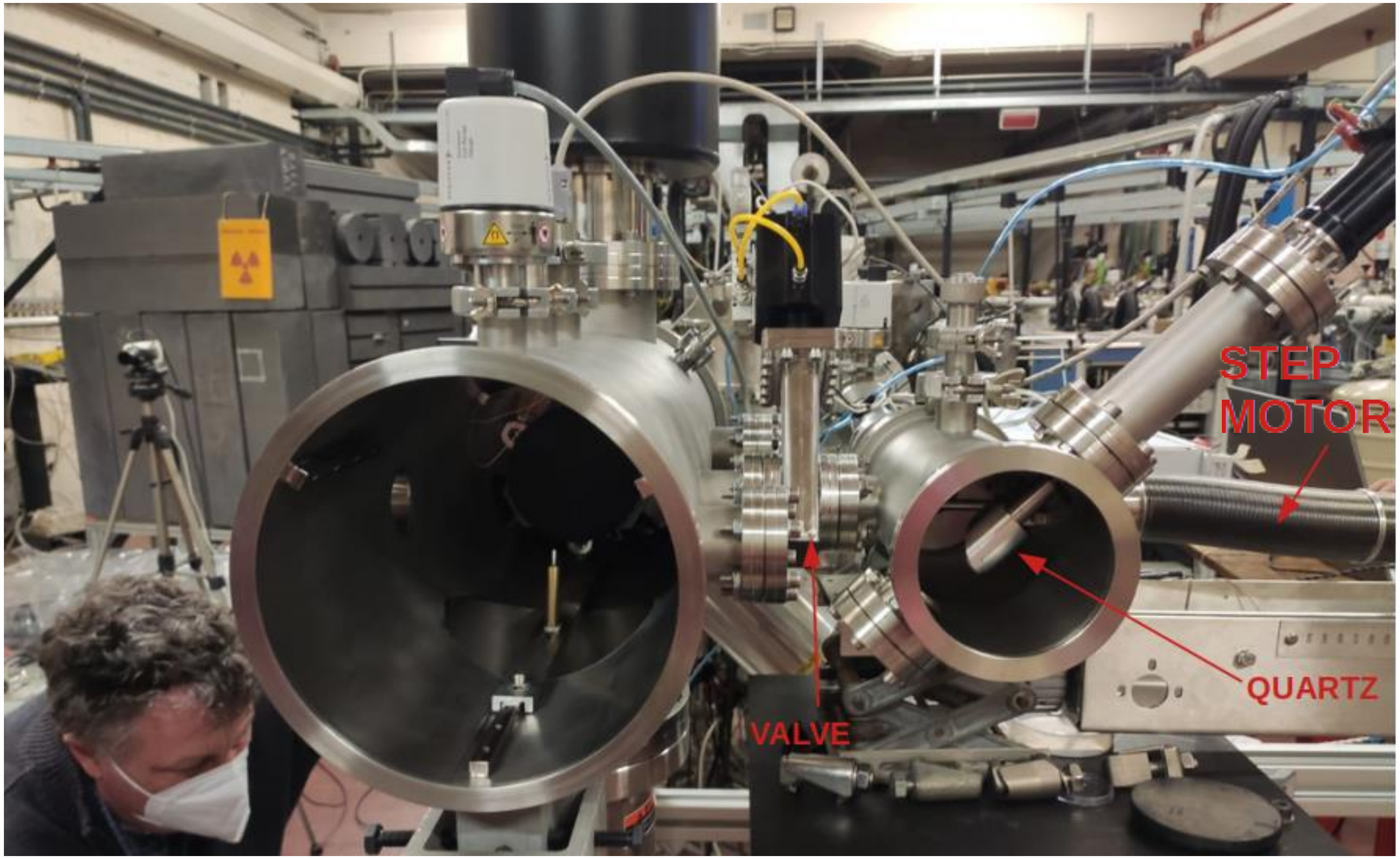


A. Giannatiempo et al.: Phys. Rev. C 98 (2018) 034305

P. Garrett et al.: Physica Scripta 93 (2018) 063001

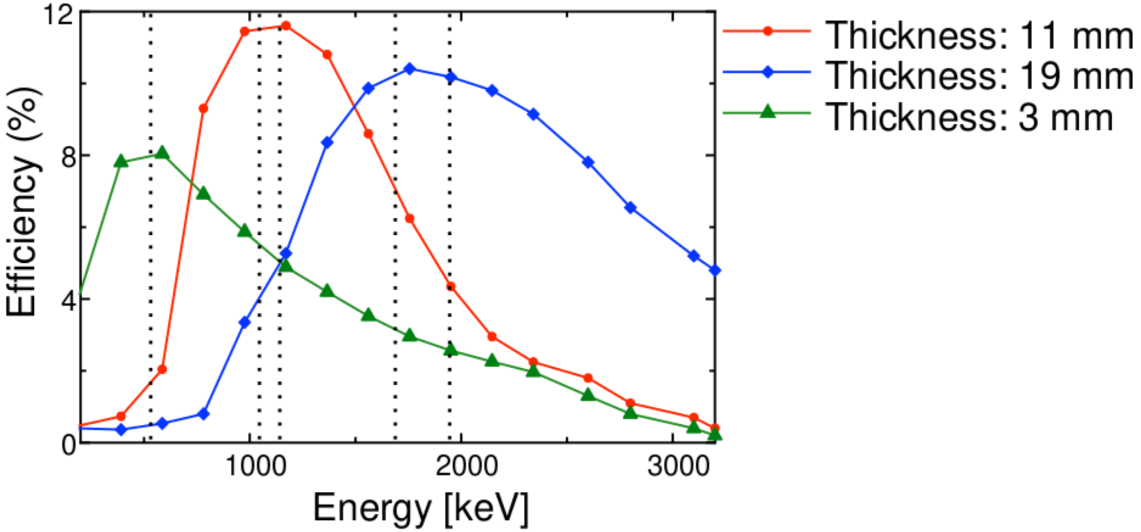
SLICES Commissioning

- ^{106}Pd(p,n) @ 5MeV → ^{106}Ag
- ^{106}Ag decays for 99% with ε decay in ^{106}Pd with $T_{1/2}$ = 24 min



