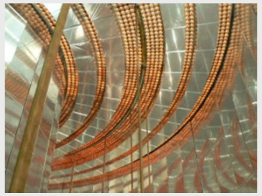
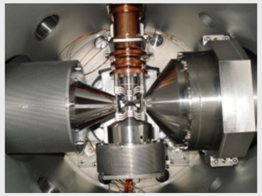
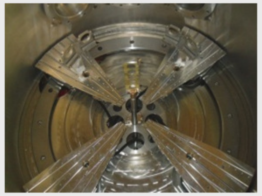


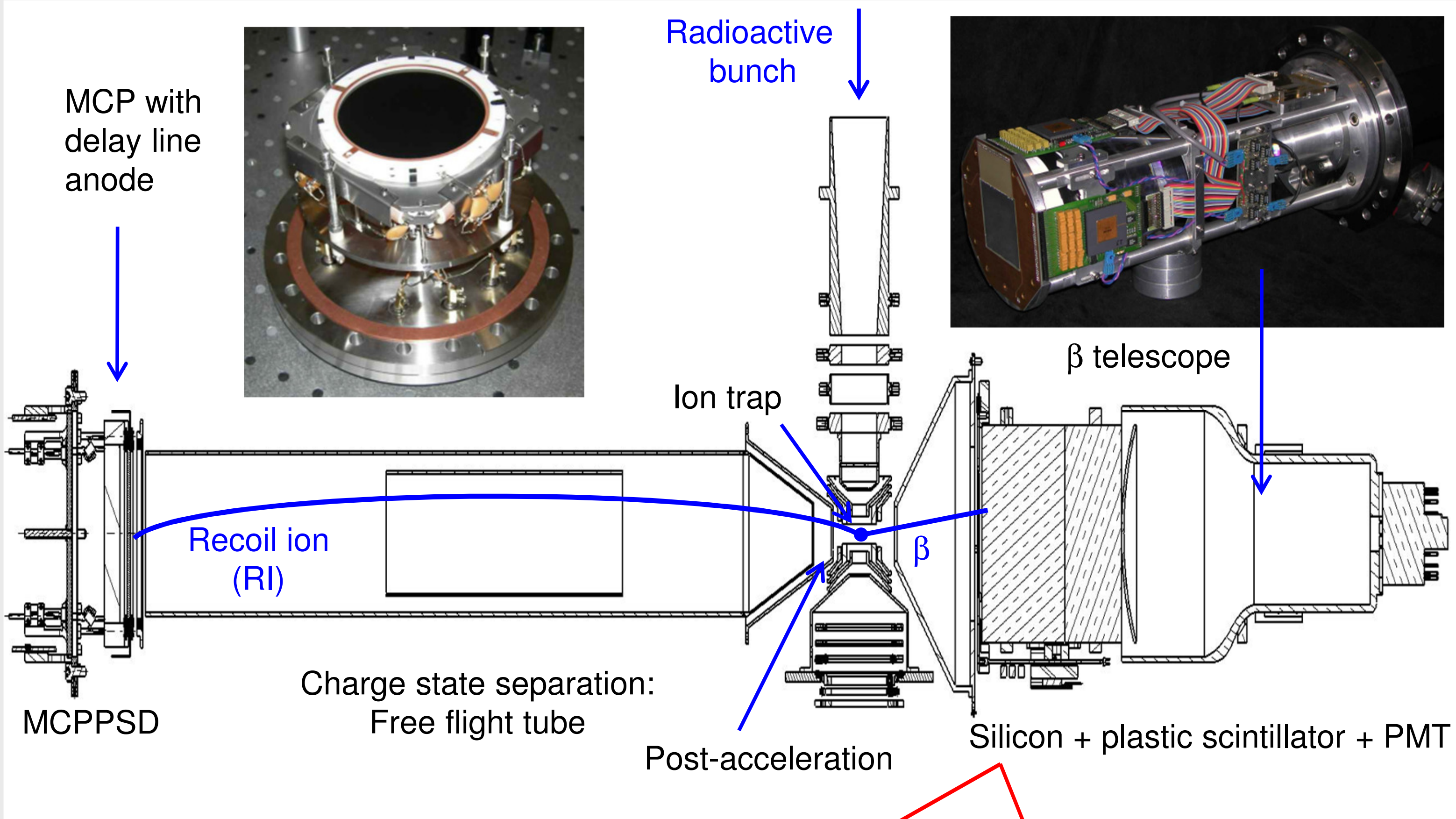




Tests of phoswich detectors for e^- detection

E. Liénard

Why a new e⁻ detector ? 1. to replace the present telescope

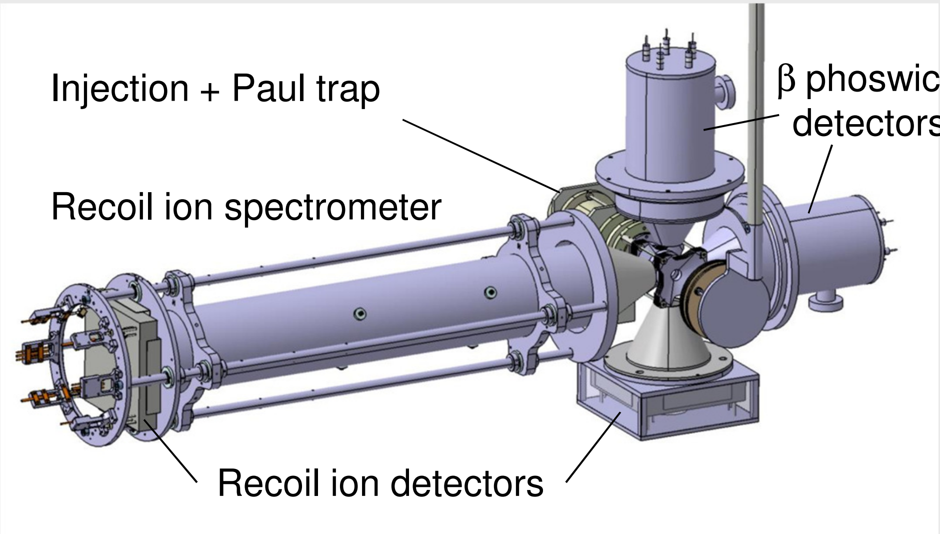


Defects :

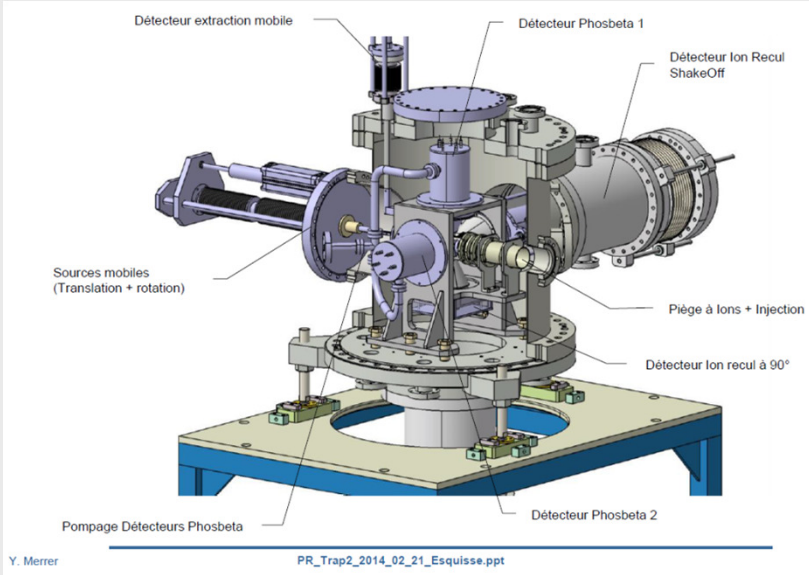
- Slow, fragile, complex
- High backscattering effect

- 60 x 60 mm x 300 μm
- 1mm spatial resolution
- ~10 keV ΔE resolution
- ΔE ~ 110 keV

Why a new e^- detector ?   2. to move to LPCTrap2



In the current chamber



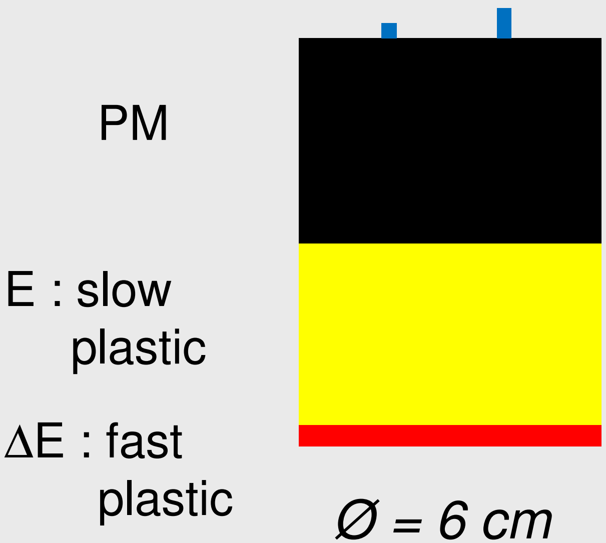
