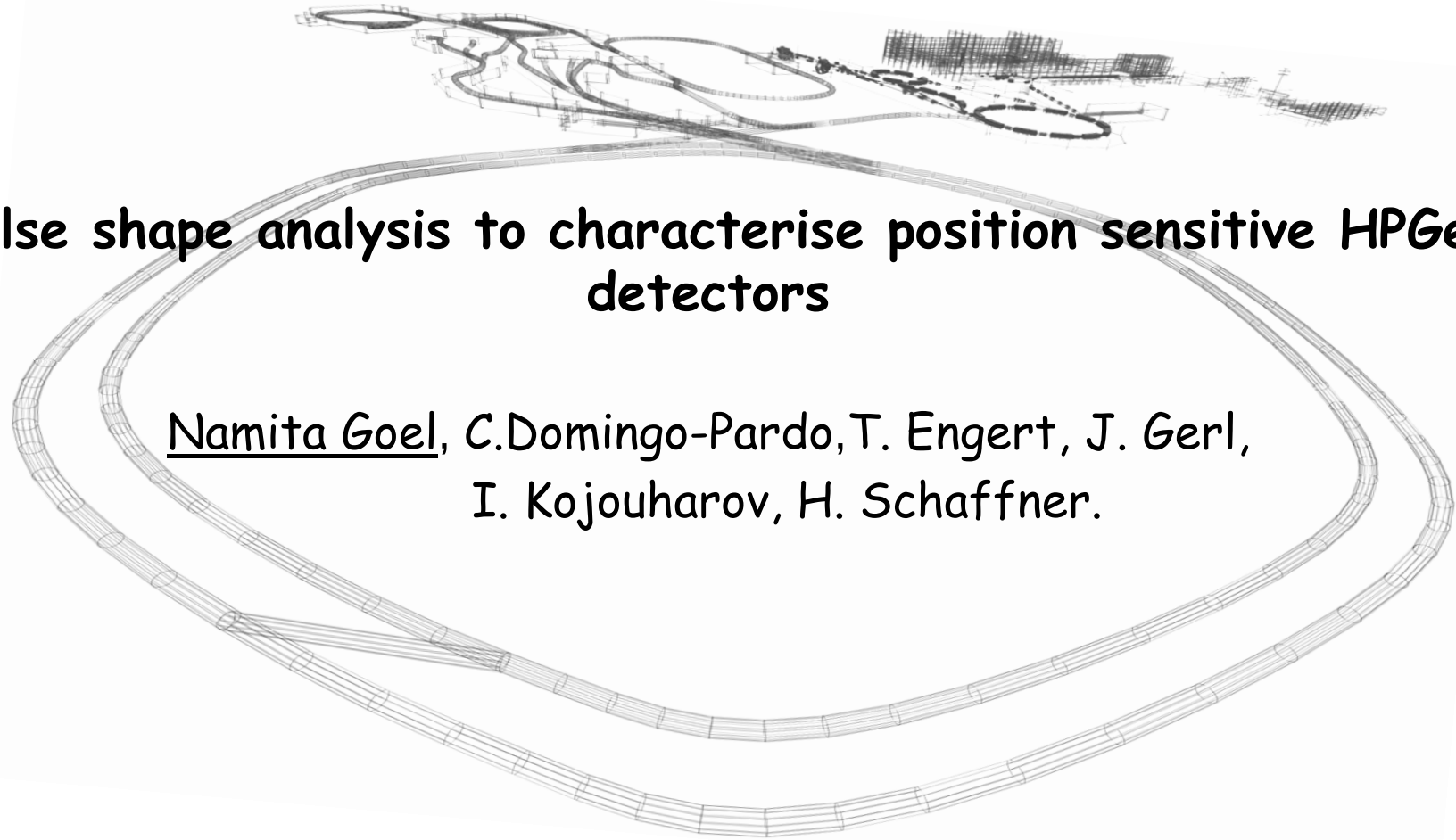
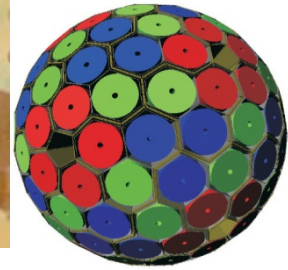
AGATA-Advanced Gamma Tracking Array



Pulse shape analysis to characterise position sensitive HPGe detectors

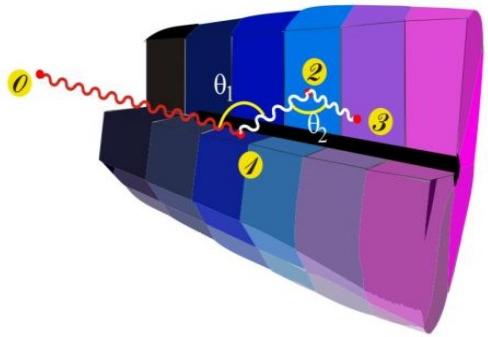
Namita Goel, C.Domingo-Pardo, T. Engert, J. Gerl,
I. Kojouharov, H. Schaffner.