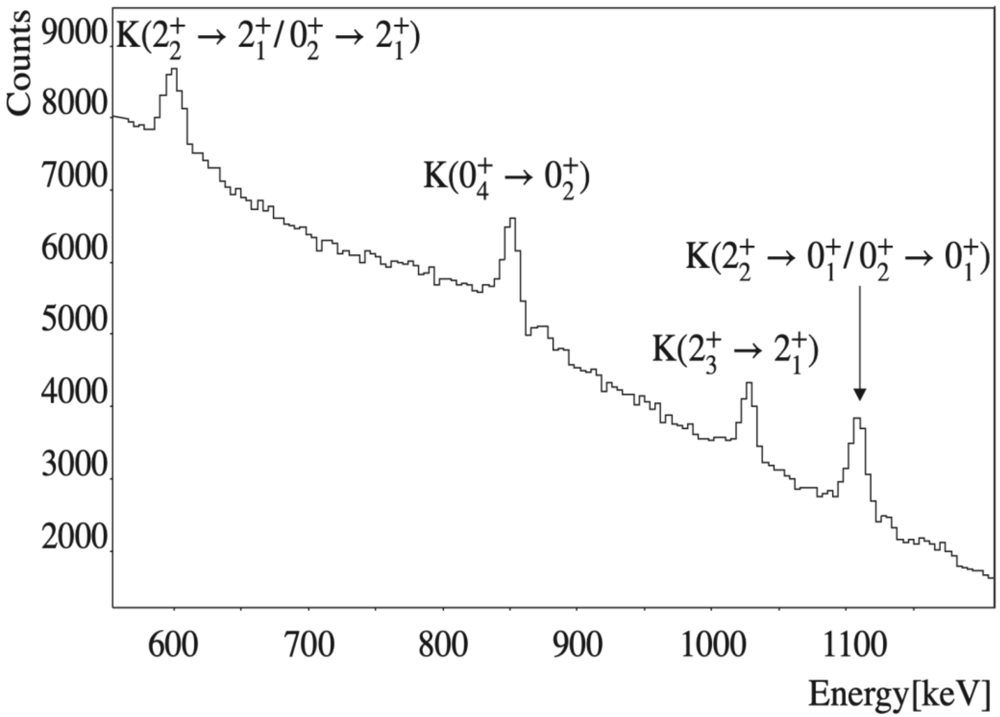
Experimental Goals

$J_i^+ \rightarrow J_f^+$	E_e [keV]
$0_2^+ \rightarrow 0_1^+$	1109
$0_3^+ \rightarrow 0_1^+$	1682
$0_4^+ \rightarrow 0_1^+$	1977
$2_2^+ \rightarrow 2_1^+$	592
$2_3^+ \rightarrow 2_1^+$	1026



