Electron spectroscopy @LNL: Present and Future perspectives

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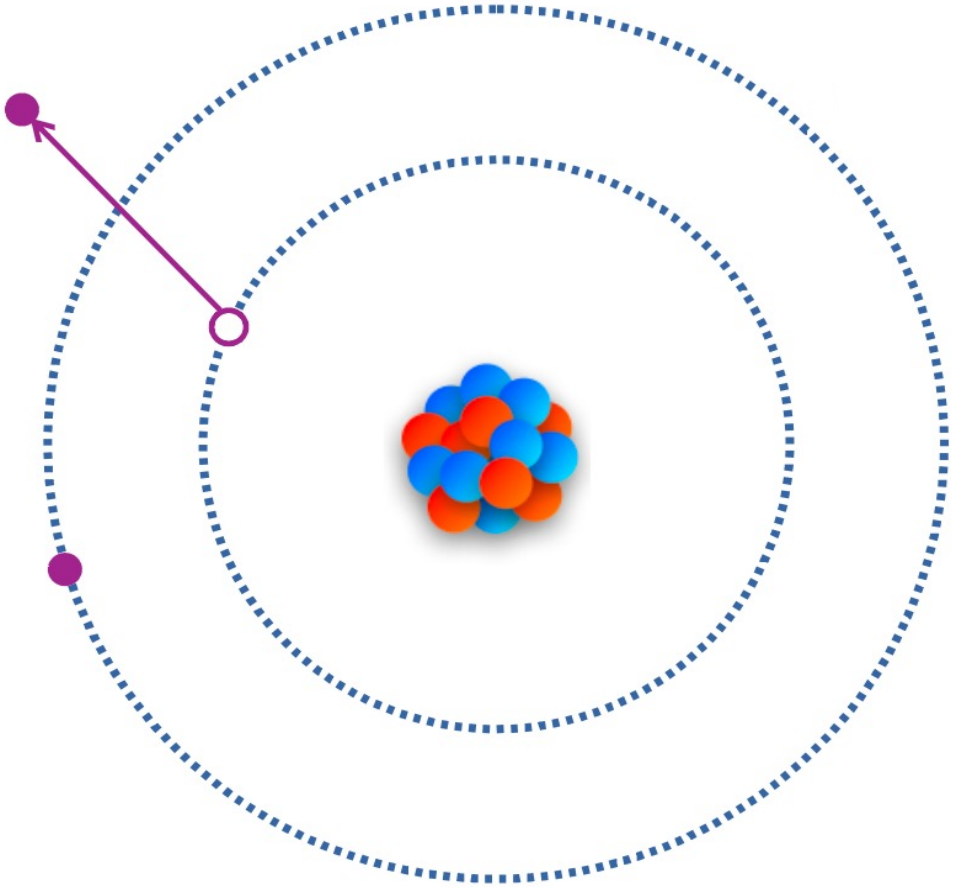
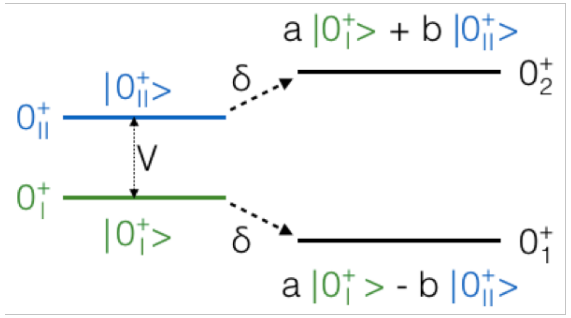


Internal Conversion Electron (ICE) spectroscopy

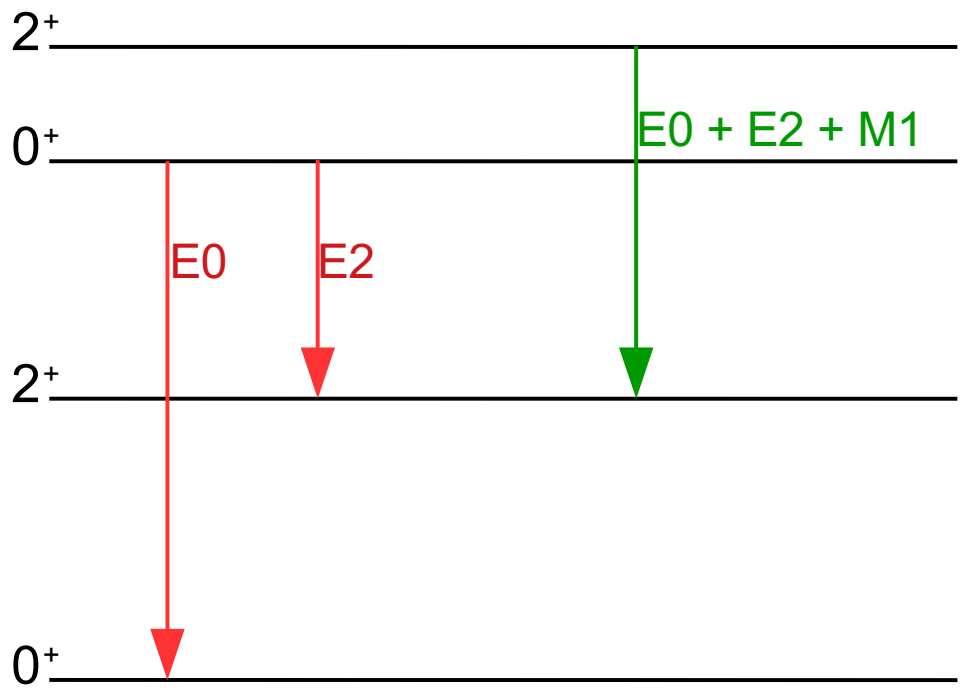
- E0 transitions are determined by a change in the radial distribution of the electric charge inside the nucleus, and high E0 strength is expected whenever configurations with different mean-square charge radii mix
- Enhanced monopole strength may be considered as a “signature” for shape coexistence
- Simple two levels mixing model:



$$\rho^2(E0) = \frac{Z^2}{R^4} a^2 b^2 \left(\Delta \left\langle r^2 \right\rangle\right)^2$$

