Detectors for Parity Experiments

What's New:

	HAPPEx	^{4}He	HAPPEx2	Pb	
A_{PV} (ppm)	15	8.5	1.5	0.5	Asymmetry ↘
$\sigma_{stat.}$ (%)	6.5	2.2	4.6	3.0	Stat. error ↘
τ (MHz)	1	12	65	860	Counting rate ↗

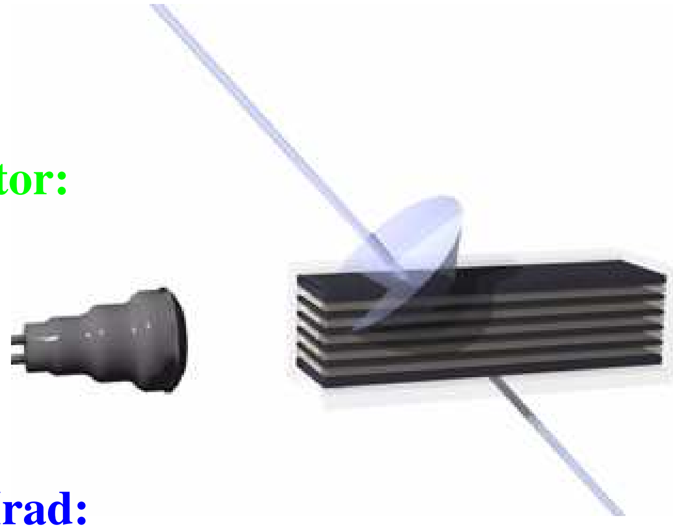
➔
- ❑ Radiation hardness
- ❑ Large integrated charges
- ❑ Steep variations of $d\sigma/d\Omega$ across the acceptance

  ⟶ segmentation?

Radiation Hardness

Keep the same idea of

integrating Cerenkov detector:



- ❑ Integrated doses > 1 Mrad:

  Replace lucite with fused quartz

  Extensively tested at SLAC and CERN

- ❑ Radiator material:

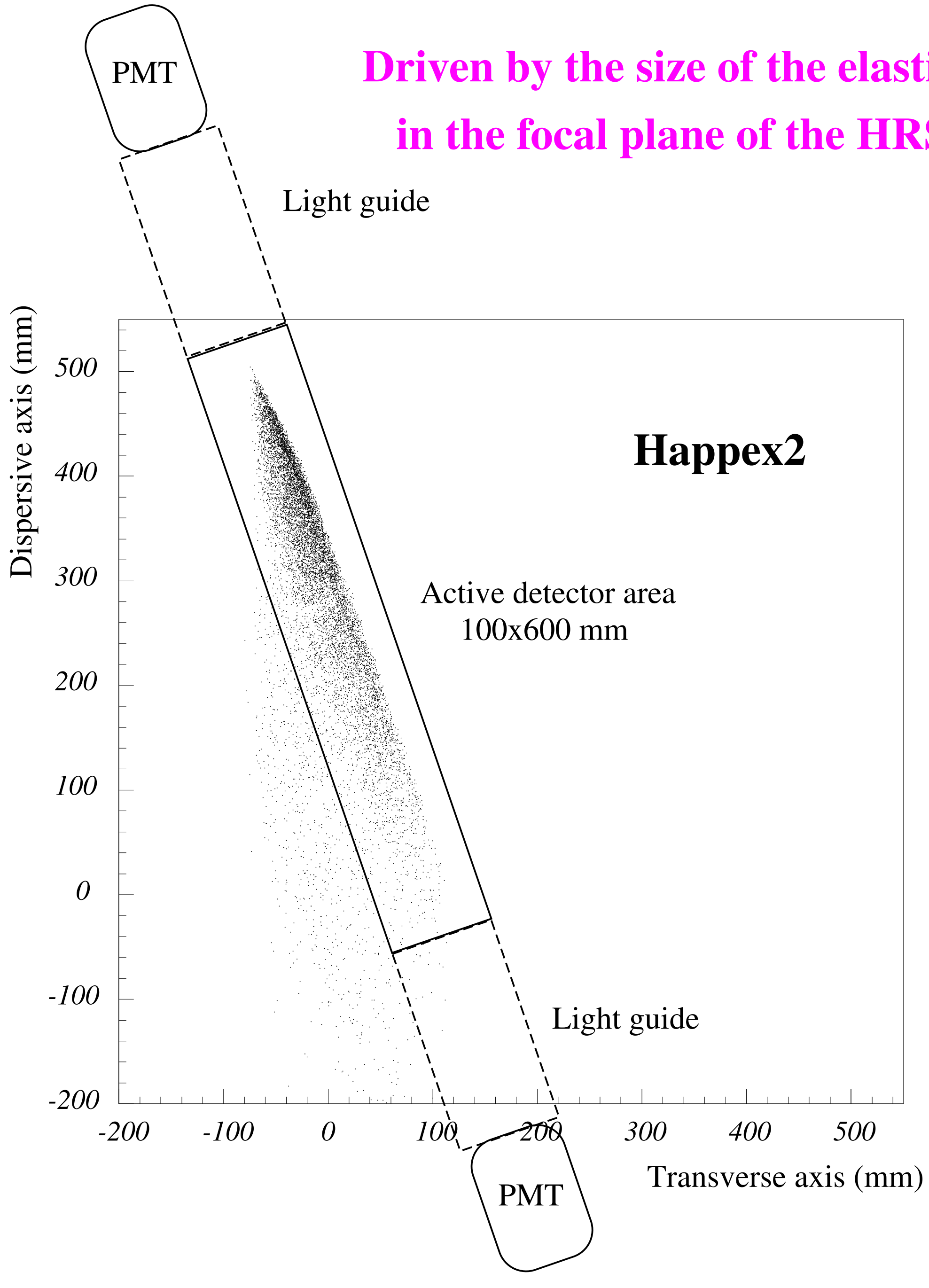
  Pb, W and Cu have small Moliere radius

  W is susceptible to activation

Sandwich Structure

Geometry:

Driven by the size of the elastic line in the focal plane of the HRS.



HRS optics have to create a gap between elastic events an others.

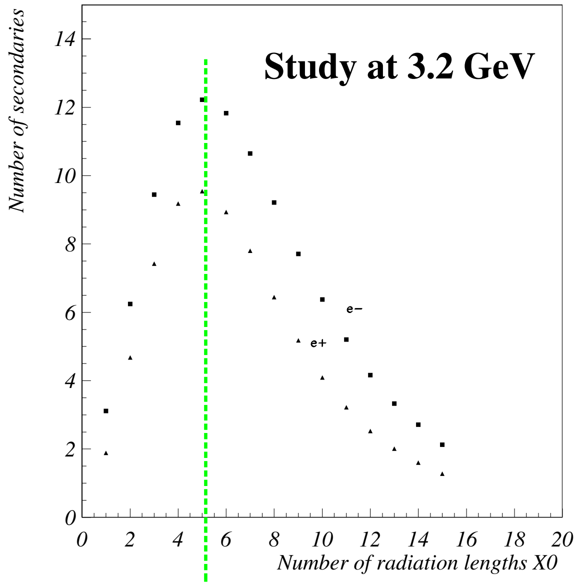
Sandwich Structure

Resolution:

$$\sigma = \sigma_{stat} \times \sqrt{\left(1 + \left(\frac{\Delta E}{E}\right)^2\right)}$$