Better solution: 4 Cluster of three magnets
11mm thick

E0 transitions in ^{106}Pd



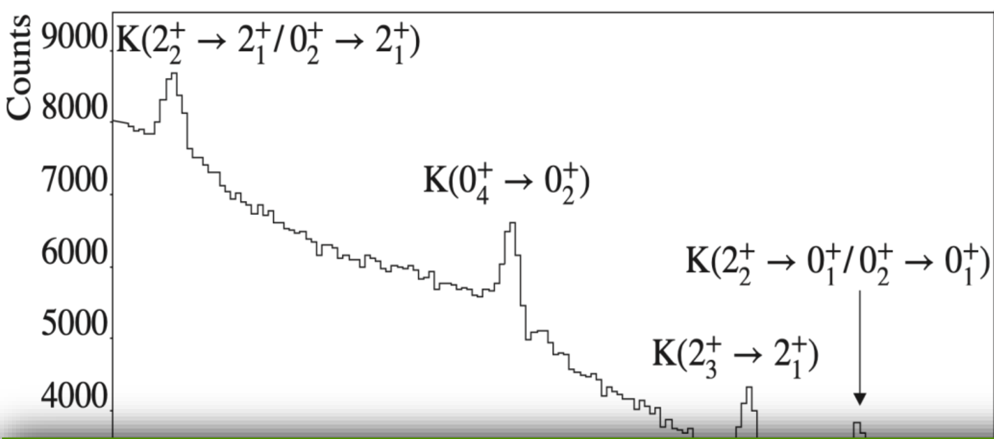
N. Marchini et al.: Phys. Rev. C 105 (2022) 054304

$J_i^\pi \longrightarrow J_f^\pi$	E_γ [keV]	$\alpha_{Exp.} \cdot 10^3$	$\alpha_K(E2) \cdot 10^3$	$\alpha_K(M1) \cdot 10^3$
$2_2^+ \longrightarrow 2_1^+$	616	2.97(11)	2.89	2.97
$2_2^+ \longrightarrow 0_1^+$	1128	0.64(9)	0.68	
$2_3^+ \longrightarrow 2_1^+$	1050	1.06(7)	0.79	0.89
$0_2^+ \longrightarrow 2_1^+$	621	2.6(2)	2.8	
$0_3^+ \longrightarrow 2_1^+$	1195	0.71(13)	0.60	
$0_4^+ \longrightarrow 2_2^+$	873	1.23(8)	1.20	

		q^2(E0/E2)		$\rho^2 \cdot 10^3$	
$J_i^\pi \longrightarrow J_f^\pi$	E_γ [keV]	Present	Previous	Present	Previous
$0_2^+ \longrightarrow 0_1^+$	1134	0.166(15)	0.162(7)	17(4)	16.4(40)
$0_3^+ \longrightarrow 0_1^+$	1706	0.09(15)		2(4)	< 3
$0_4^+ \longrightarrow 0_1^+$	2001	0.124(18)		< 19	
$0_4^+ \longrightarrow 0_2^+$	867	0.22(6)		< 90	
$2_2^+ \longrightarrow 2_1^+$	616	0.027(38)		5(8)	
$2_3^+ \longrightarrow 2_1^+$	1050	4.2(18)	5.8(33)	26(11)	34(22)

- Test the validity of the new setup
- Definite value for the $\alpha_K(2_3 \to 2_1)$
- Extraction of additional q^2(E0)

E0 transitions in ^{106}Pd



$J_i^\pi \longrightarrow J_f^\pi$	E_γ [keV]	$\alpha_{Exp.} \cdot 10^3$	$\alpha_K(E2) \cdot 10^3$	$\alpha_K(M1) \cdot 10^3$
$2_2^+ \longrightarrow 2_1^+$	616	2.97(11)	2.89	2.97
$2_2^+ \longrightarrow 0_1^+$	1128	0.64(9)	0.68	
$2_3^+ \longrightarrow 2_1^+$	1050	1.06(7)	0.79	0.89
$0_2^+ \longrightarrow 2_1^+$	621	2.6(2)	2.8	
$0_3^+ \longrightarrow 2_1^+$	1195	0.71(13)	0.60	
$0_4^+ \longrightarrow 2_2^+$	873	1.23(8)	1.20	