Wave function mixing

Difference in mean square radii

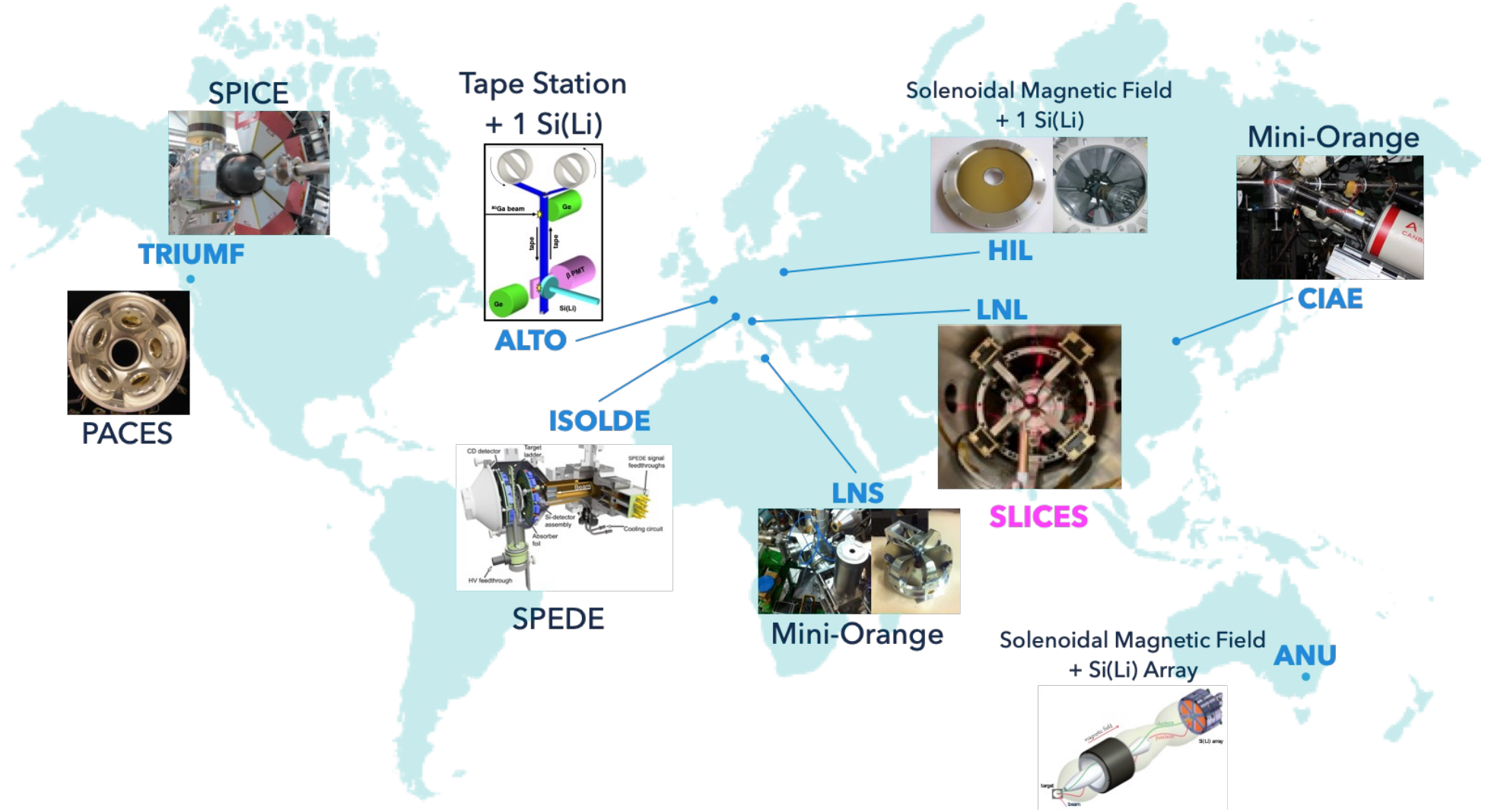


Nuclear Observable

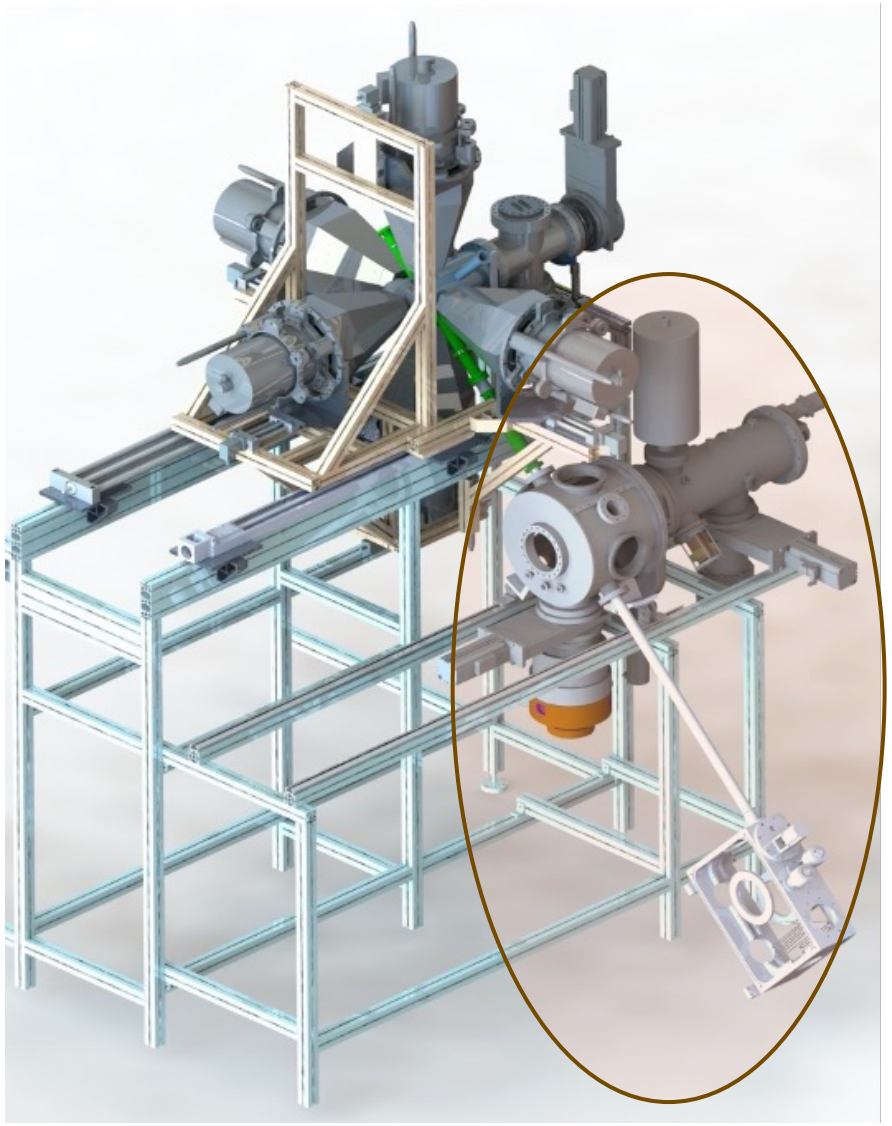
$$\rho^2(E0) = C \frac{I_K(0_i^+ \rightarrow 0_f^+)}{I_K(0_i^+ \rightarrow 2_k^+)} \tau^{-1}$$

C = tabulated and calculated values

ICE around the world

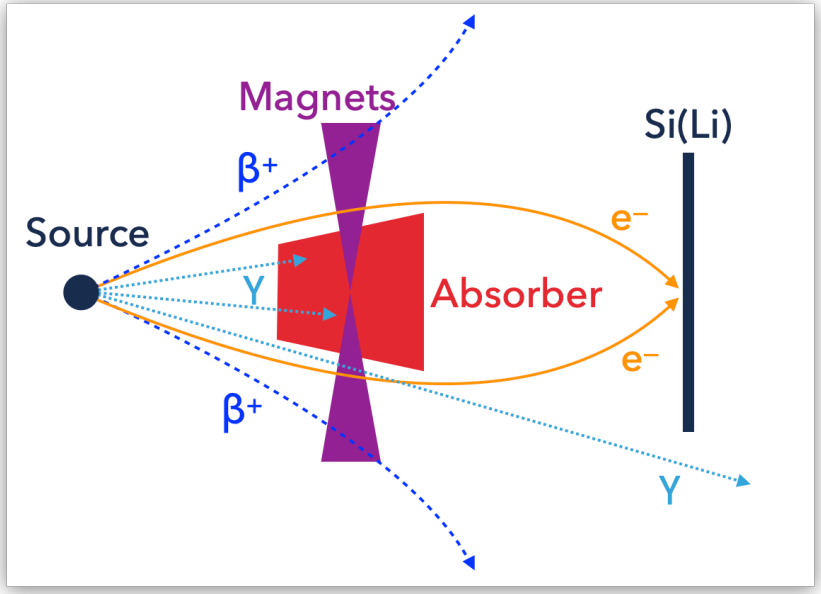