- Detectors number X 2
- FASTER DAQ system

➡ Gain in stat: Factor of ~ 4

Why a phoswich detector ?

- Backscattering limitation → light element
- Deadtime reduction → plastic scintillator
- β/γ discrimination → phoswich

Principle : 2 scintillators (thin & thick) with ≠ risetime, read by a single PM



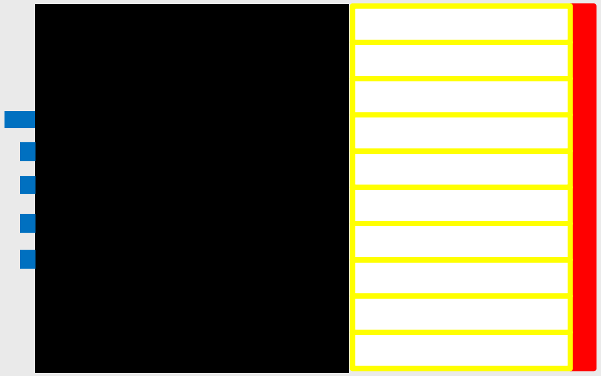
Ø = 6 cm

Rôle	type	thickness	ΔE
E	slow *τ = 285 ns*	3cm	> 5.5 MeV
ΔE	fast *τ = 1.8 ns*	1mm	~ 200 keV

- Tests 1: checking the operation with FASTER
- Problem: loss of position information

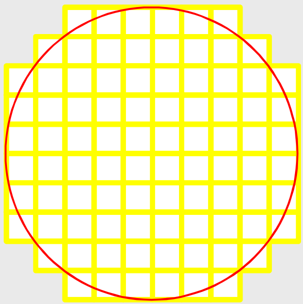
How retrieve the position ?