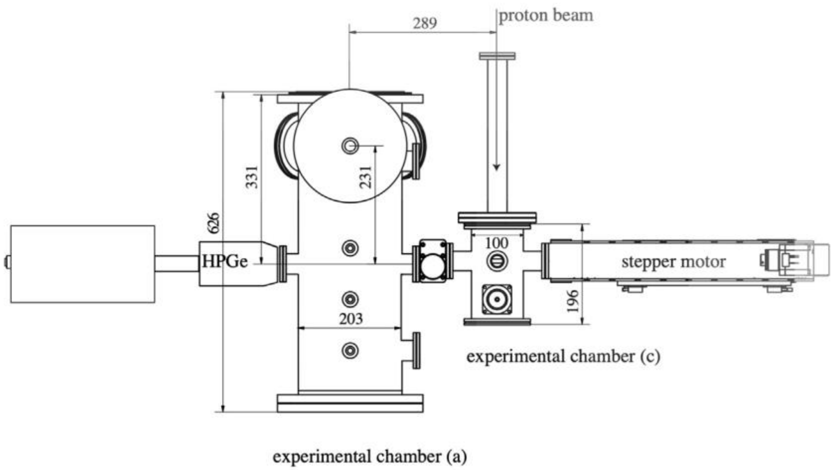
		q^2(E0/E2)		$\rho^2 \cdot 10^3$	
$J_i^\pi \longrightarrow J_f^\pi$	E_γ [keV]	Present	Previous	Present	Previous
$0_2^+ \longrightarrow 0_1^+$	1134	0.166(15)	0.162(7)	17(4)	16.4(40)
$0_3^+ \longrightarrow 0_1^+$	1706	0.09(15)		2(4)	< 3

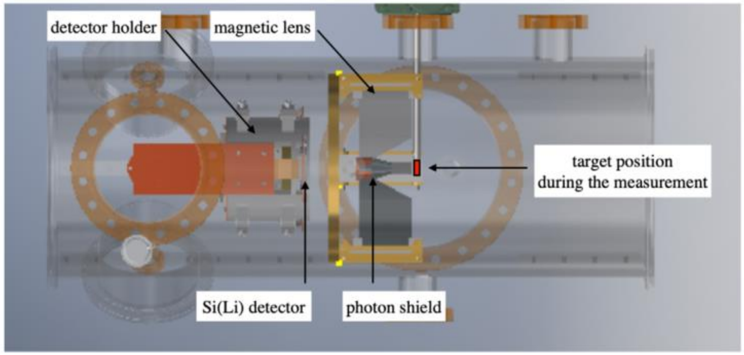
Interpretation with a simple two level mixing model --
Suggestion of shape coexistence scenario

- Definite value for the $\alpha_K(2_3 \rightarrow 2_1)$
- Extraction of additional q^2(E0)

SLICES - ^{68}Zn

- $^{68}Zn(p,n)$ @ 5.5 MeV → ^{68}Ga
- ^{68}Ga ε decays (99%) in ^{68}Zn with $T_{1/2}$ = 68m → cycles of irradiation and measurement
- Same magnetic transport system configuration of the commissioning



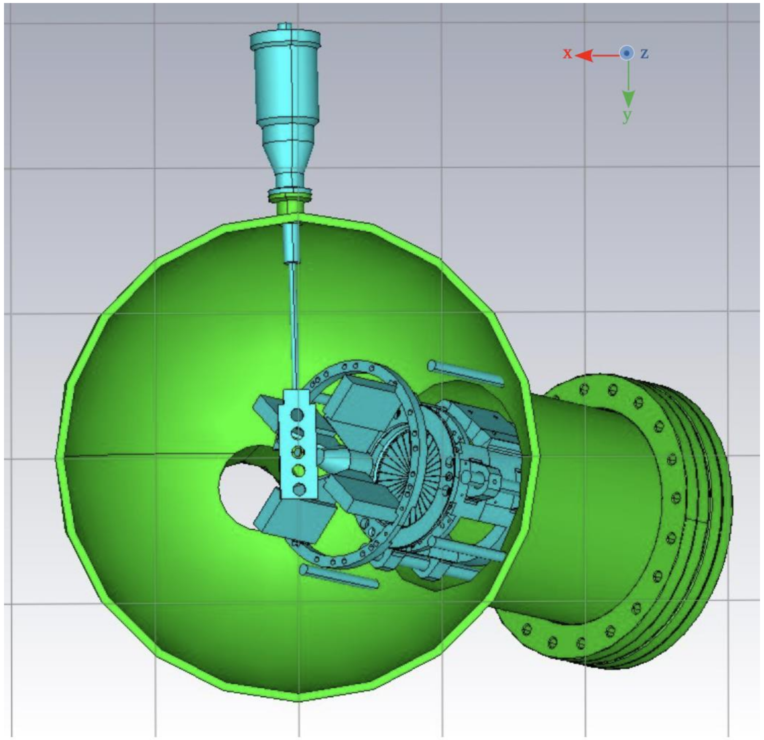


Transition	Energy [keV]
$0_2^+ \to 2_1^+$	578
$2_2^+ \to 2_1^+$	806
$2_1^+ \to 0_1^+$	1077
$2_3^+ \to 2_1^+$	1261
$0_2^+ \to 0_1^+$	1659
$2_2^+ \to 0_1^+$	1883