SLICES - Spes Low energy Internal Conversion Electron Spectrometer



SLICES - Spes Low energy Internal Conversion Electron Spectrometer

- Si(Li) Detector
- Magnetic Transport System
- HPGe Detector
- Plastic scintillator
- Moving Tape



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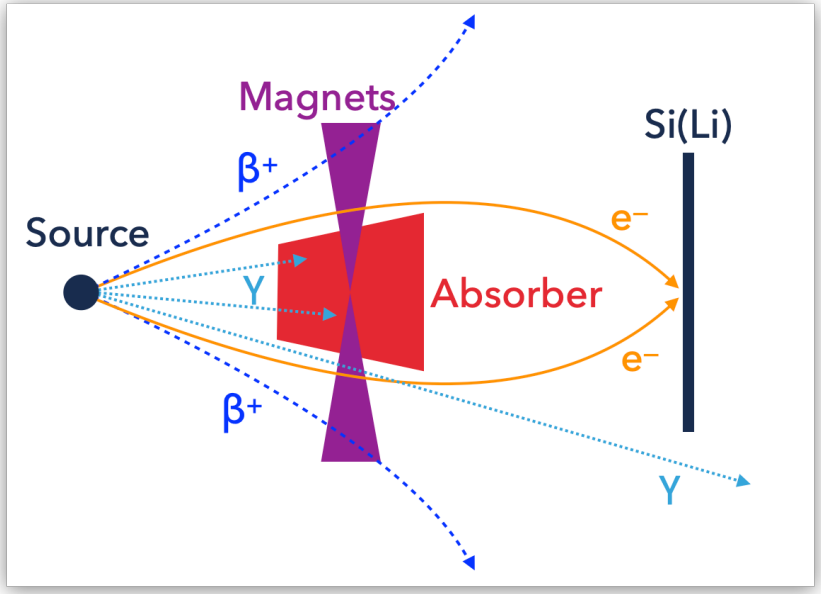
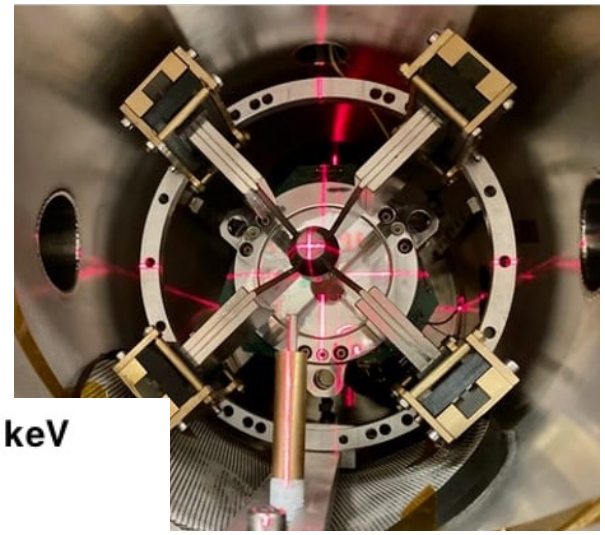


