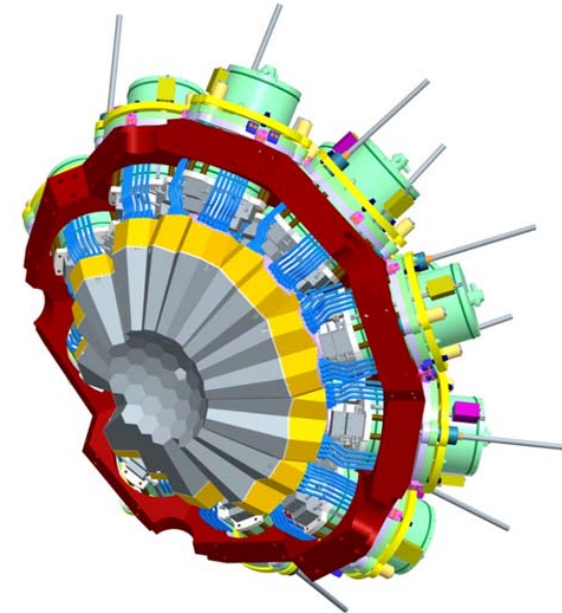


Use of the BGO Inner Ball detectors for AGATA detector characterisation

Frontiers of gamma-ray spectroscopy



Dr Andy Boston
ajboston@liv.ac.uk



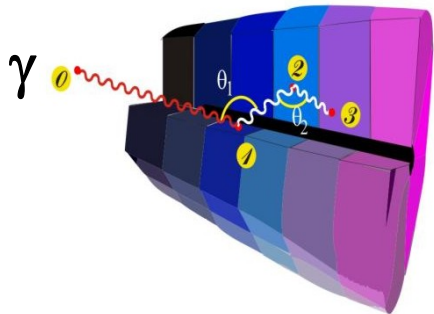
UNIVERSITY OF
LIVERPOOL



Ingredients of Gamma-Tracking

1

Highly segmented
HPGe detectors



2

Digital electronics
to record and
process segment
signals

Identified
interaction

$(x, y, z, E, t)_i$

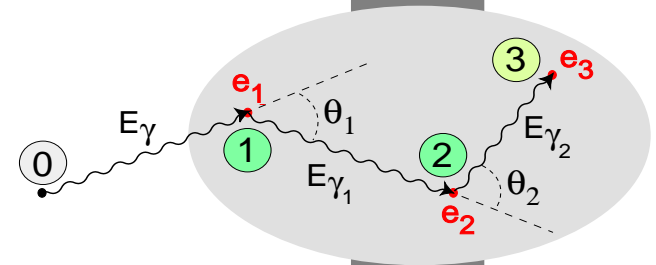
Pulse Shape Analysis
to decompose
recorded waves