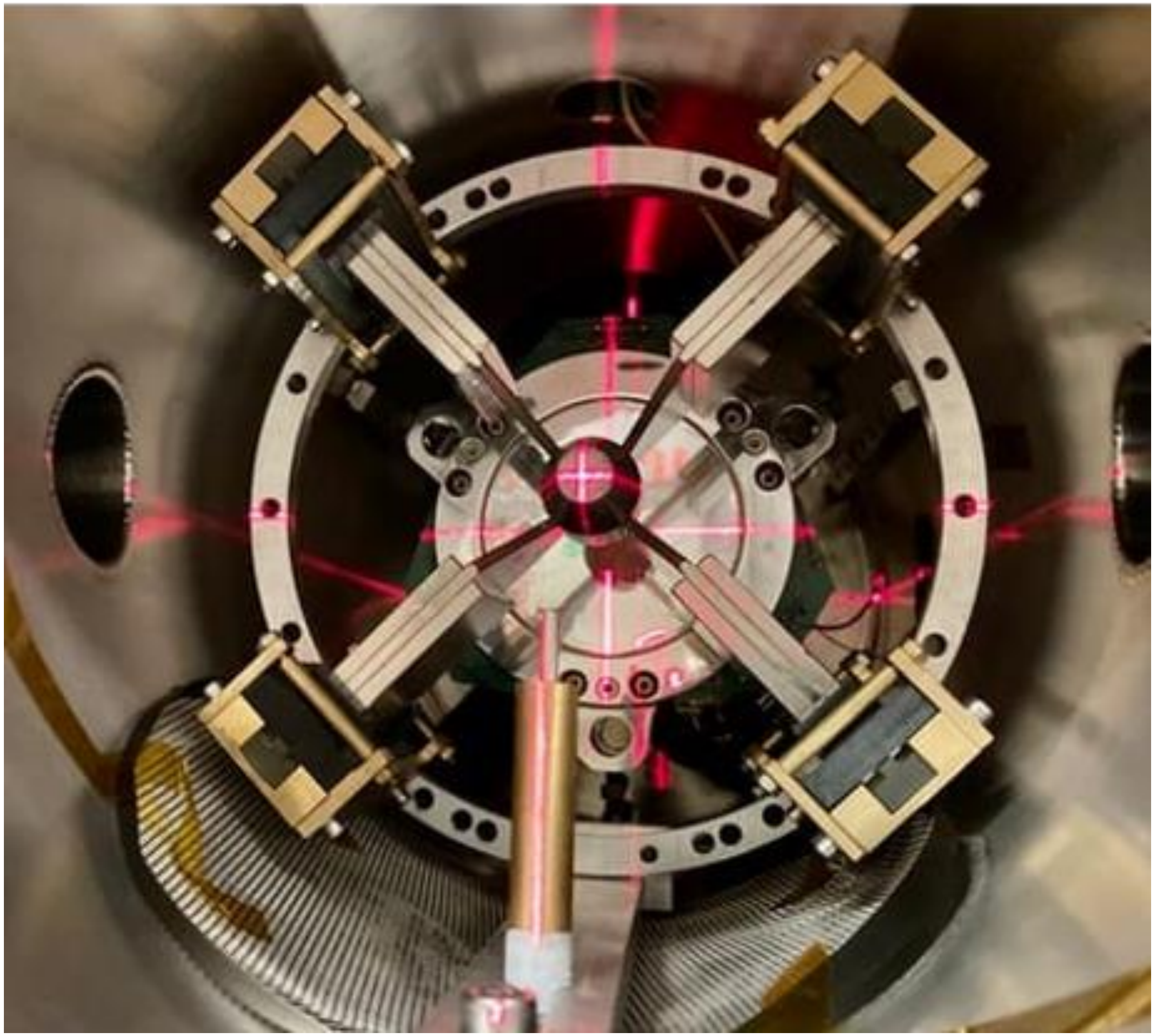
SLICES possibly coupled with AGATA

Letter of Intent for AGATA at zero degrees
Electron conversion measurements with SLICES and AGATA