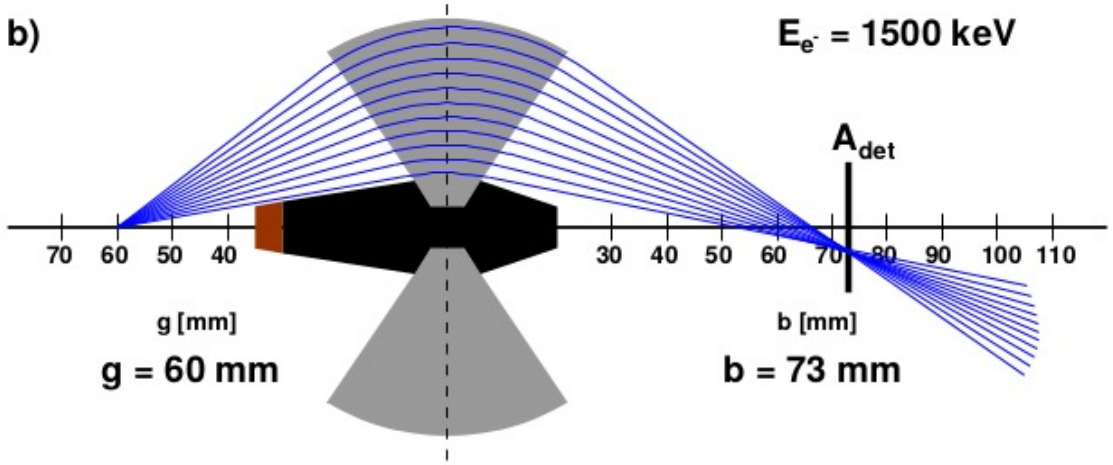
Photon Shield :

To reduce the γ rays background in the Si(Li)

Magnetic Lens :