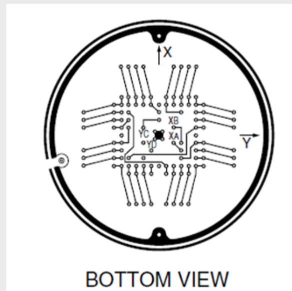
- Tests 2: With scintillating fibers



- Square section of 0.5 cm side
- Direct light
- Fast/slow switch

PM Hamamatsu R2486-02

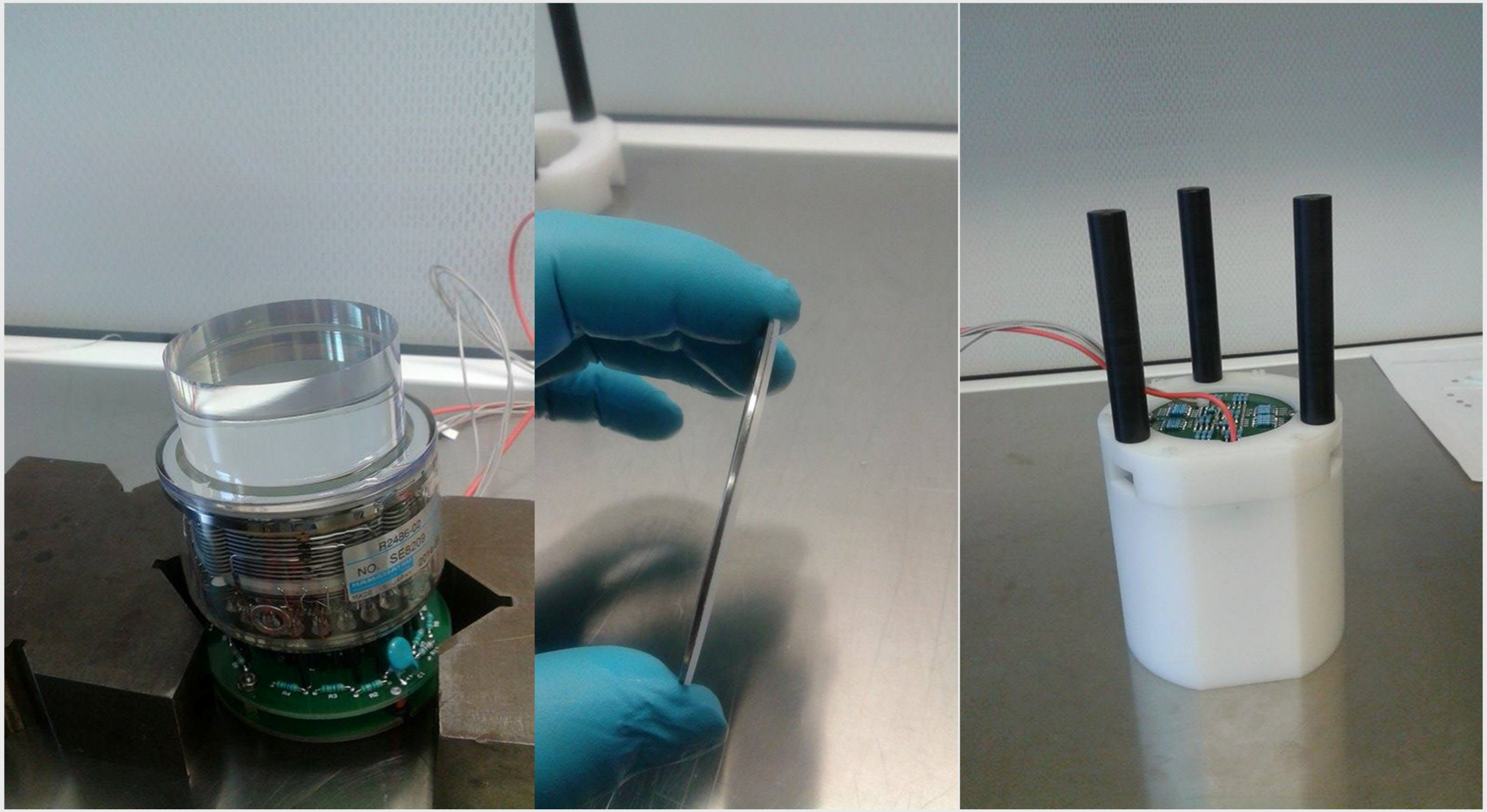




Summary of first tests

(M1 internship)

- Characterization of a phoswich based on 2 plastic scintillators using FASTER
  → 2 elements mechanically coupled
  → PS PM & simple PM



Summary of first tests

(M1 internship)

- Source: ^{207}Bi

			IC e$^-$		γ	
$^{207}_{83}$Bi	31.8 y	EC	0.481 e^-	2%	0.569	98%
			0.975 e^-	7%	1.063	75%
			1.047 e^-	2%	1.770	7%
					Pb K x rays	78%