N. Marchini[1], A. Nannini[2], M. Ottanelli[2], M. Rocchini[2], A. Saltarelli[3], M. Perri[3], G. Benzoni[4], P. Garrett[5], A. Goasduff[6], J. J. Valiente Dobón[6], K. Hadynska-Klek[7], D. Mengoni[8], and M. Zielinska[9]

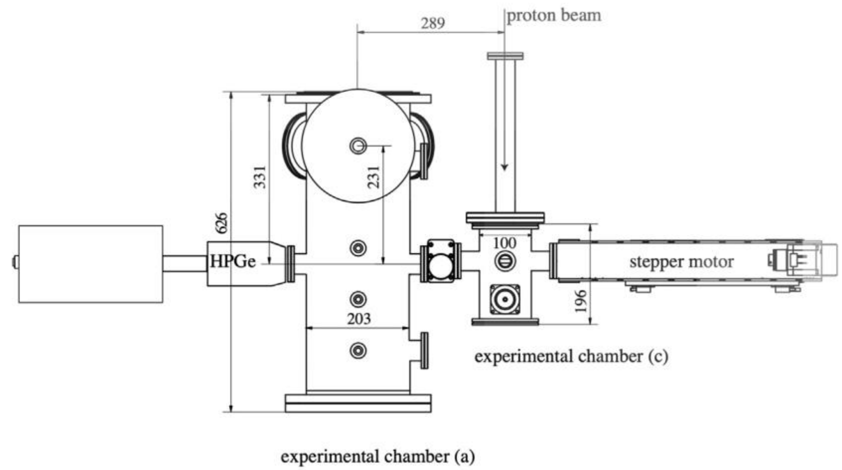


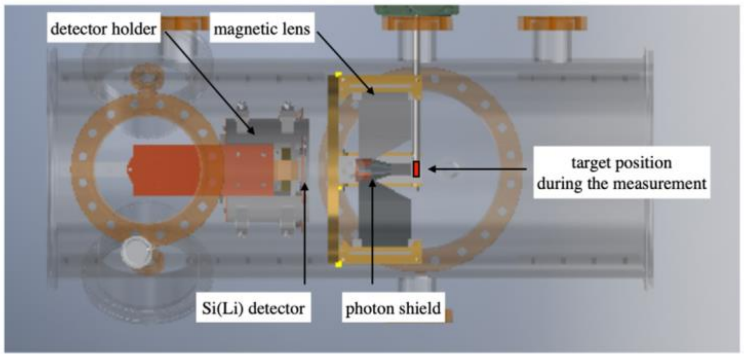
Thank you for the attention!!!