To focus the electrons on the Si(Li) increasing the efficiency

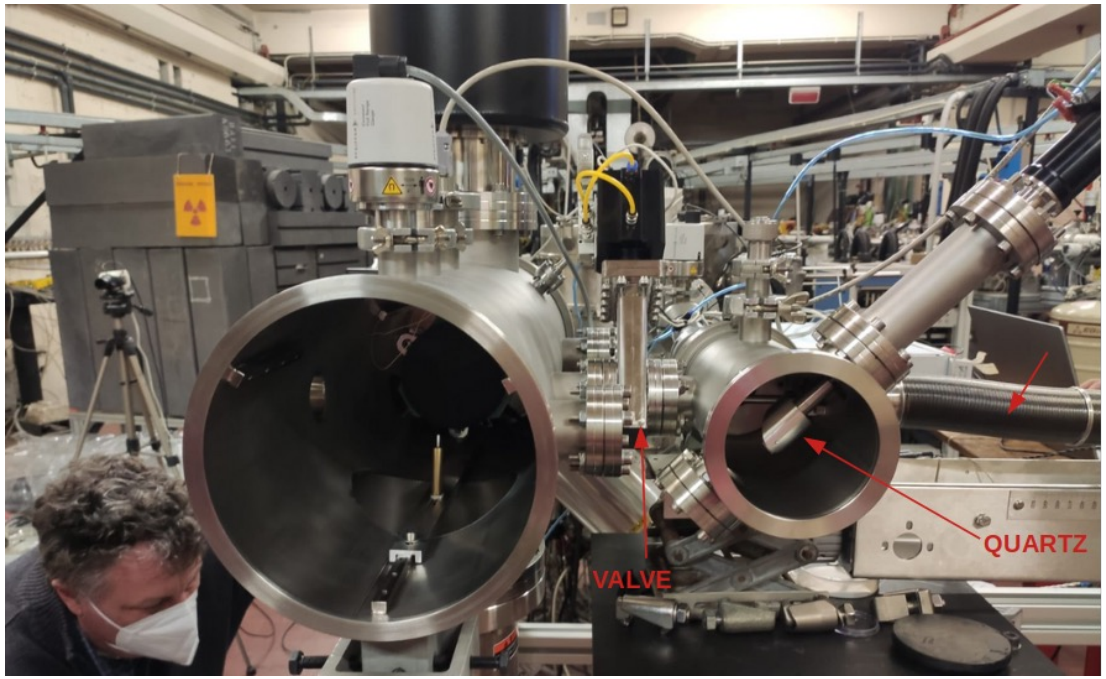




N. Marchini et al. In: Nuclear Inst. and Methods in Physics Research, A 1020 (2021)

SLICES – Commissioning @CN

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



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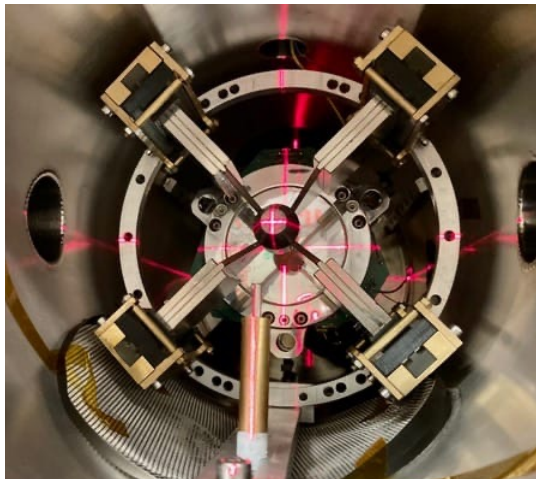
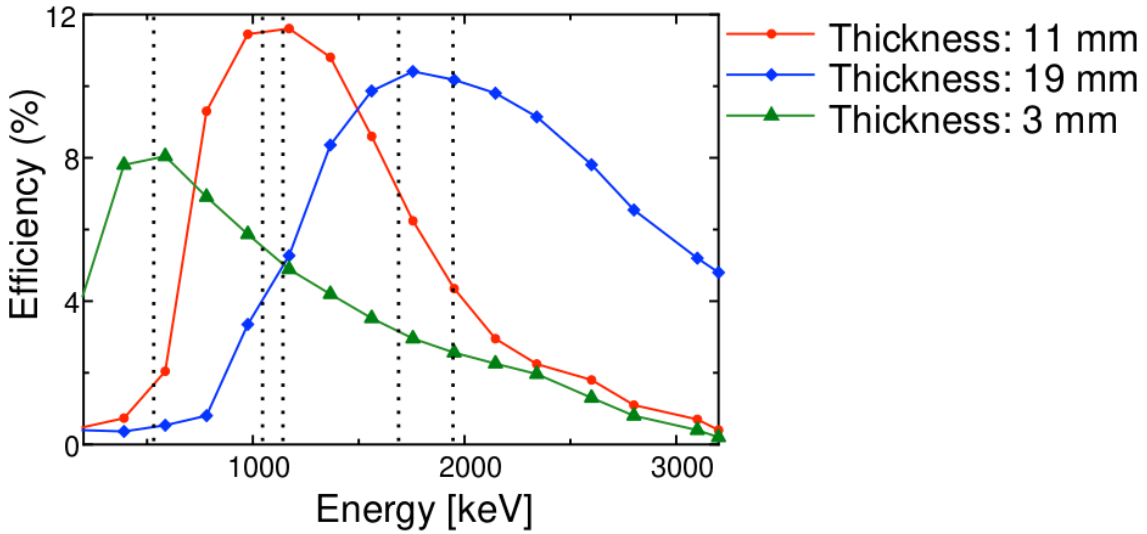
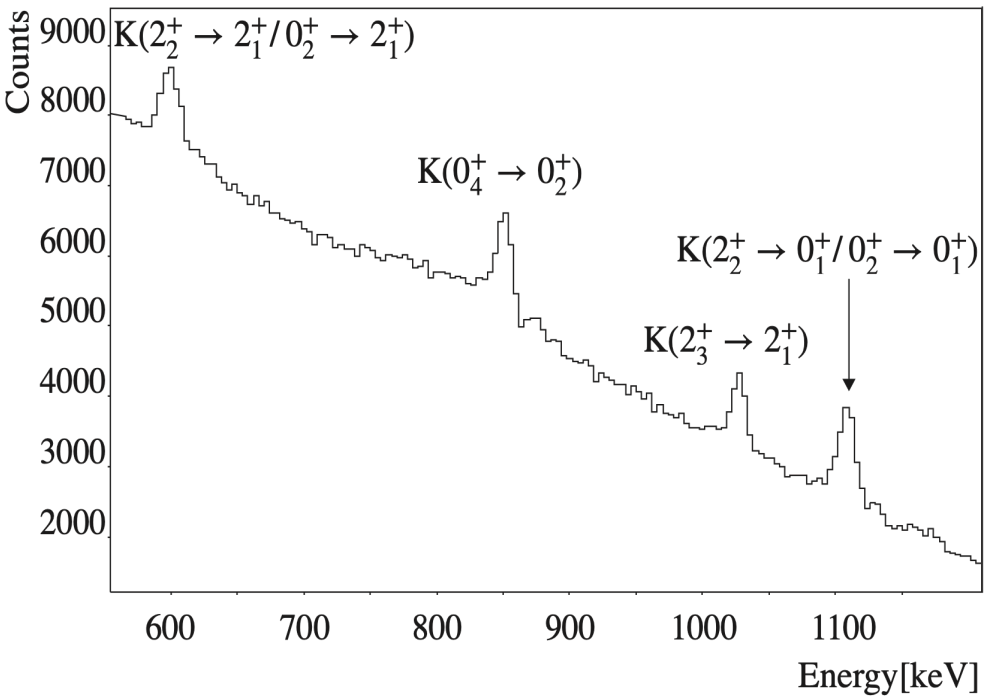