AGATA
Advanced Gamma Tracking Array



36-fold segmented detector

Digital electronics

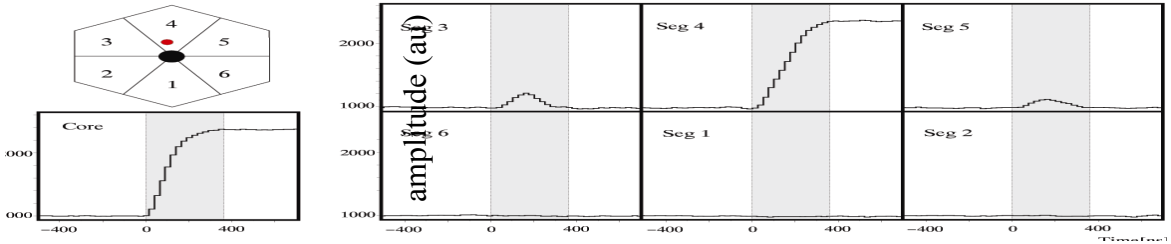


For each event, there are (36+1) x100 samples of preamplifier signals

(x,y,z,E,t)

The γ-ray tracks can be reconstructed from the angle-energy relation of Compton scattering formula

Pulse shape analysis



Radial information -> Segment 4

Azimuthal information -> Segment 3 & 5

SCANNER

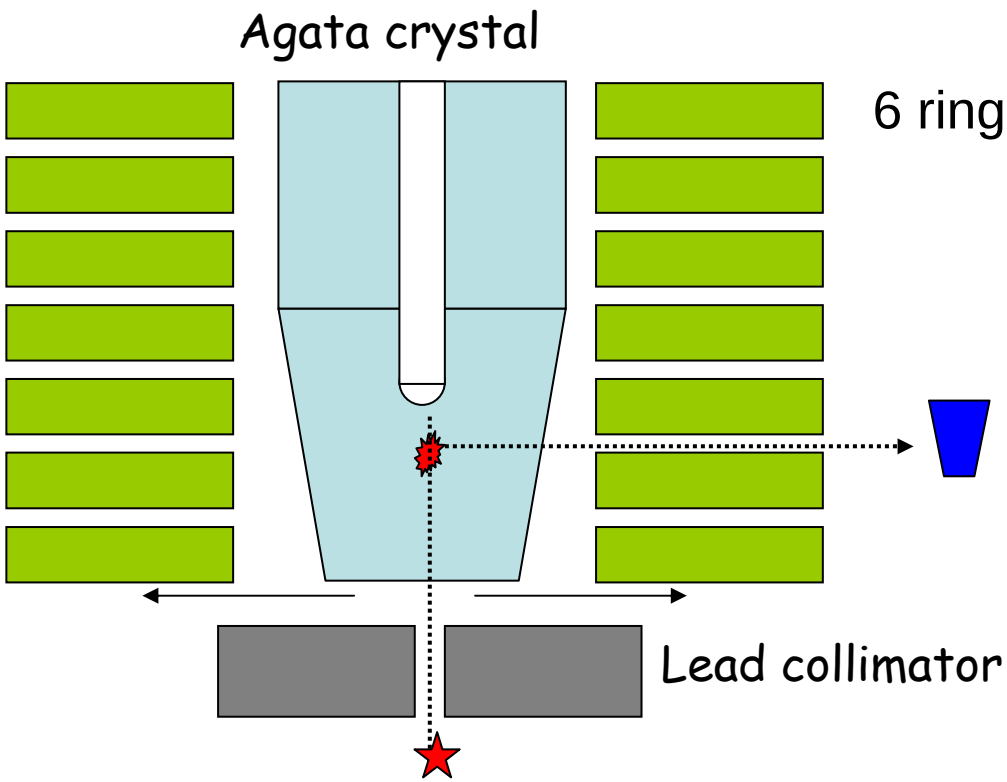
PSA requires a system to scan the detector

For each 3D interaction point (x,y,z)
there exists a unique set of pulse shapes

A data base can be used
to relate a measured set of
pulse shapes to an interaction
point(x,y,z)

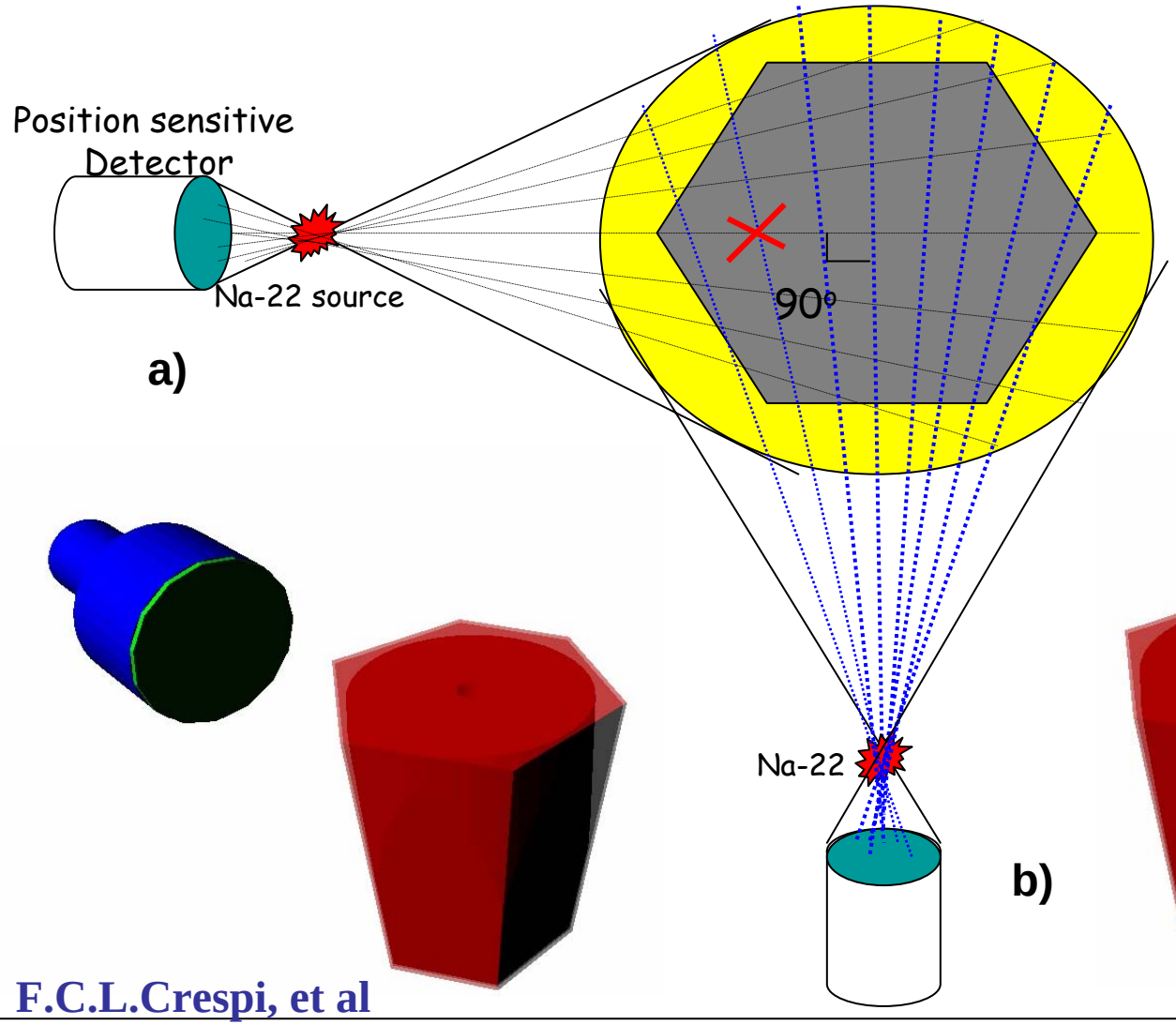
An efficient system to
scan the
detector to obtain the data base