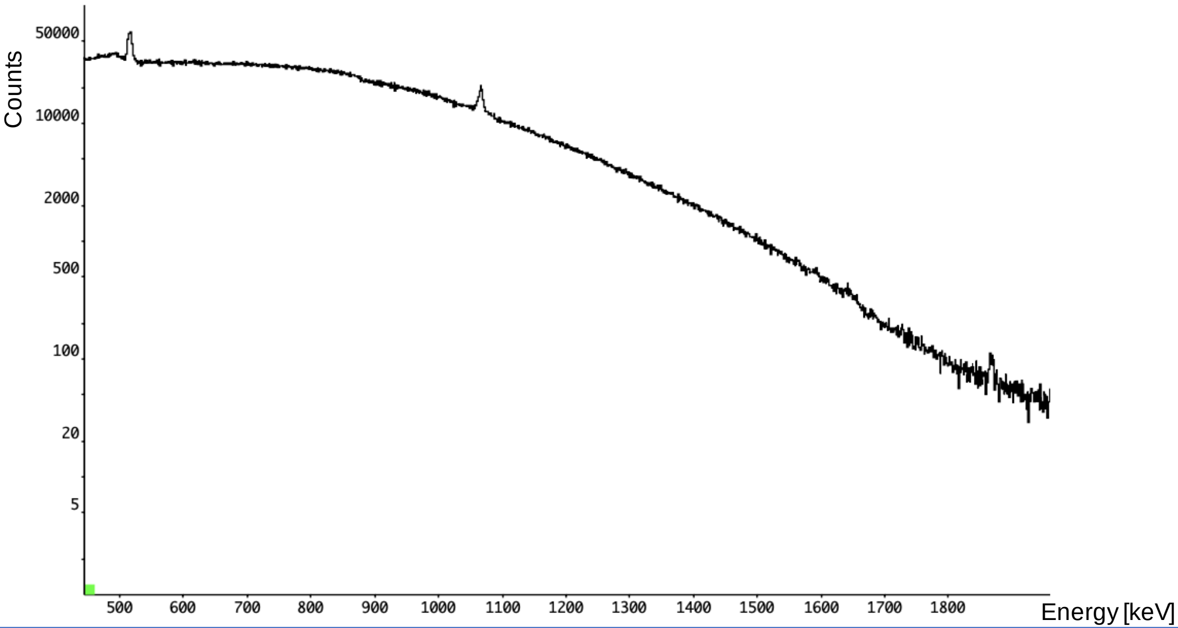


SLICES - ^{68}Zn

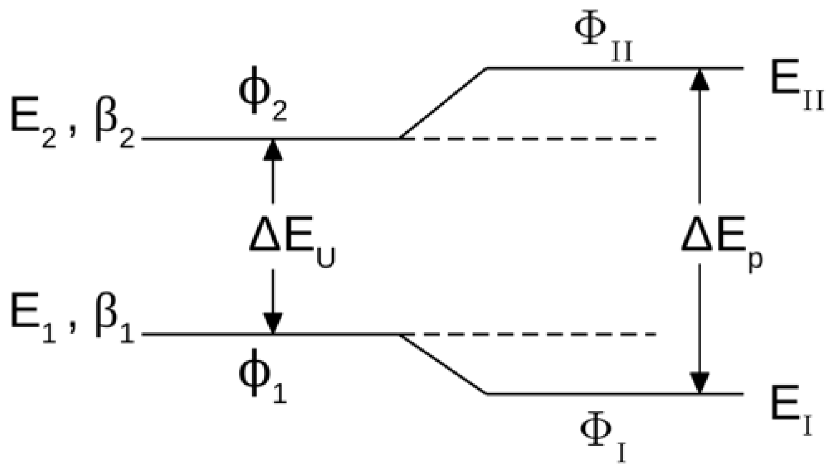
Transition	Energy [keV]
$0_2^+ \rightarrow 2_1^+$	578
$2_2^+ \rightarrow 2_1^+$	806
$2_1^+ \rightarrow 0_1^+$	1077
$2_3^+ \rightarrow 2_1^+$	1261
$0_2^+ \rightarrow 0_1^+$	1659
$2_2^+ \rightarrow 0_1^+$	1883



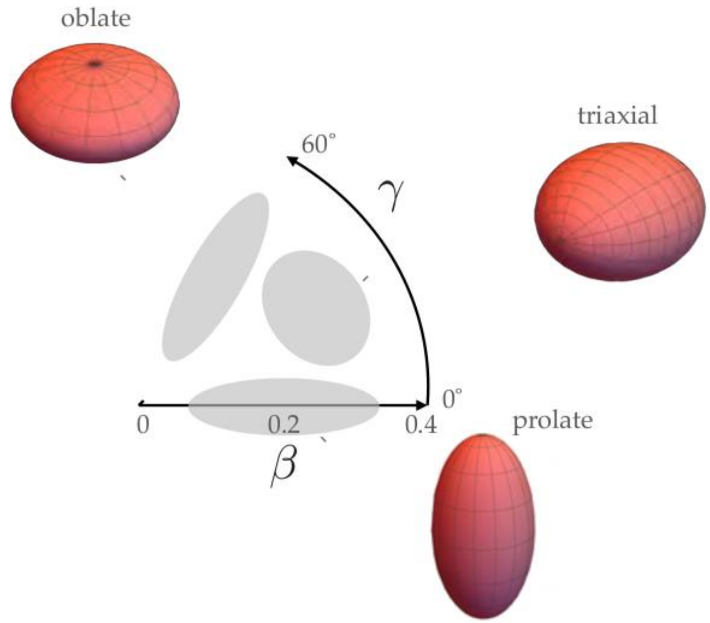




Two-Level Mixing



$$\rho^2(0_2^+ \rightarrow 0_1^+) = (\frac{3Z}{4\pi})^2 a^2(1-a^2)[(\beta_1^2 - \beta_2^2) + \frac{5\sqrt{5}}{21\sqrt{\pi}}(\beta_1^3 cos3\gamma_1 - \beta_2^3 cos3\gamma_2)]^2$$



Two-Level Mixing

As a first step, only the terms up to the second order in β have been considered. In this approximation the expression for the E0 strength becomes:

$$\rho^2(0_2^+ \rightarrow 0_1^+) = (\frac{3Z}{4\pi})^2 a^2(1-a^2)|(\beta_1^2 - \beta_2^2)|^2 = 17$$