- Different conditions: optical grease
  integration windows / threshold
  amplifier …

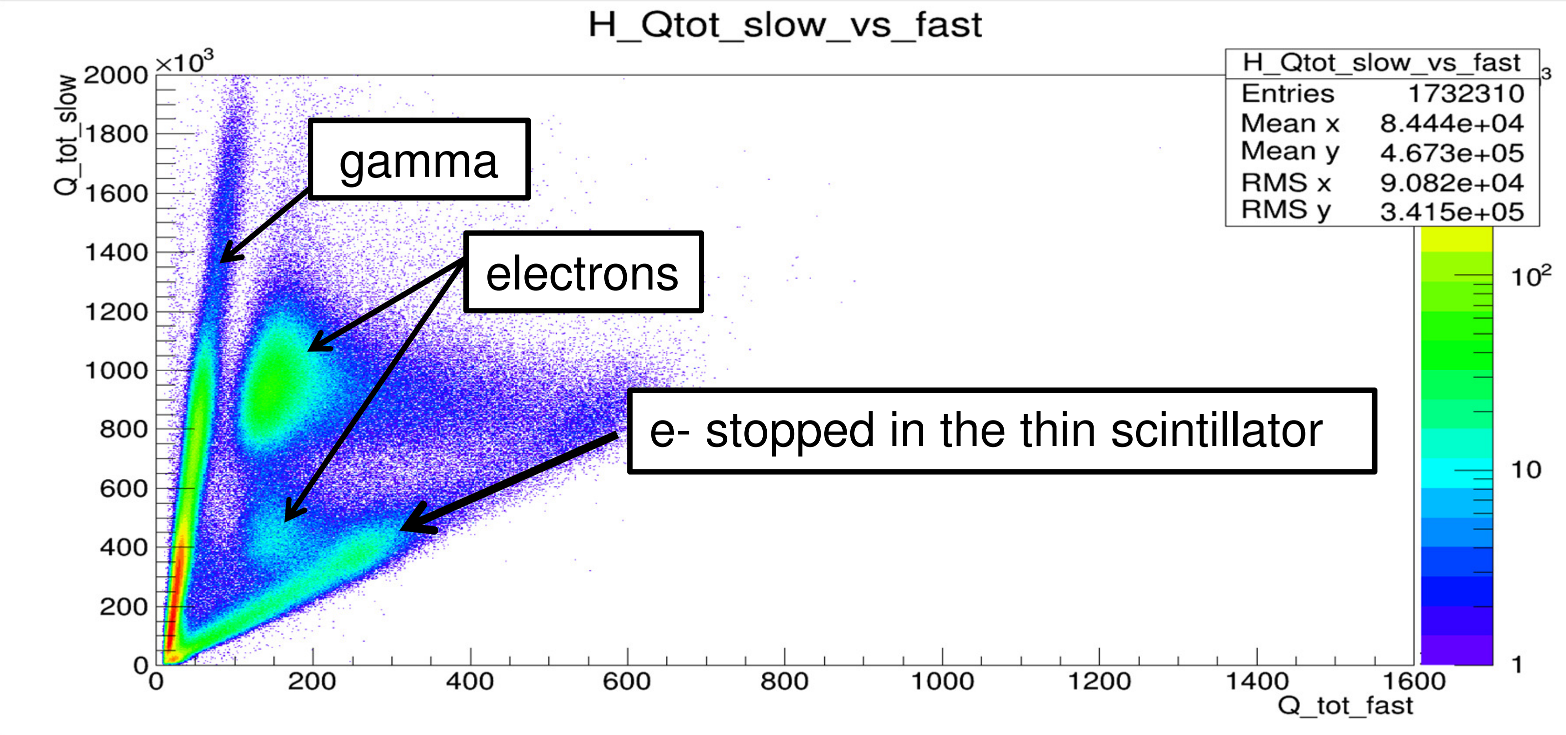
- Position Sensitive PM

Summary of first tests

(M1 internship)

- Typical two-dimensional spectrum

Qtot = Q1 + Q2 + Q3 + Q4 (4 signals)