Nb of γ_e /event

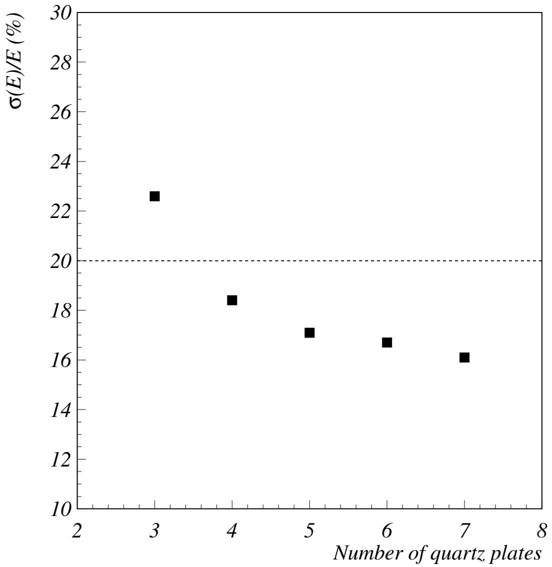
Fluctuations in the deposited E



→ **"thick" (~7χ_0) sandwich structure to contain the cascades and produce enough light/event.**

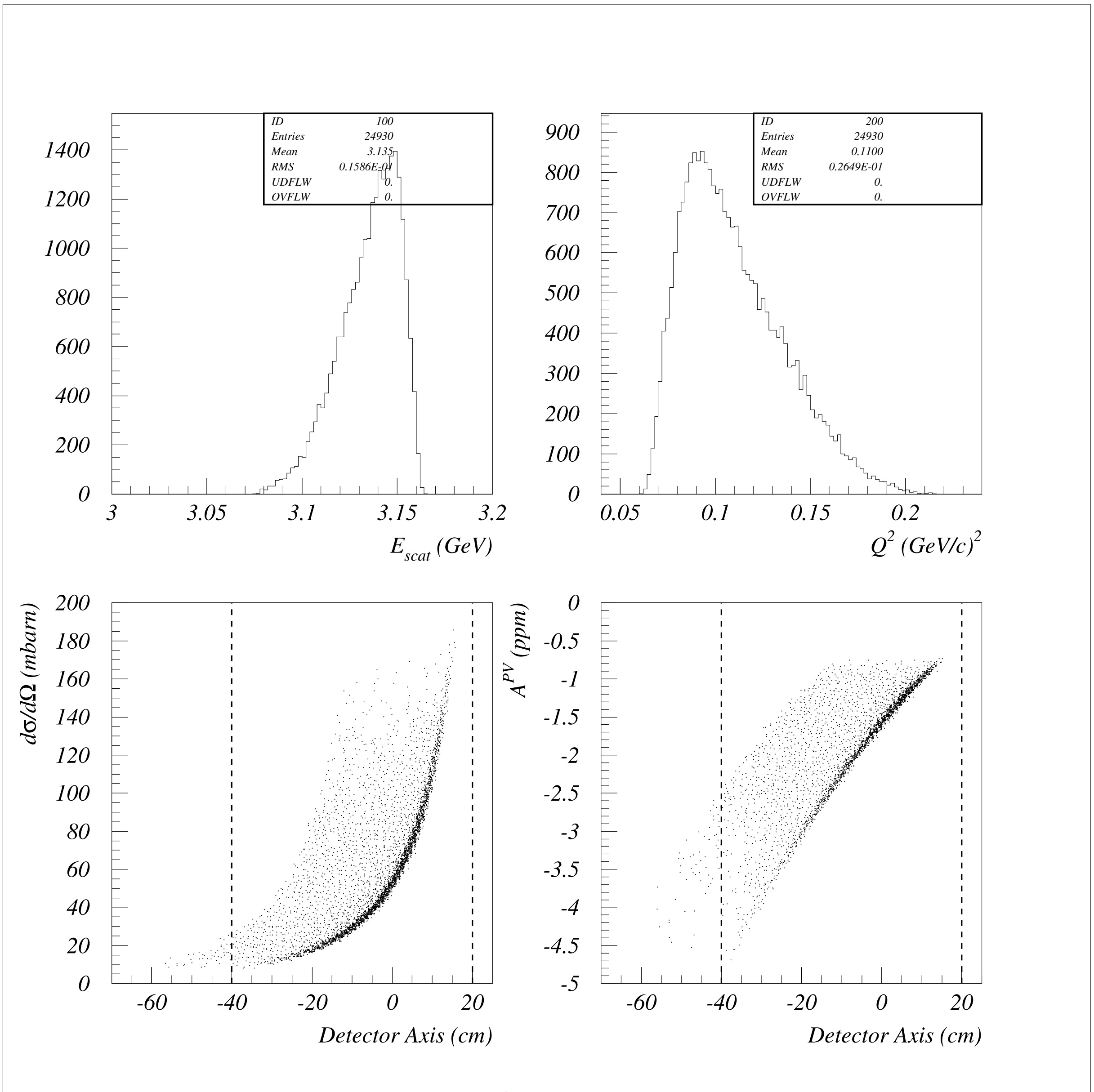
❑ **Specification: ΔE/E<20%**

→ **5 quartz plates**



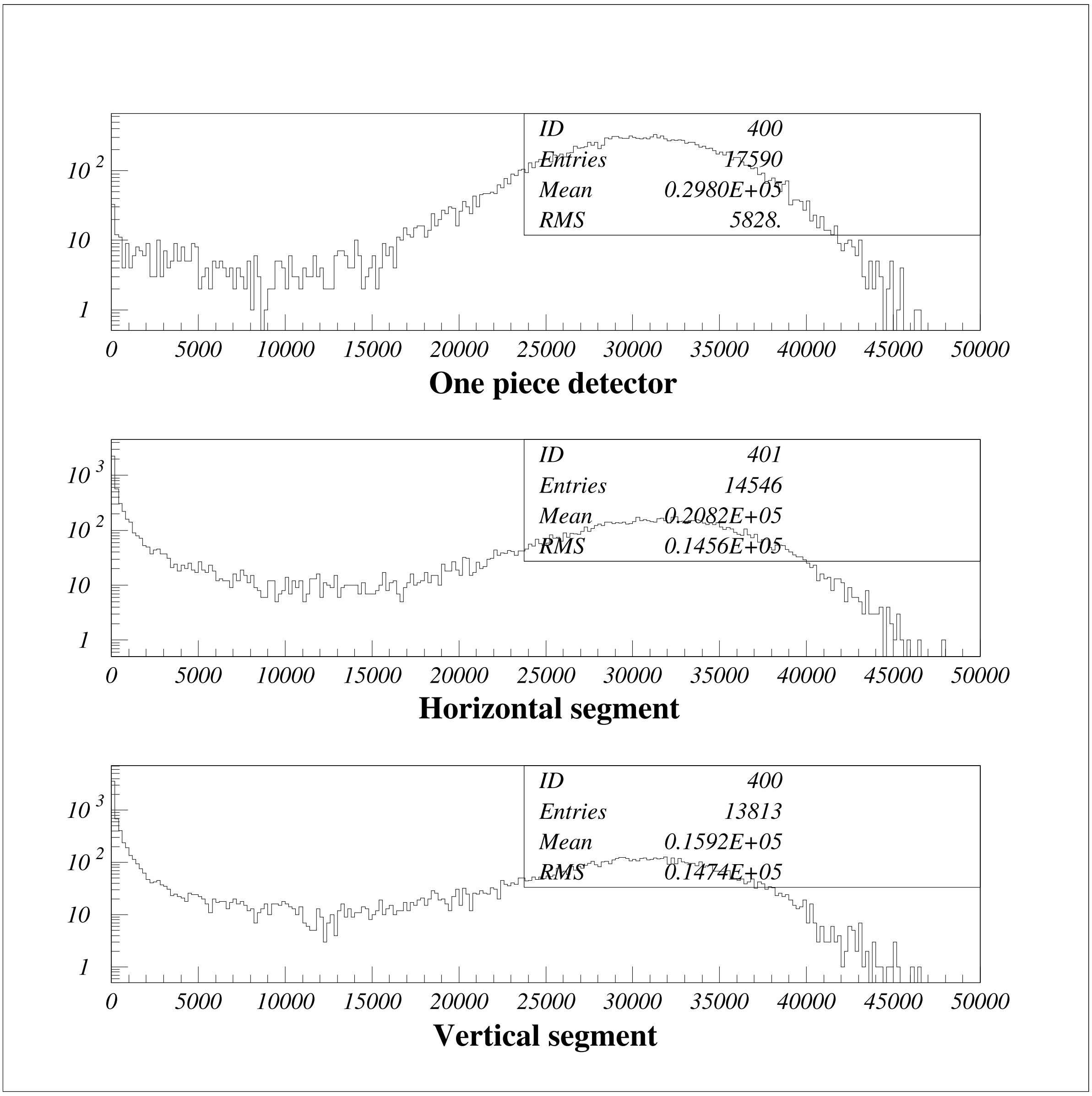
Segmentation

HAPPEx2 kinematics



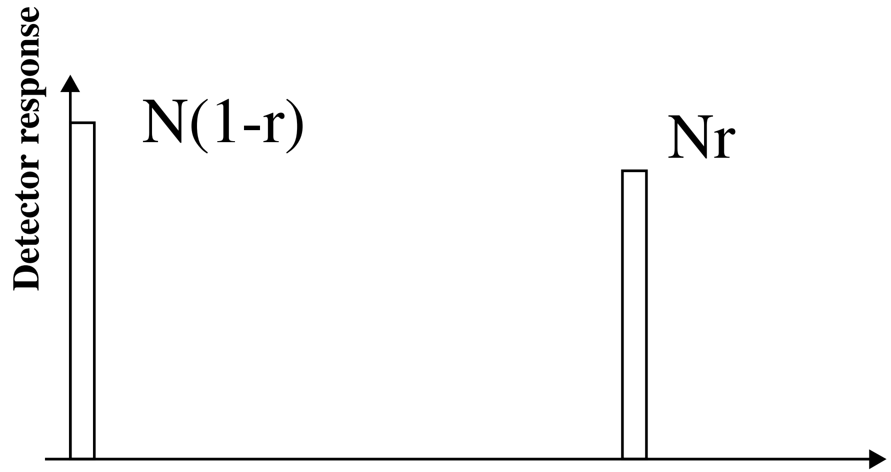
- Two bins in Q^2
- Better control of the systematics