Principle



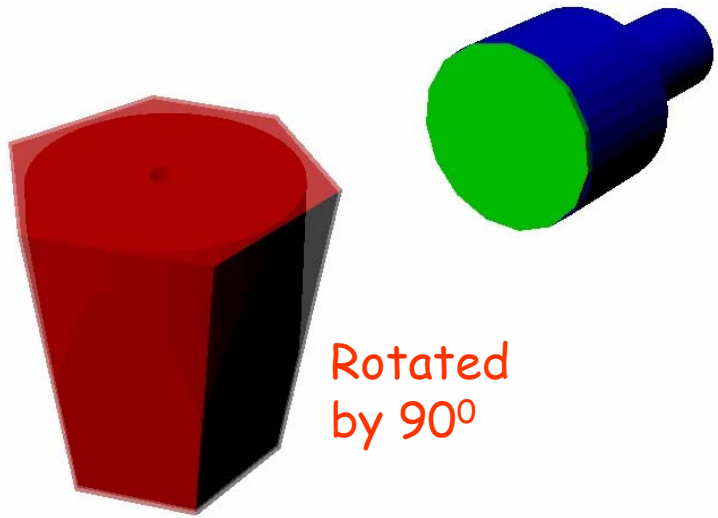
Needs long time to scan one crystal !

Principle...
PET technique



Recording the pulse shapes for two positions (a) and (b).

For identical signals one knows the crossing points (x,y,z)