3



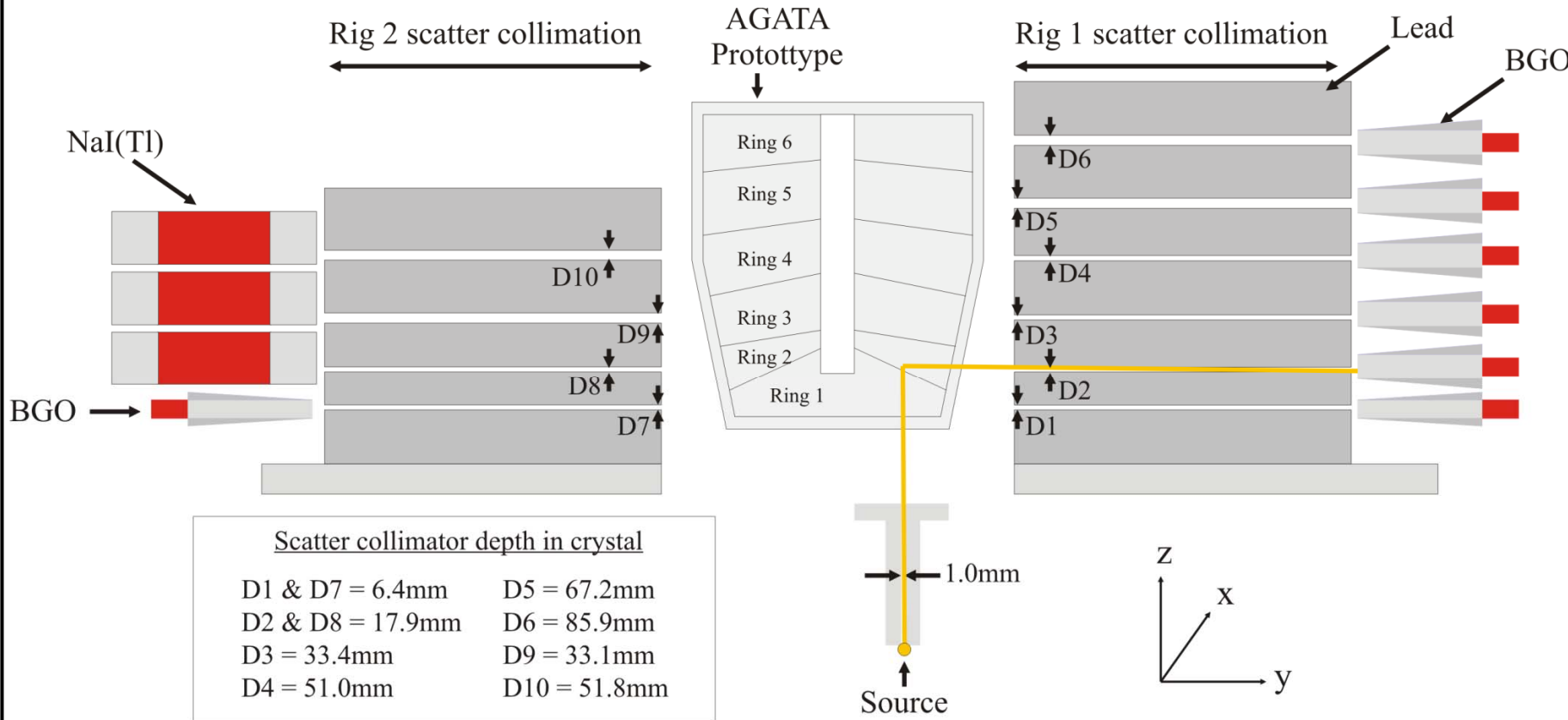
4

Reconstruction of tracks
e.g. by evaluation of
permutations
of interaction points