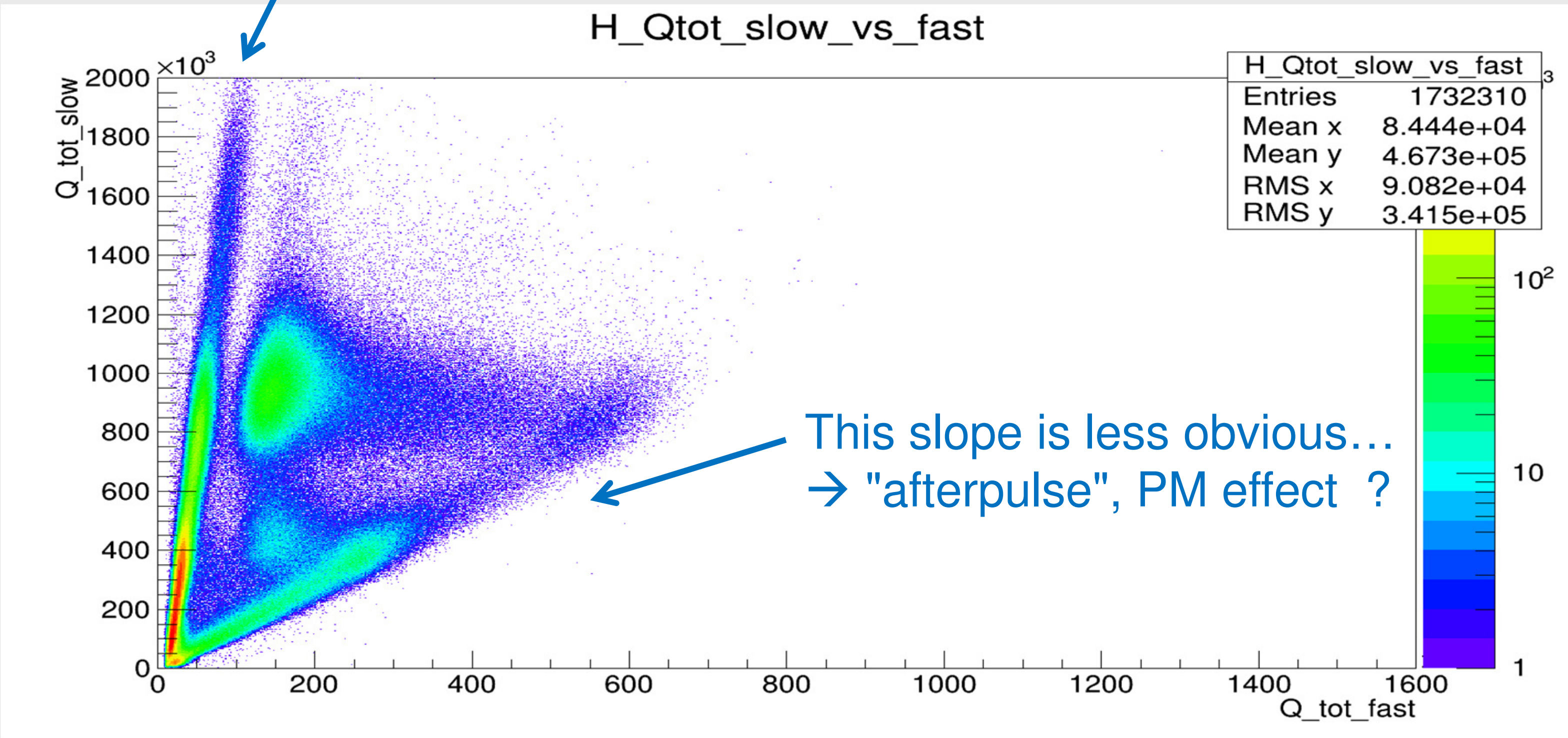


Summary of first tests

(M1 internship)

- Correction and energy calibration

Qfast always contains a Qslow component

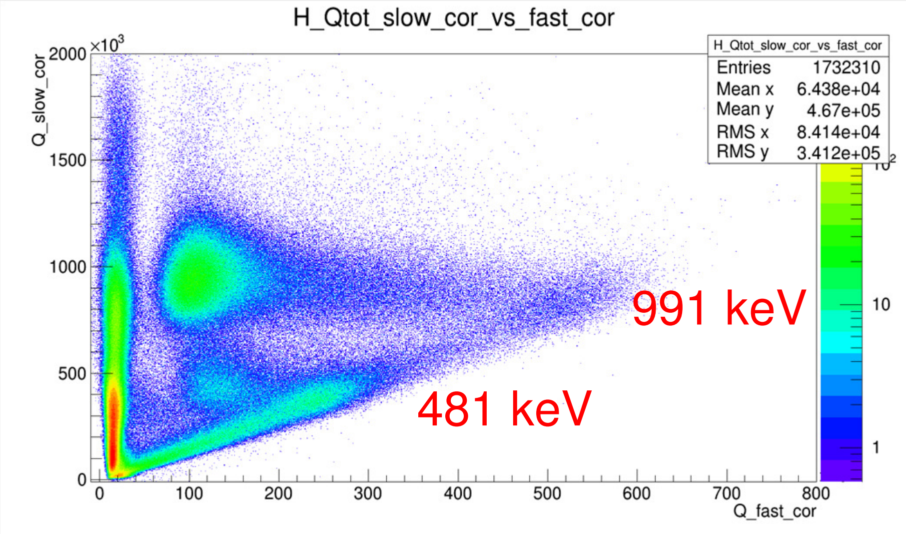


This slope is less obvious…
→ "afterpulse", PM effect ?