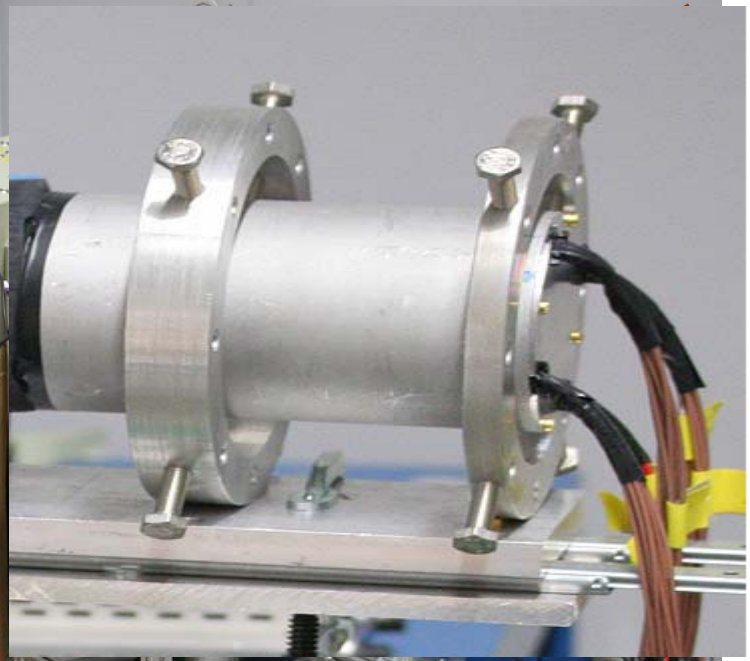
Rotated by 90^0

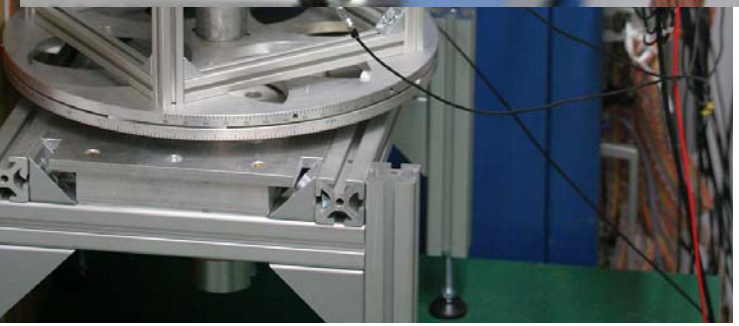
F.C.L.Crespi, et al

GSI

Scanner at GSI

Position sensitive detector





LYSO crystal

Diameter=76 mm

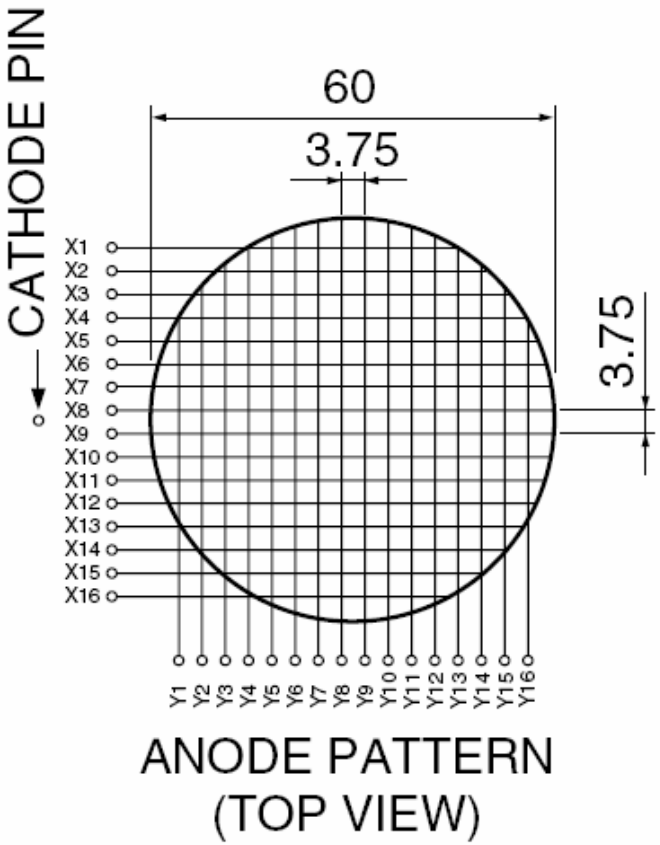
Thickness=3 mm

Density=7.4g/cm^3

Gamma-ray camera
Individual multi-anode readout

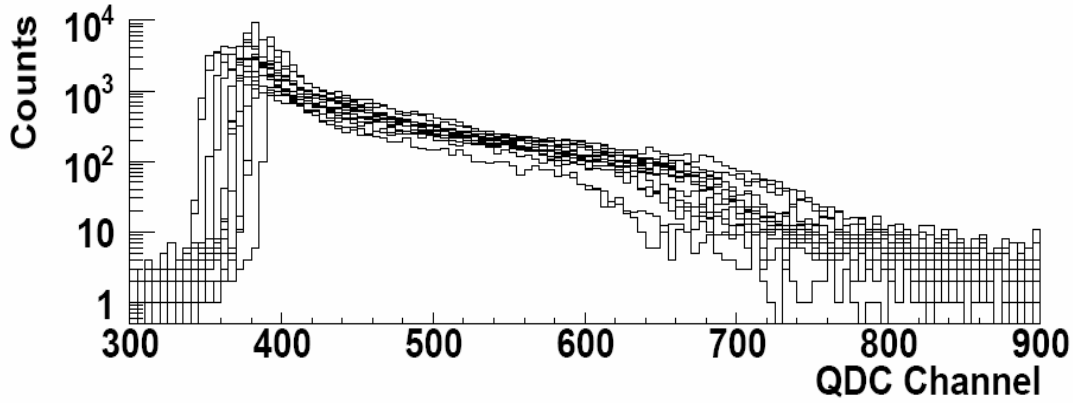
16 wires in X axis and

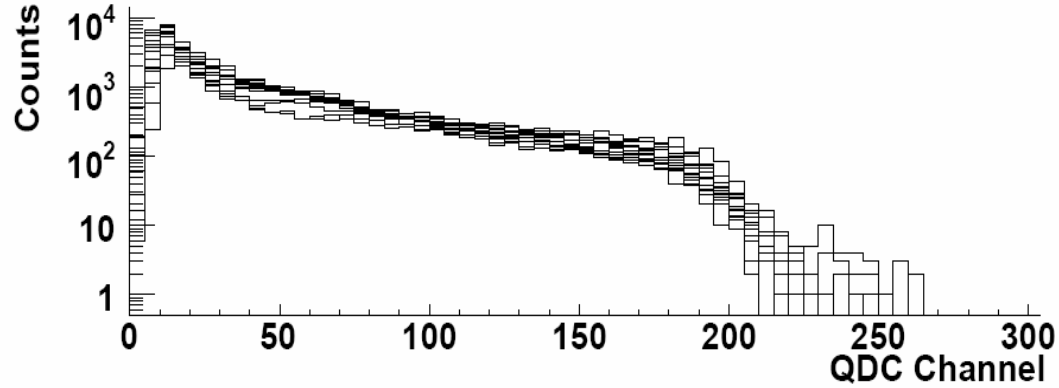
16 wires in Y axis



ANODE PATTERN
(TOP VIEW)