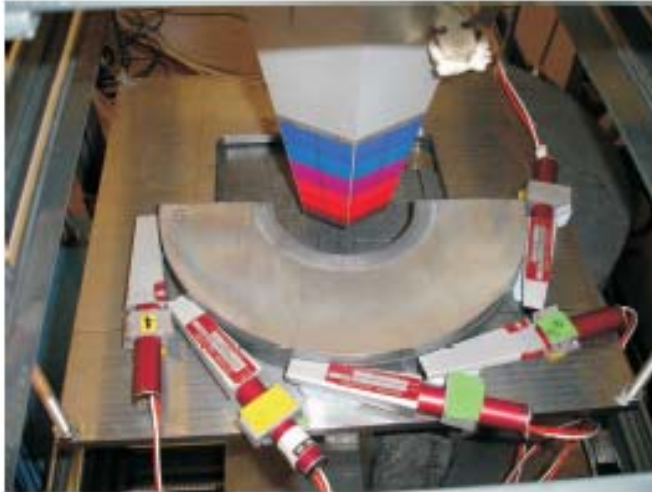


reconstructed γ -rays

AGATA Coincidence scanning



AGATA Coincidence scanning



a) Rig 1, collimation depth 1



b) Rig 1 (far) and Rig 2 (near) collimation

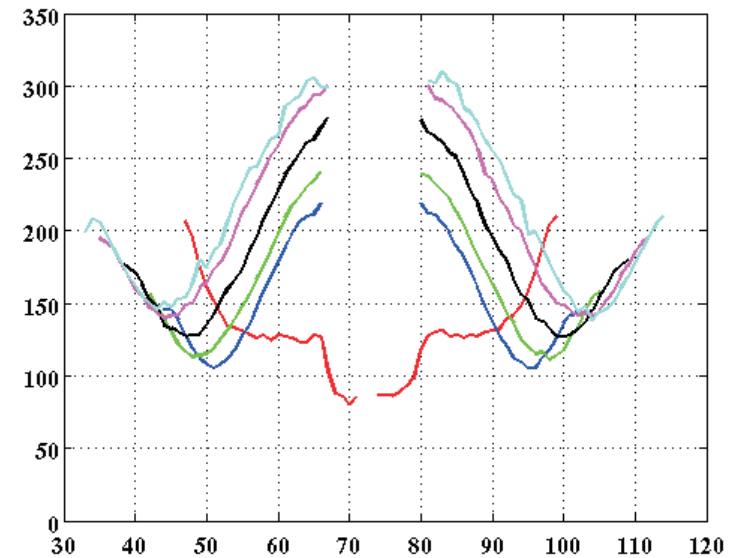
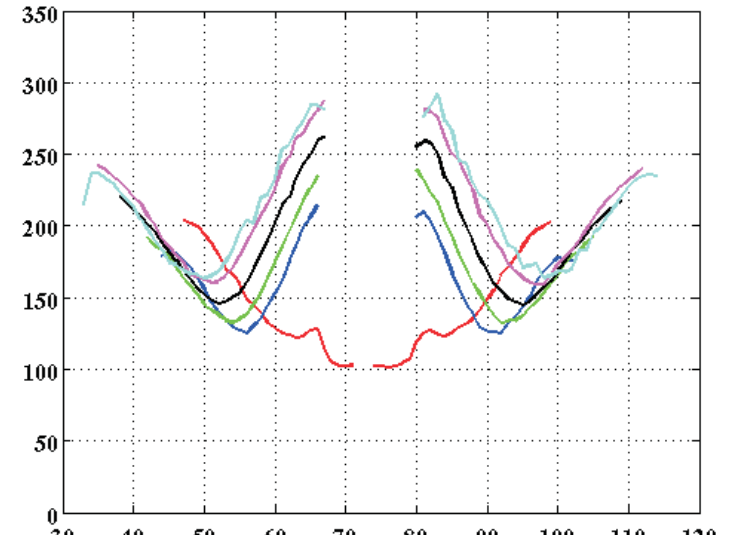
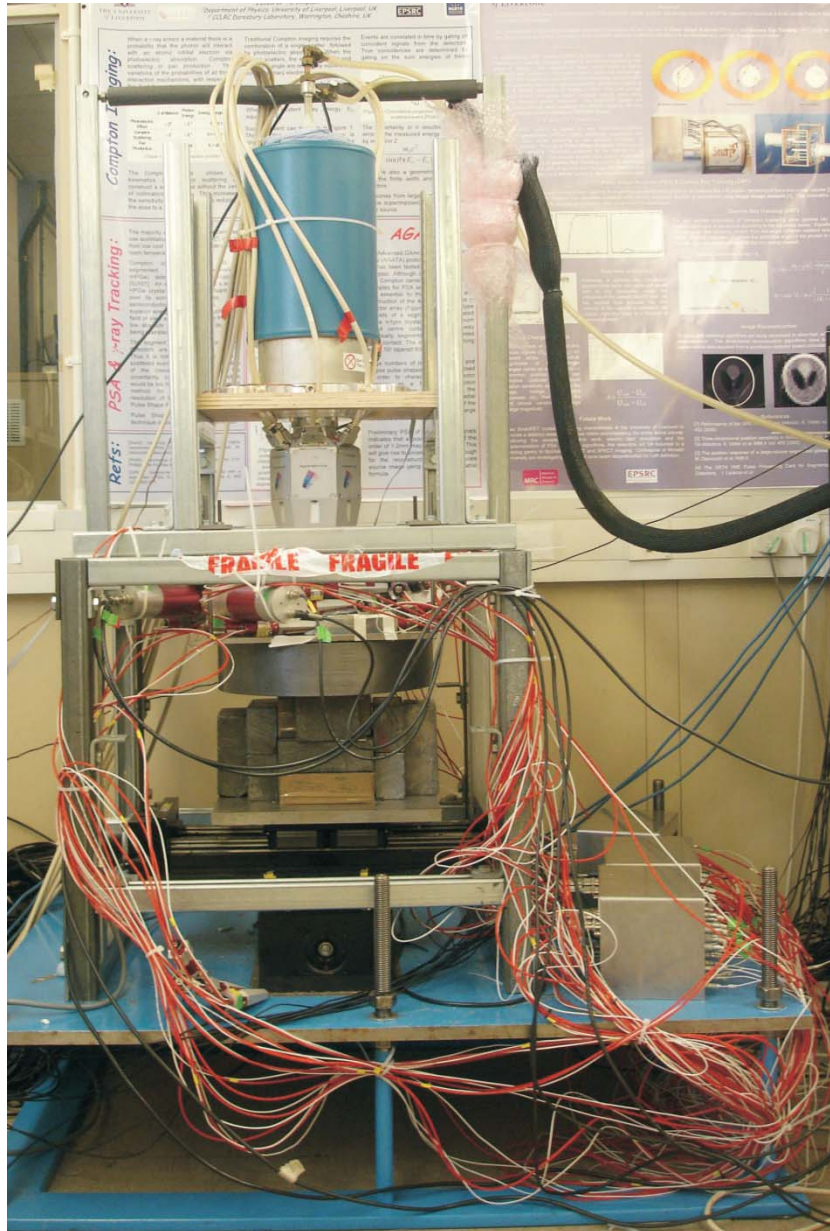