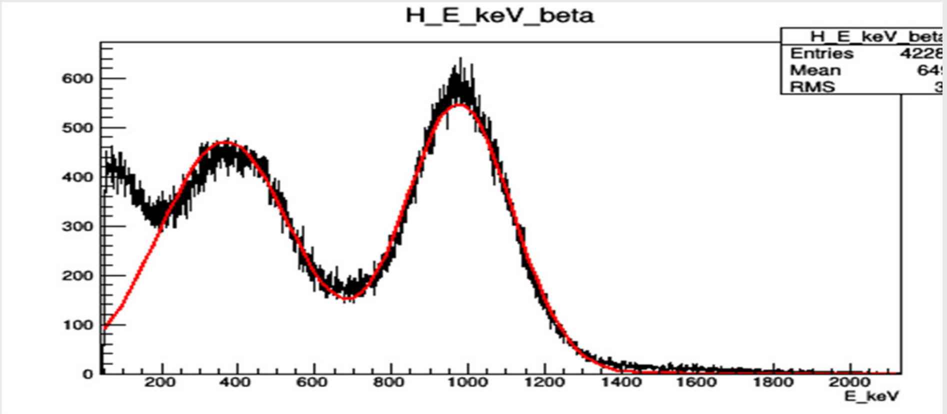
Summary of first tests

(M1 internship)

- Correction and energy calibration



$$E_{tot} = \alpha \times Q_{slow} + \beta \times Q_{fast}$$



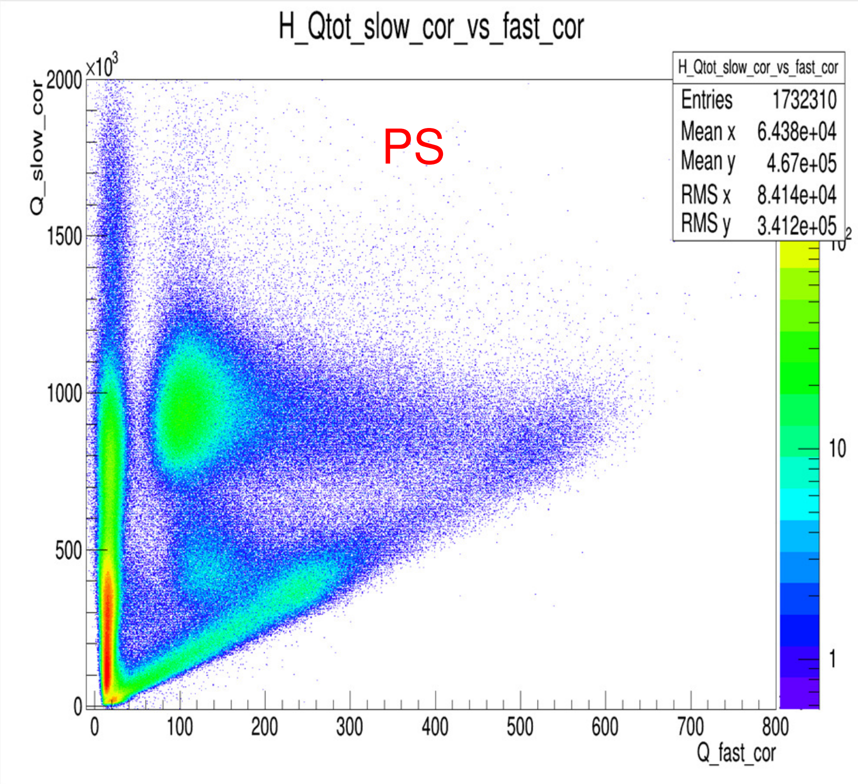
R = FWHM/E ~ 25 %

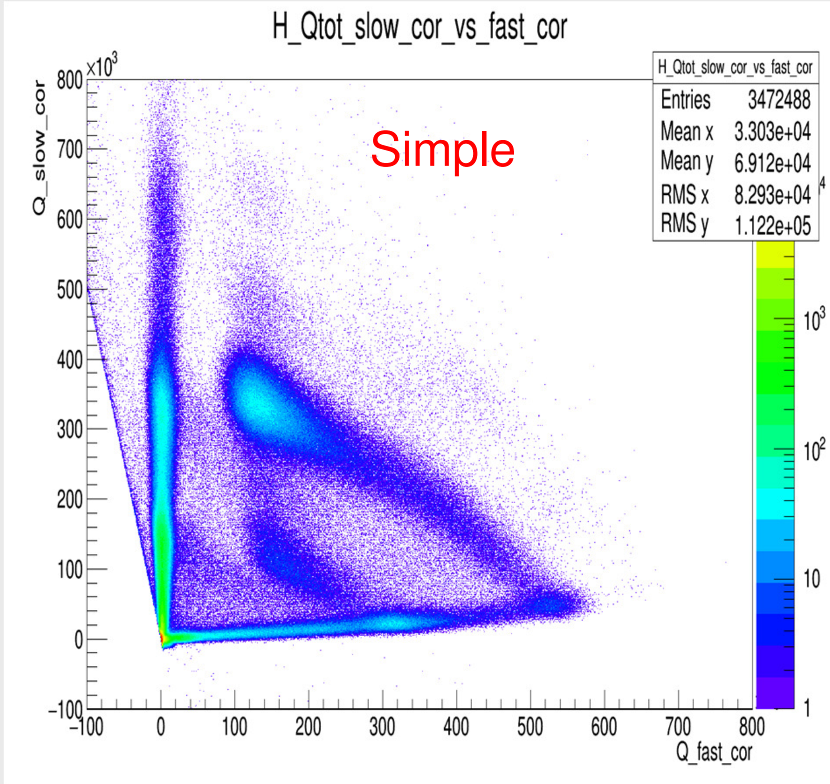
Threshold ~ 120 keV

Summary of first tests

(M1 internship)

- PS PM → simple PM (R329-02 Hamamatsu 51mm < 60 mm)