Raw QDC pulse height spectra

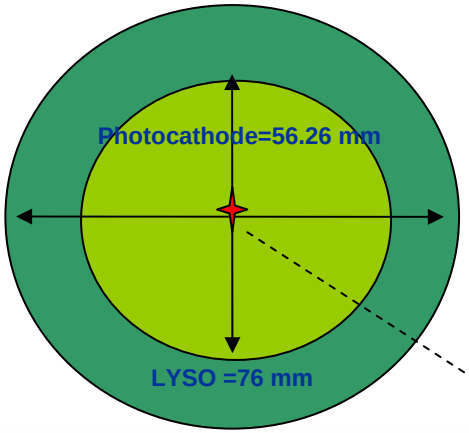




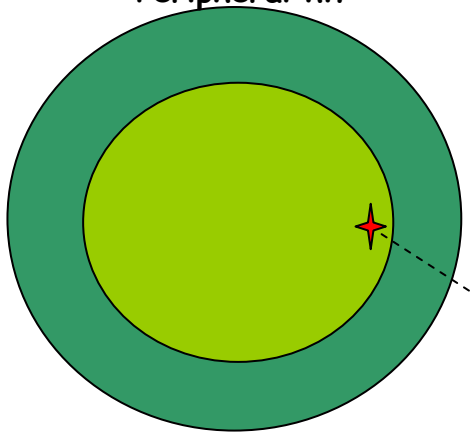
Calibrated QDC pulse height spectra

Position Reconstruction

Central hit

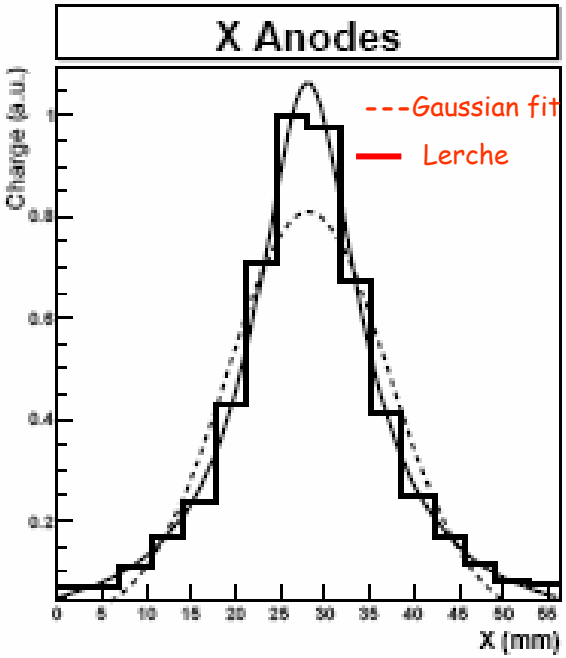


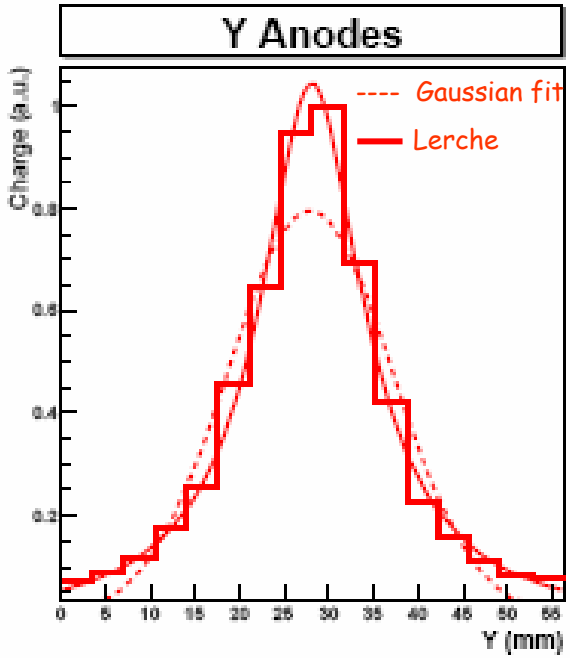
Peripheral hit

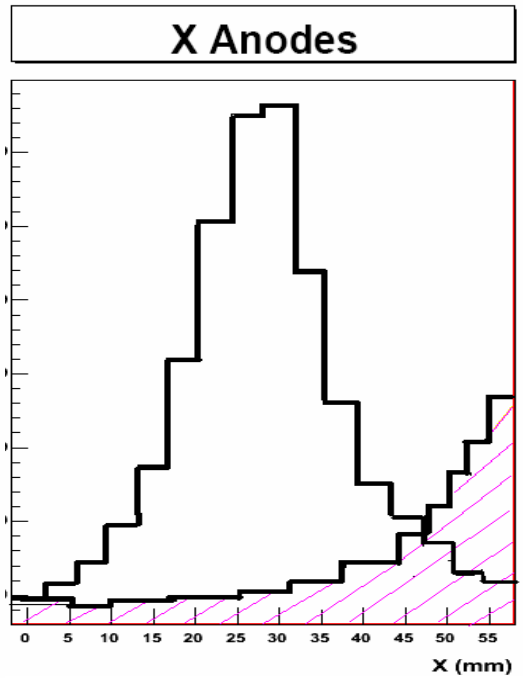


Only the tail of charge distribution is measured.

Reflections from the edge of crystal also effects the charge distribution.