Better solution: 4 Cluster of three magnets
11mm thick

SLICES – Commissioning @CN



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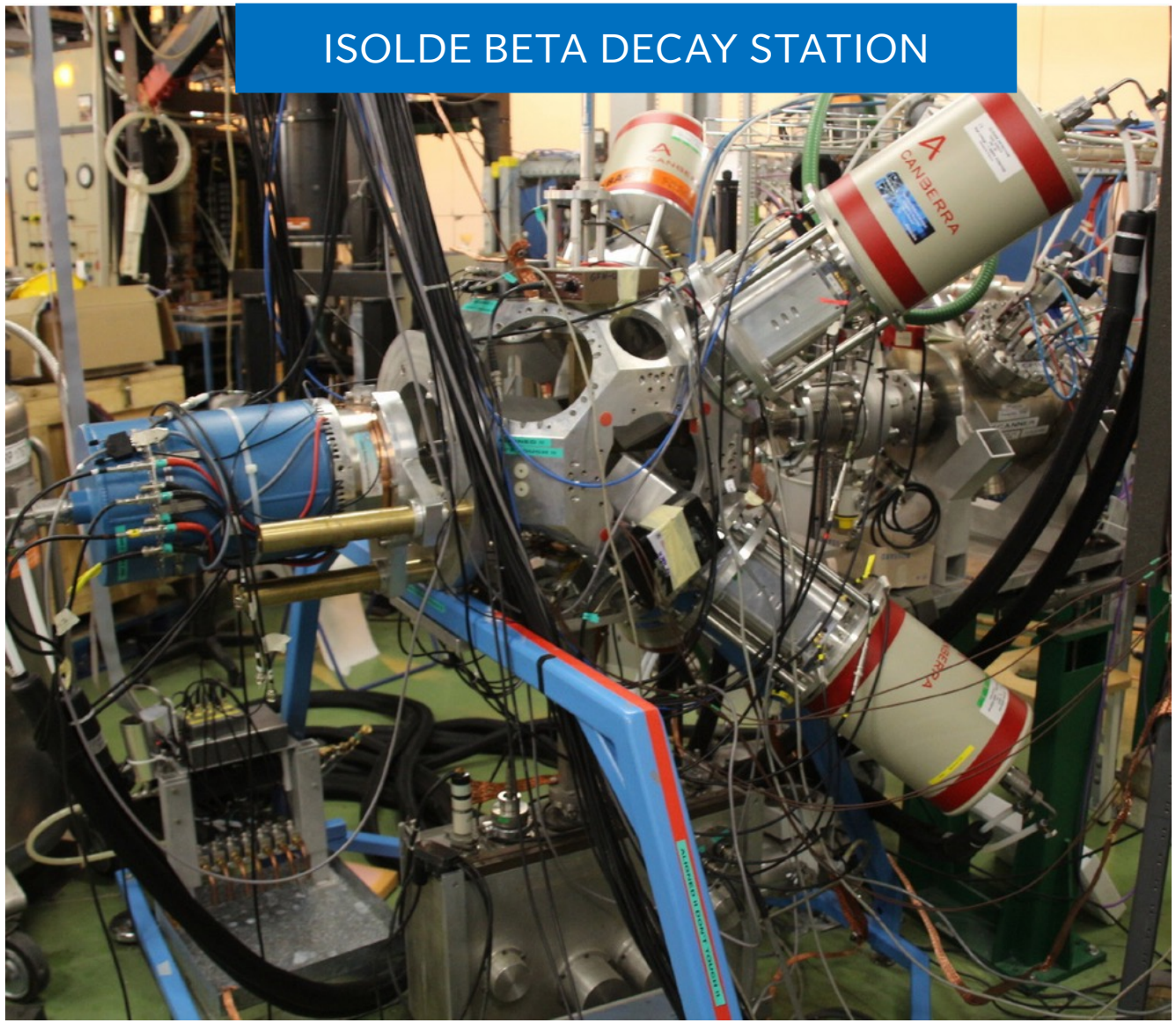
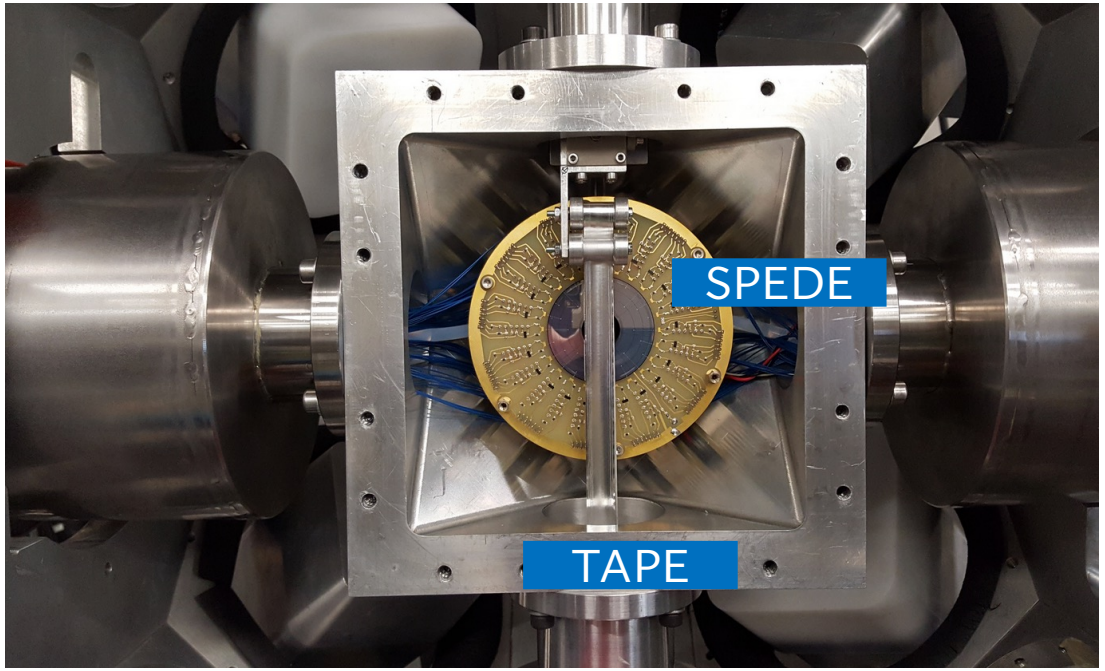
$J_i^\pi \longrightarrow J_f^\pi$	E_γ [keV]	$\alpha_{Exp.} \cdot 10^3$	$\alpha_K(E2) \cdot 10^3$	$\alpha_K(M1) \cdot 10^3$
$2_2^+ \longrightarrow 2_1^+$	616	2.97(11)	2.89	2.97
$2_2^+ \longrightarrow 0_1^+$	1128	0.64(9)	0.68	
$2_3^+ \longrightarrow 2_1^+$	1050	1.06(7)	0.79	0.89
$0_2^+ \longrightarrow 2_1^+$	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	