c) Rig 1 BGO detectors

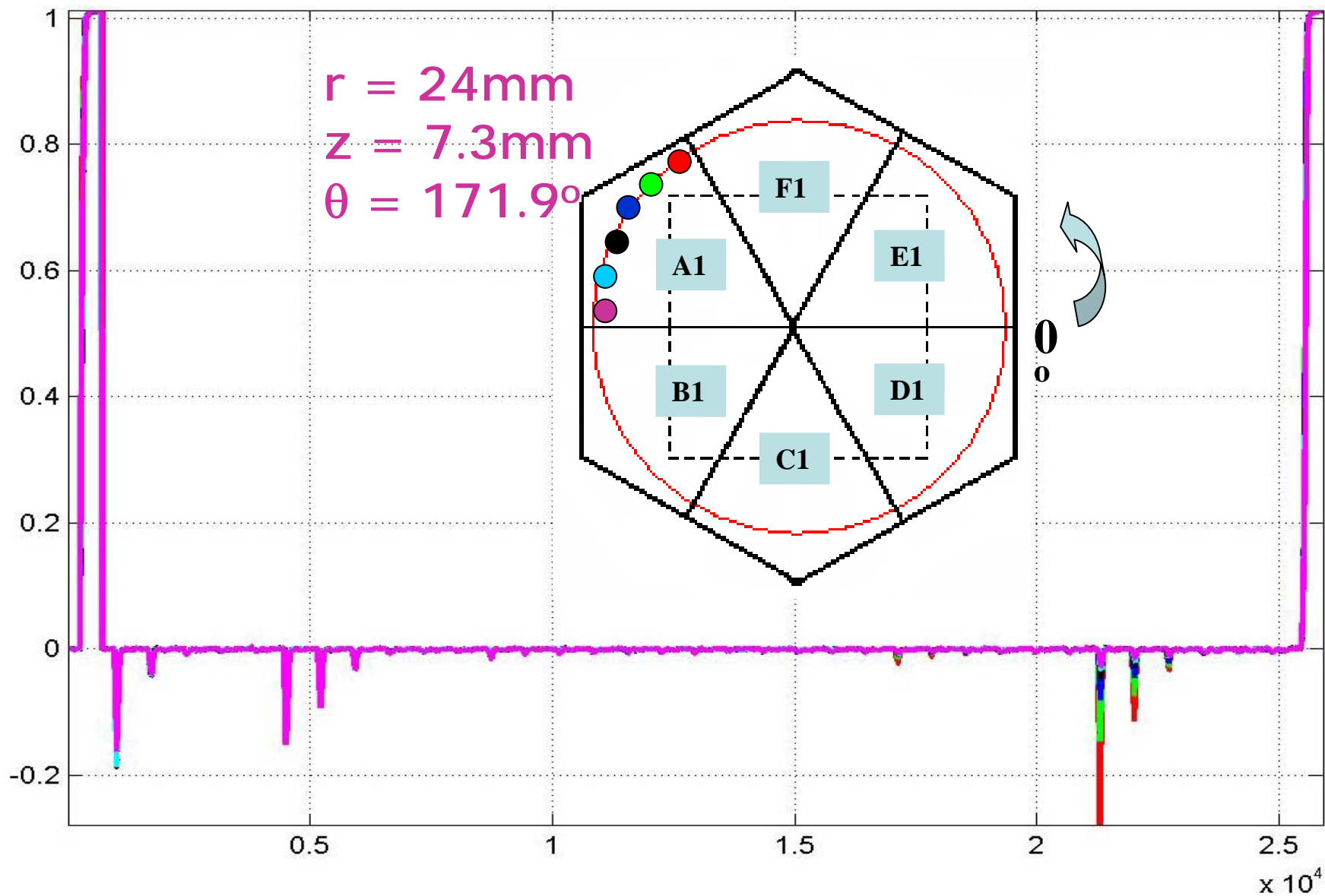


d) Rig 2 NaI(Tl) detectors

AGATA Coincidence scanning



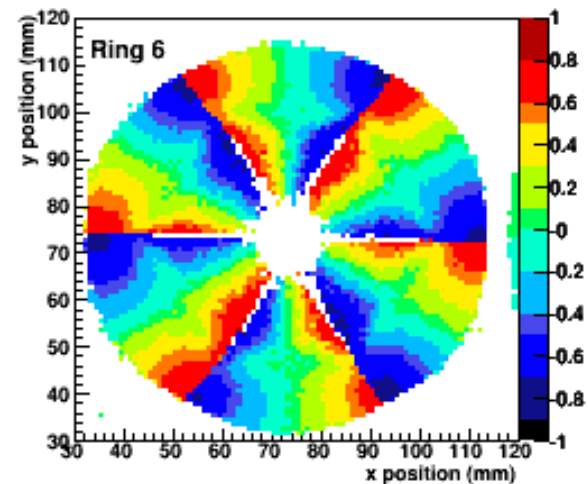
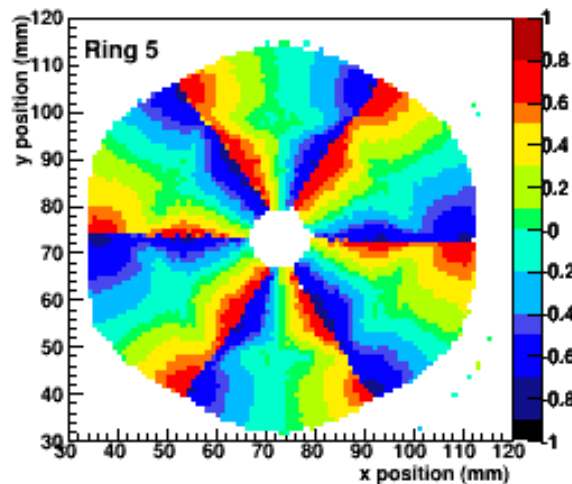
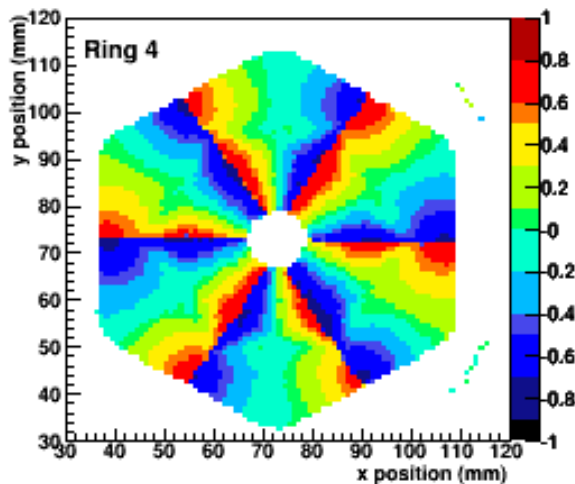