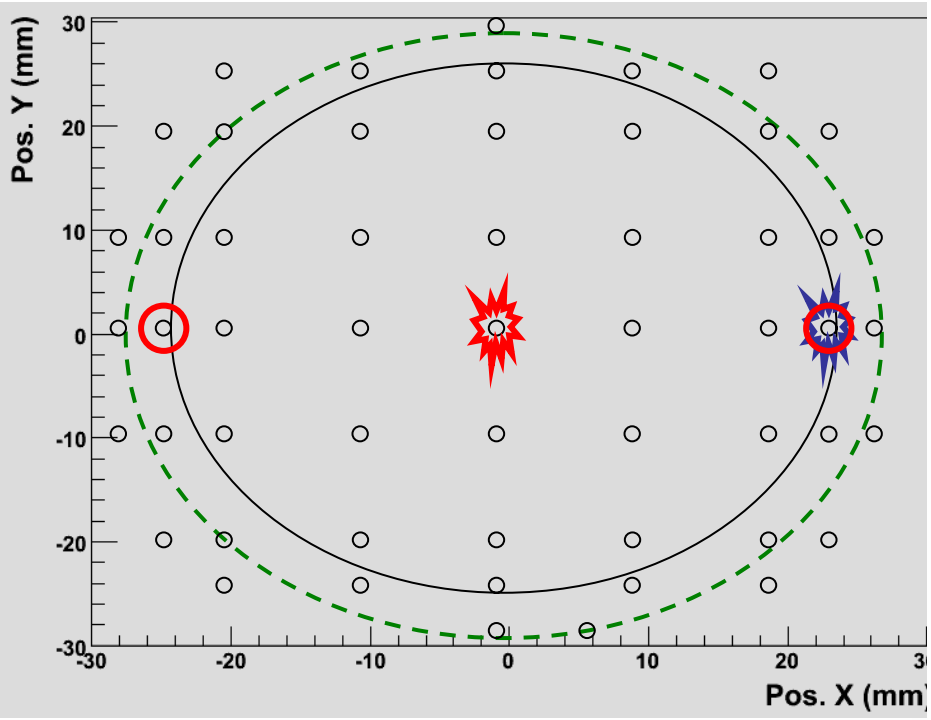




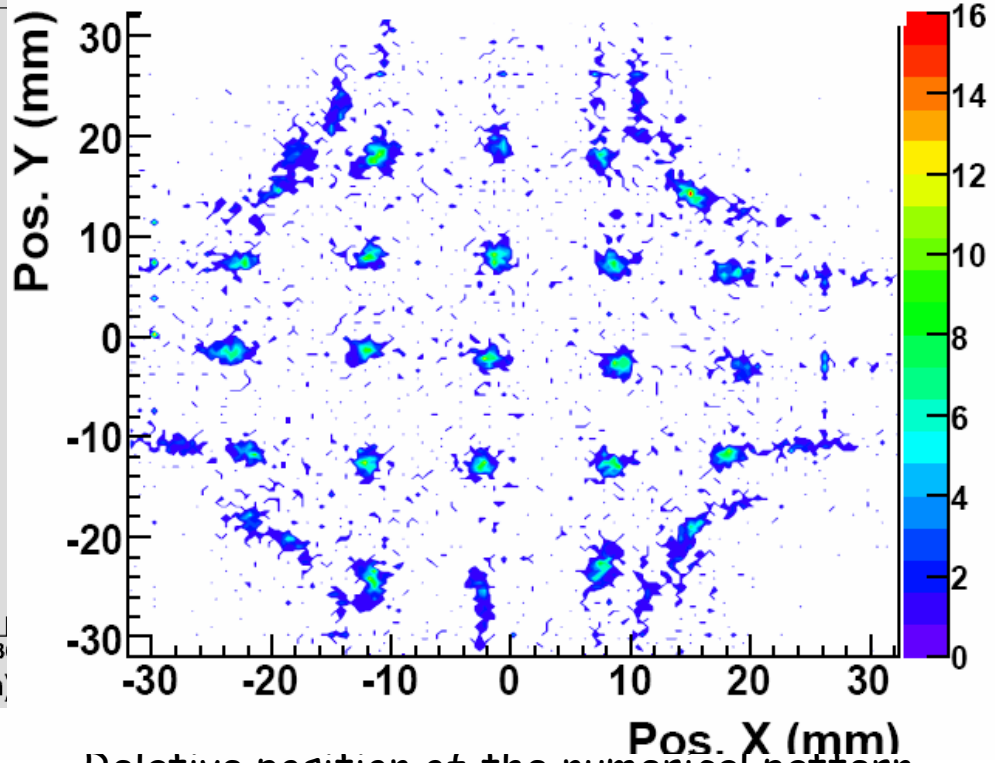
C.W.Lerche, et.al., NIM A, vol 537, pp. 326-330, Jan. 2005

Position reconstruction

Collimated Na-22 source
placed at different positions



Pattern fitting approach



Relative position of the numerical pattern
at center is changed until the pattern
matches with measured charge profile

Gaussian fitting works relatively
well in the central region

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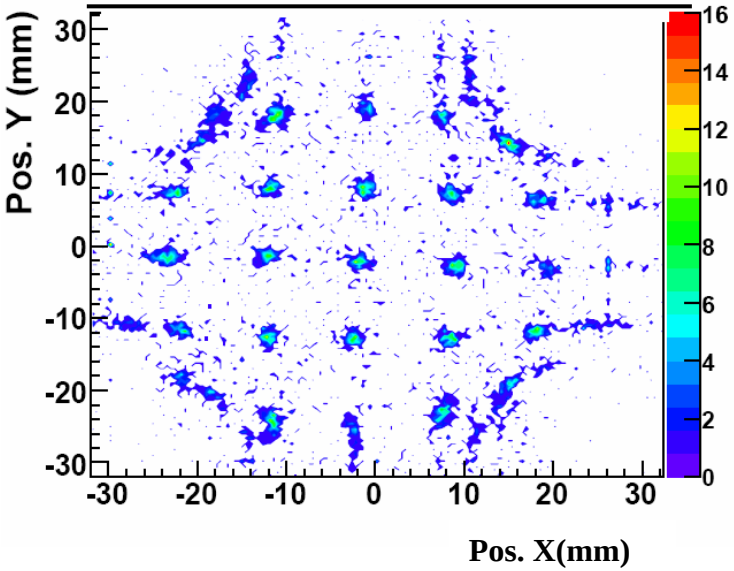
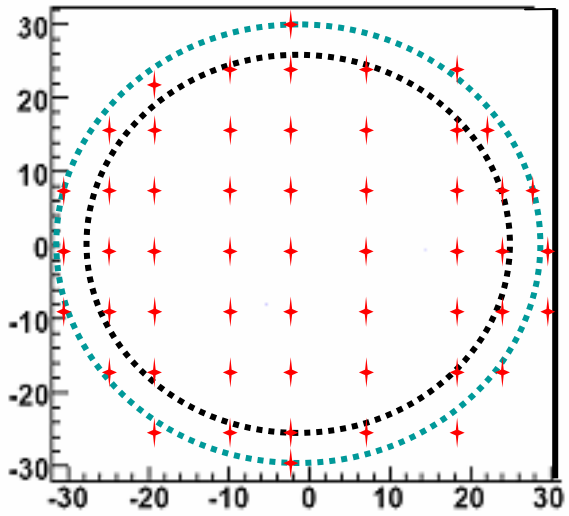
Position reconstruction:Enhanced active area