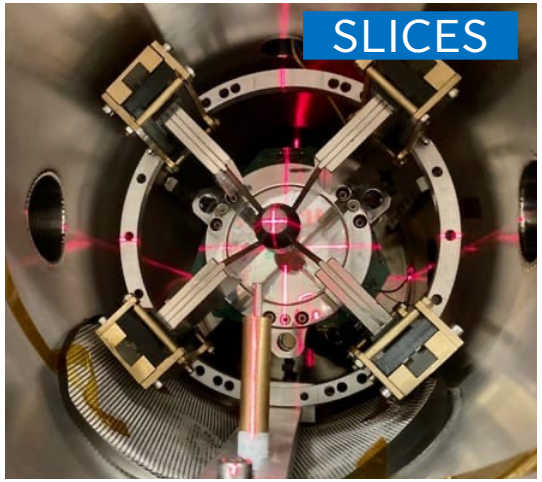
		q^2(E0/E2)		$\rho^2 \cdot 10^3$	
$J_i^\pi \longrightarrow J_f^\pi$	E_γ [keV]	Present	Previous	Present	Previous
$0_2^+ \longrightarrow 0_1^+$	1134	0.166(15)	0.162(7)	17(4)	16.4(40)
$0_3^+ \longrightarrow 0_1^+$	1706	0.09(15)		2(4)	< 3
$0_4^+ \longrightarrow 0_1^+$	2001	0.124(18)		< 19	
$0_4^+ \longrightarrow 0_2^+$	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 $\alpha_K(2_3 \rightarrow 2_1)$
- Extraction of additional q^2(E0)