R: 25% 18%

Th: 120 keV 88 keV

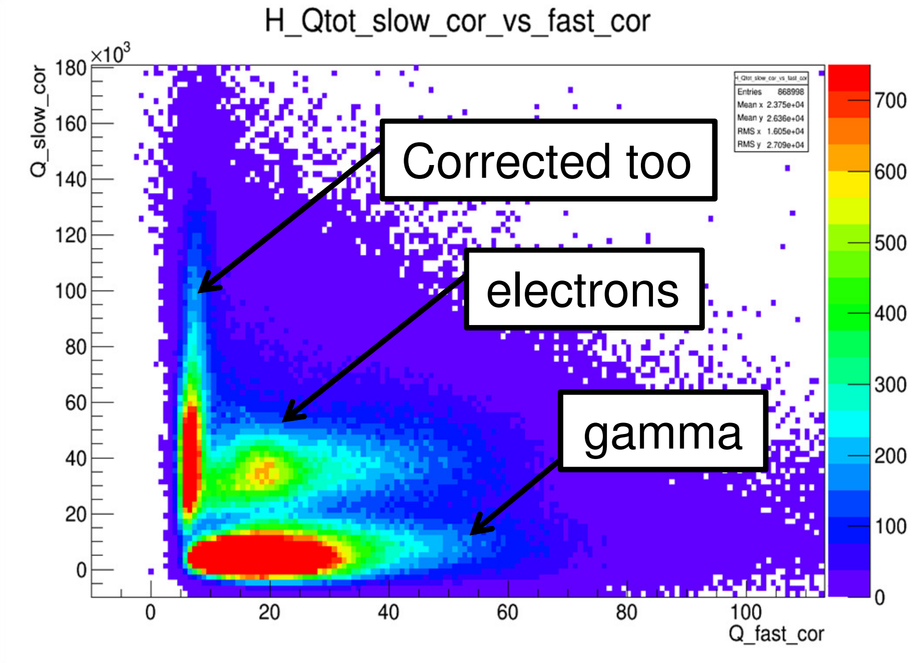
& no "afterpulse"

Summary of first tests

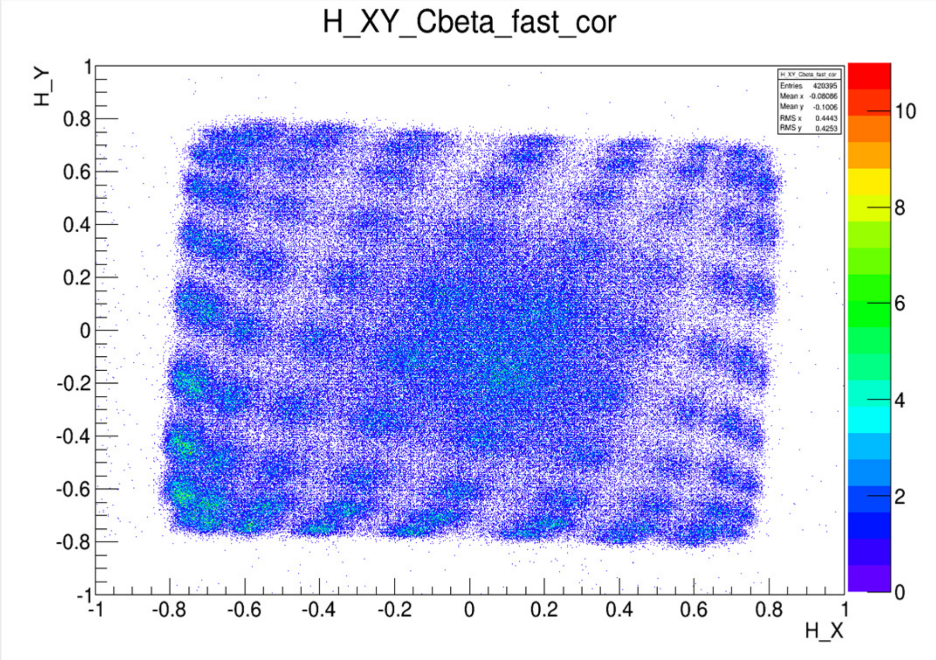
(M1 internship)

- Phoswich with fibers and PS PM (tricky mounting)

Fast/slow switch



without mask …



Many distortions and "dead" zones, high energy threshold

→ Appears more complicated than the present telescope …

Summary of first tests

(M1 internship)

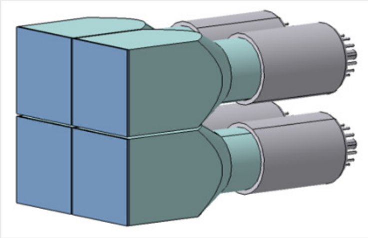
- Good β/γ discrimination
- Bad E resolution with PS PM, better with simple PM
- Fibers system seems not easy to manage, not suited for precision measurements

Conclusion:

- Principle adopted
- Position sensitivity: multi-phoswich detector 2x2
- Further tests to be performed

- Matching between areas (Plastics – PM)
  9814SB ET enterprises
- Slow/fast or fast/slow? EJ-212, EJ-240 Scionix
- ΔE thickness ? 0.5 & 1 mm