Gaussian fitting approach

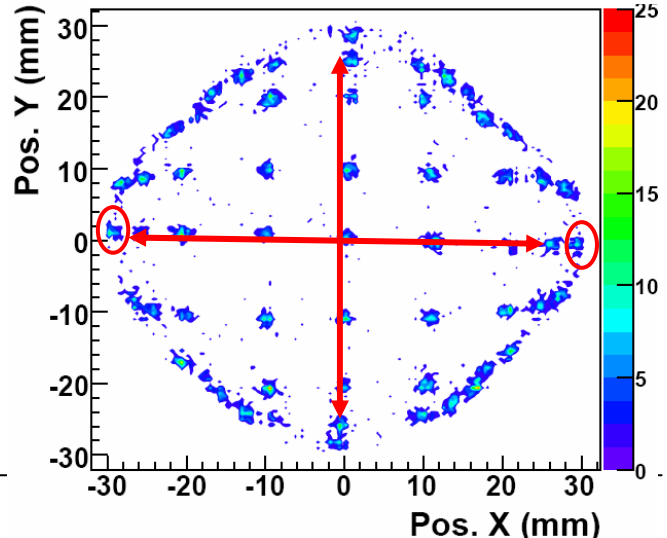


Pattern fitting approach

Diameter of photocathode = 56.25 mm

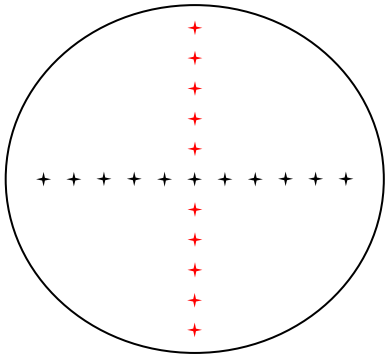
Linearity = 50 mm

Active area = 19 cm^2



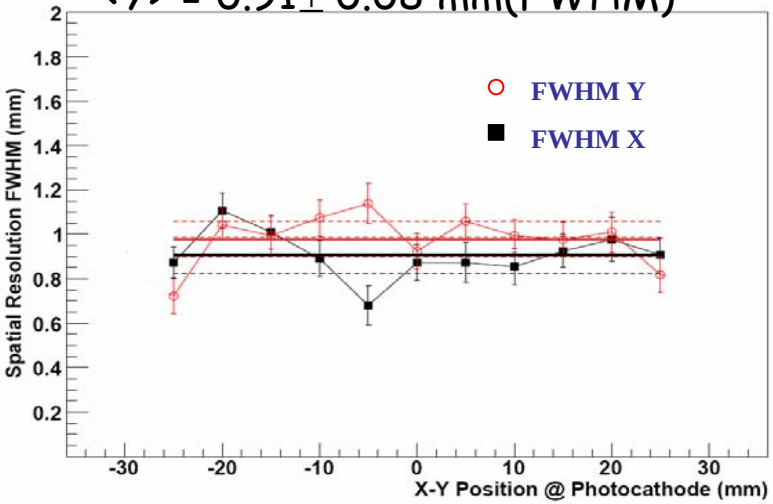
Position Resolution

Scanning with a Pb collimator(Φ = 1 mm)

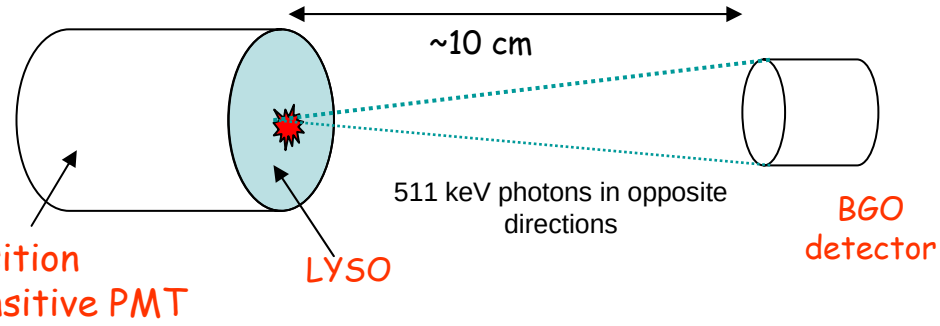


<X> = 0.98± 0.08 mm(FWHM)

<Y> = 0.91± 0.08 mm(FWHM)