Future perspectives - SLICES @CERN





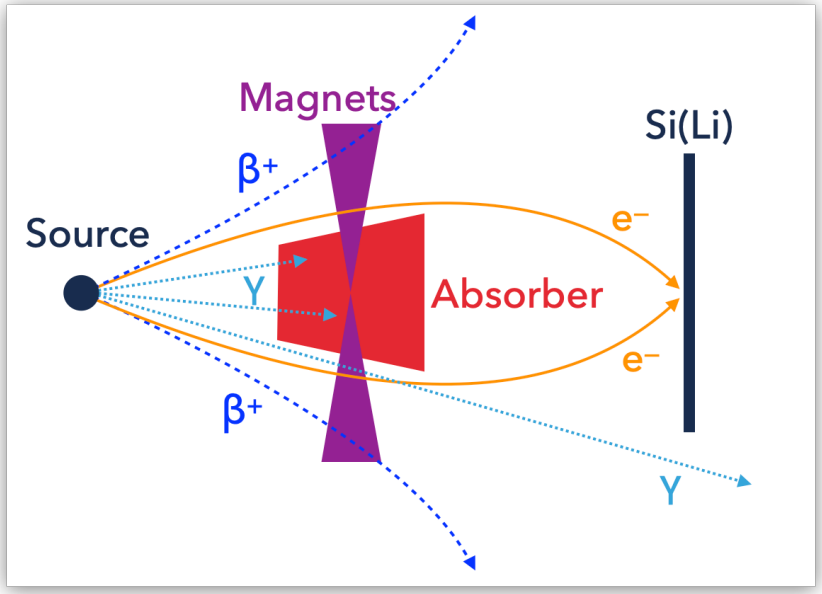


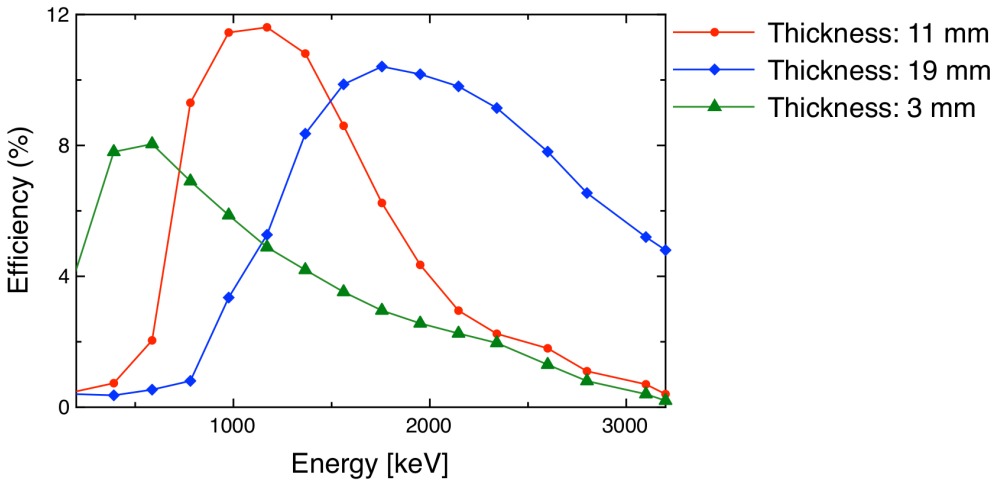
Future perspectives - ARDE

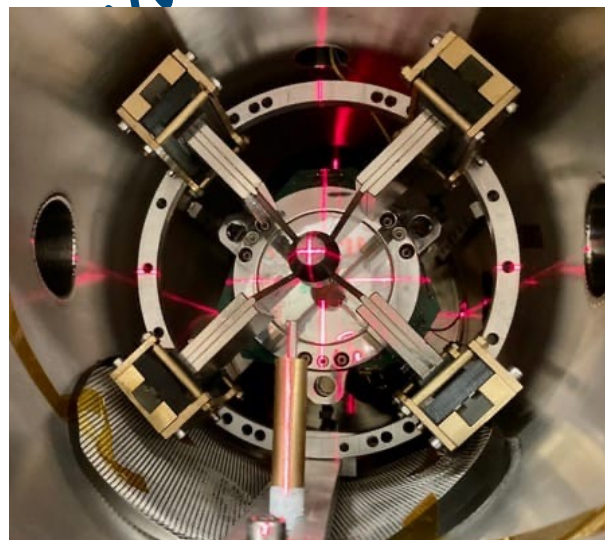
ARDE – Algoritmi basati su Reti neurali per la Discriminazione tra Elettroni e raggi γ

SLICES limitations:

- The total efficiency of the setup depends on the electron energy range of interest
- Large dimension of the setup







Future perspectives - ARDE

ARDE – Algoritmi basati su Reti neurali per la Discriminazione tra Elettroni e raggi γ

- Study the efficiency of discrimination in semiconductor detectors between gamma rays and electrons using AI

  I. The electrons interaction in Si(Li) detectors cannot be considered localized with respect to the width of the cristal
  II. The electrons interact continuously in a primary trace
  III. Tha gamma rays interact especially via single Compton scattering inducing a localized charge

Future perspectives - ARDE

ARDE – Algoritmi basati su Reti neurali per la Discriminazione tra Elettroni e raggi γ

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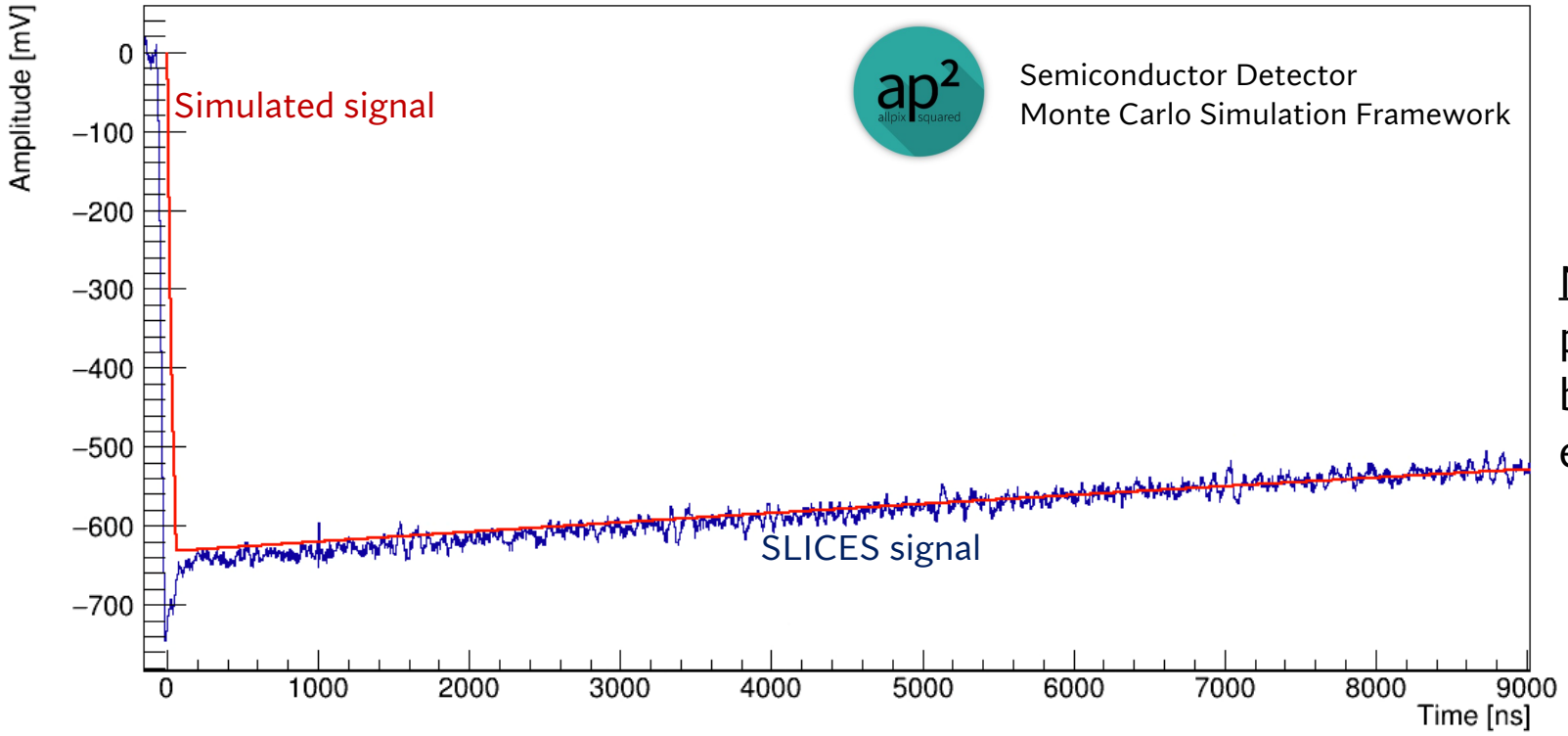

Next step: Study the key parameters for discrimination between the gamma and electron signals

THANK YOU FOR YOUR ATTENTION