β unmixed are linked with the $\beta(0_1)$ and $\beta(0_2)$ by the expression:

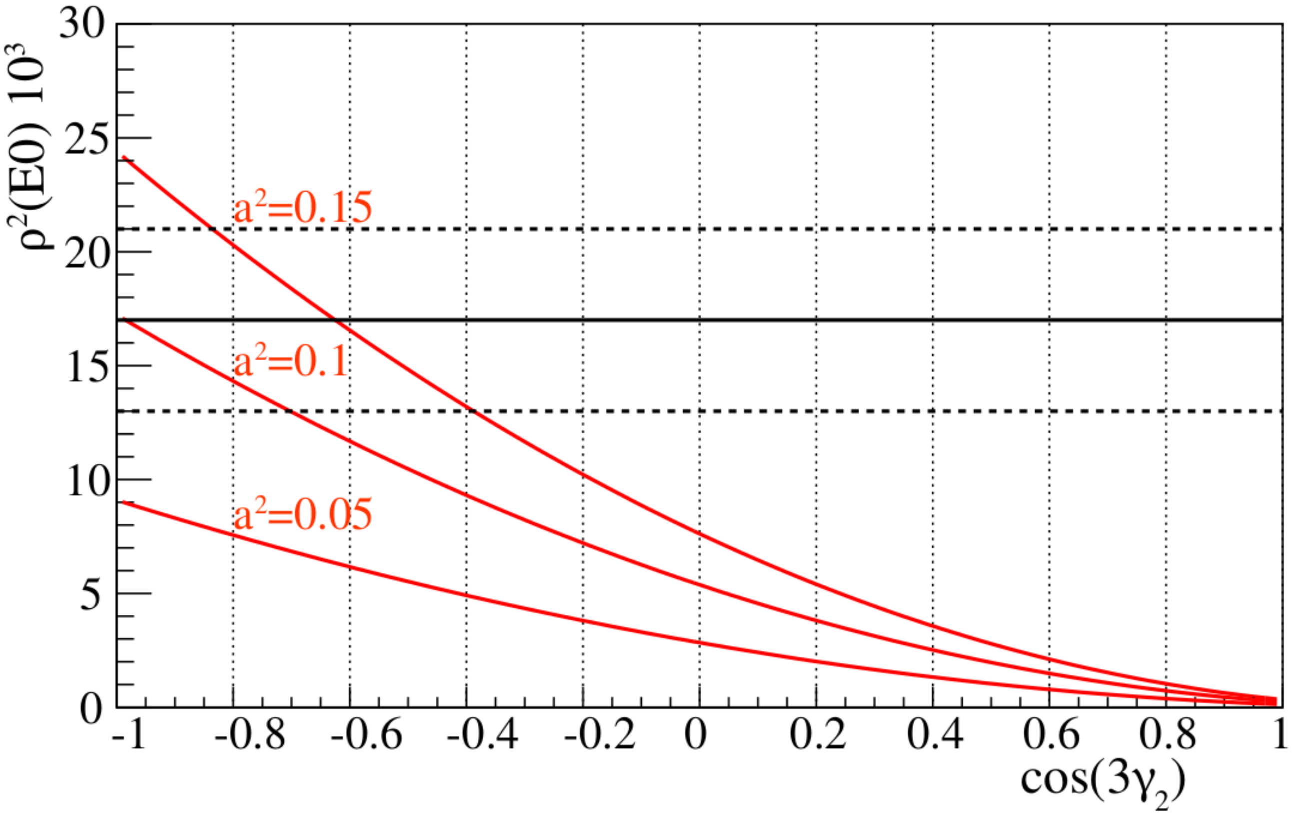
$$\beta^2(0_1) = a^2\beta_1^2 + b^2\beta_2^2 = 0,47$$

$$\beta^2(0_2) = b^2\beta_1^2 - a^2\beta_2^2 = 0,51$$

$a^2 = 0.1$ Small Mixing

Two-Level Mixing – Small Mixing

$$\rho^2(0_2^+ \rightarrow 0_1^+) = (\frac{3Z}{4\pi})^2 a^2(1-a^2)[(\beta_1^2 - \beta_2^2) + \frac{5\sqrt{5}}{21\sqrt{\pi}}(\beta_1^3 cos3\gamma_1 - \beta_2^3 cos3\gamma_2)]^2$$



$\beta_1 = 0{,}29$

$\beta_2 = 0{,}21$

$\gamma_1 = 20°$

$\gamma_2 = 45°$

↓

Shape coexistence