- Same detector used for several experiments

Edge effects



- ❑ Keep a good resolution
- ❑ No sizeable effect in the sensitivity to position differences

Segmentation



~0 amplitude from leakage, edge effects.

Dirac response of

1 “perfect” segment

$$\sigma = \sigma_{stat} = \underline{1/\sqrt{Nr}}$$

$$\sigma = \sigma_{stat} \oplus \sigma(E)/E$$

Binomial distribution:

$$\sigma = 1/\sqrt{N} \oplus \sqrt{Nr(1-r)}/Nr = \underline{1/\sqrt{Nr}}$$

Integrated charge

❑ **Maximum continuous anode current:**

$$I = 40\ 10^{6} \times G_{PM} \times N\gamma_{e} \times 1.6\ 10^{-19} < 10\ \mu A$$

$$\rightarrow G_{PM} \times N\gamma_{e} < 1.5\ 10^{6}$$

G_{PM} → ~few 10^{3} → **Being tested at Saclay**

$N\gamma_{e}$ → ~few 10^{2} (3000 expected) → **Neutral density filters in front of the PMT**

❑ **C ~ 300 nC, ADC specifications?**

Happex2 detector

- ❑ Saclay in charge.
- ❑ Budget ~ 85 k$
- ❑ Mechanics designed
- ❑ Segmented option with L shape
- ❑ Quartz ordered