Efficiency

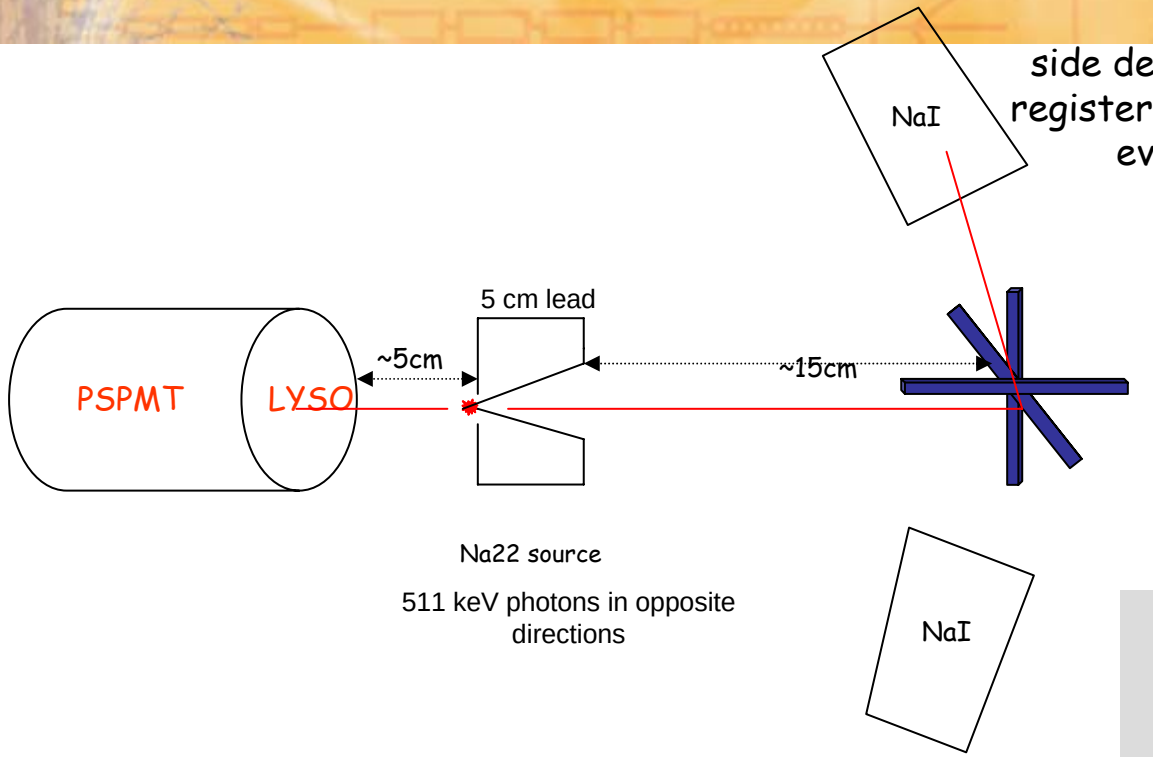


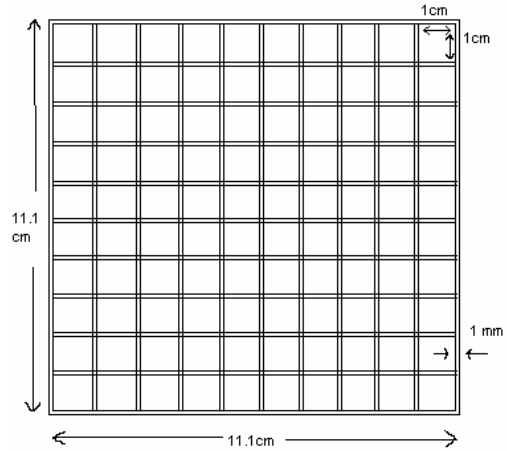
Acquisition triggered by BGO detector(LYSO self-activity)

$$\varepsilon = \frac{N(\text{coincidence})}{N(\text{singles})}$$

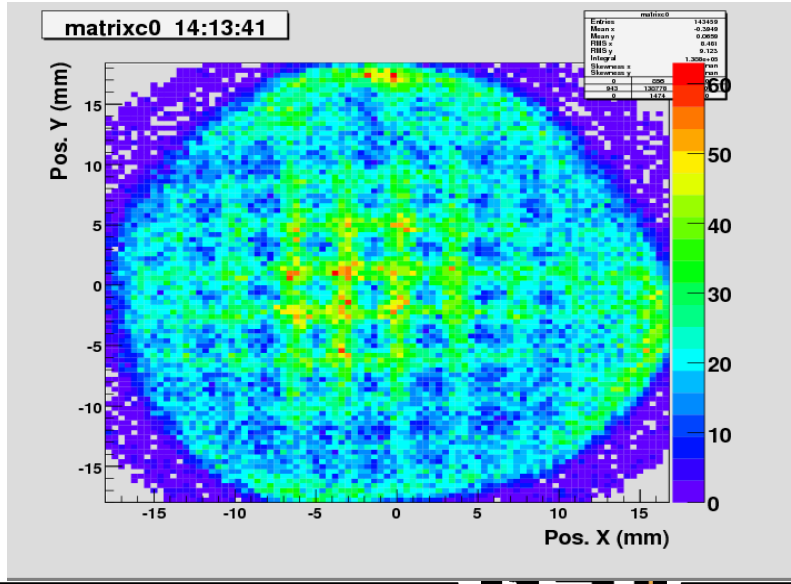
$< \varepsilon > = (7.5 \pm 0.2)\%$ @511 keV

Outlook





$$(X_m , Y_m) = F (X_r , Y_r)$$



Outlook

The complete position calibration of the gamma camera will be done using imaging techniques

Once this is done, a Germanium detector will be scanned