➡ Material funded with LPC money remaining



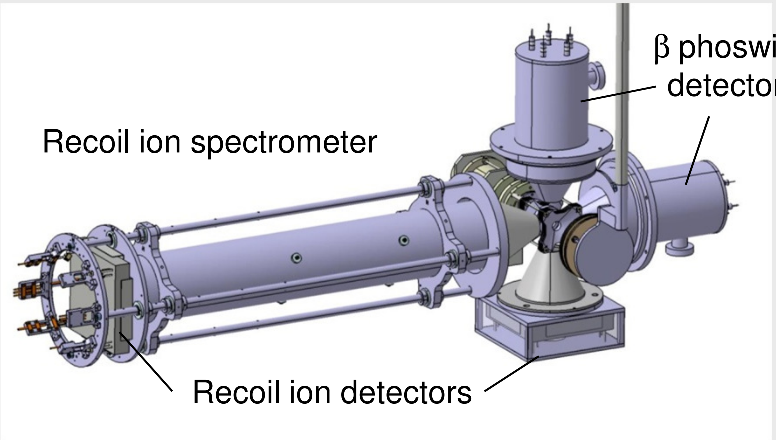
© Y. Merrer first draft

KUL money
→ final design

Final design ?

- Two projects

LPCTrap2 (*a* in mirrors)



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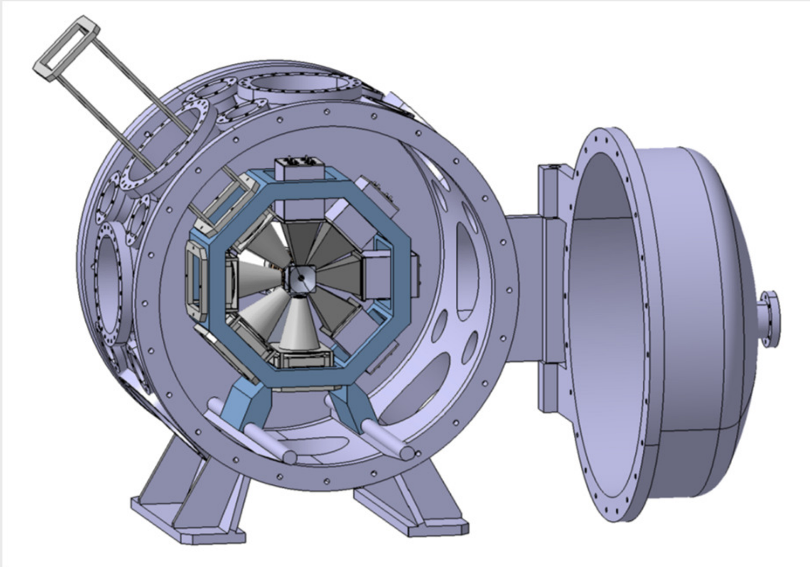
4 detectors in the present chamber

Winningmotions (*D* or *a*)

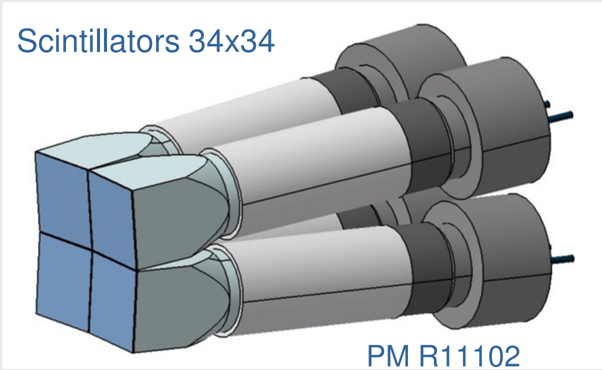


8 detectors in a new big chamber

- LPCTrap2 funded, Winningmotions ??
- β detector: ~ the same function

➡ Same basic design

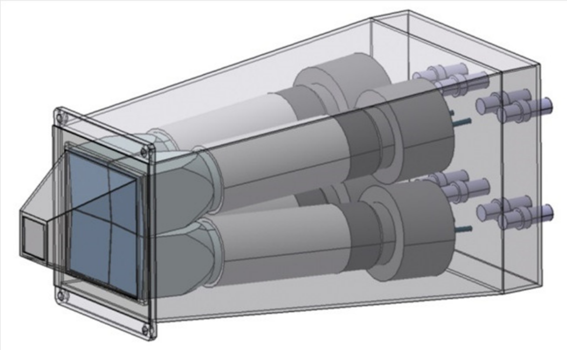
Constraints: existing chamber in LPCTrap2, maximal solid angle in the 2 configurations



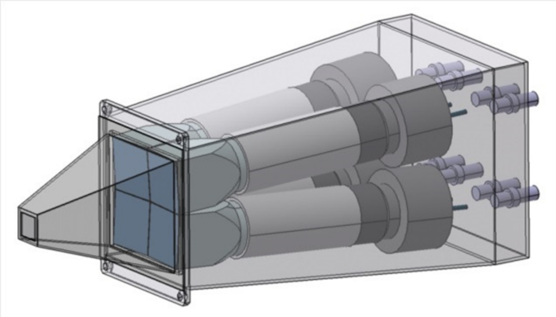
Final design ?

- Two projects, an adapted basic design

LPCTrap2 (*α* in mirrors)



Winningmotions (*D* or *α*)



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