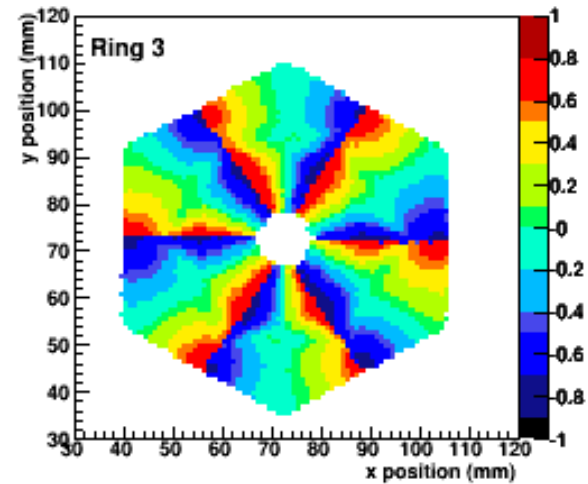
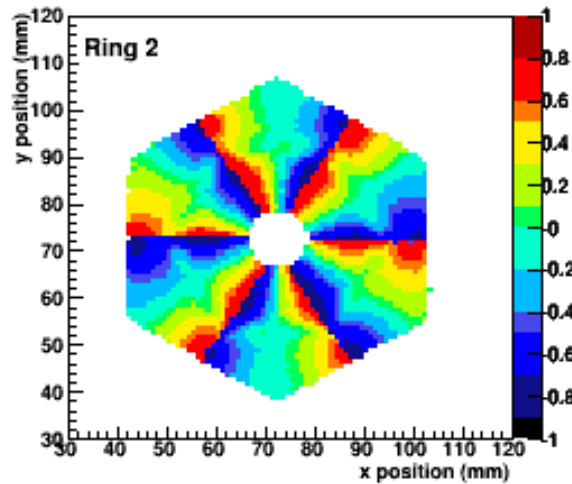
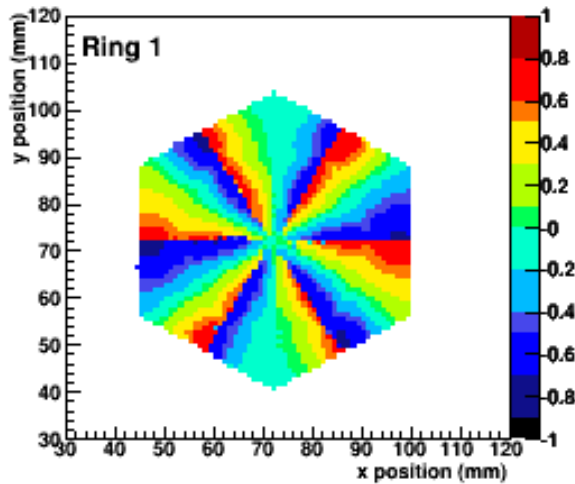
Azimuthal detector sensitivity



Azimuthal Position Information

✳ Image Charge
Asymmetry (ICA)

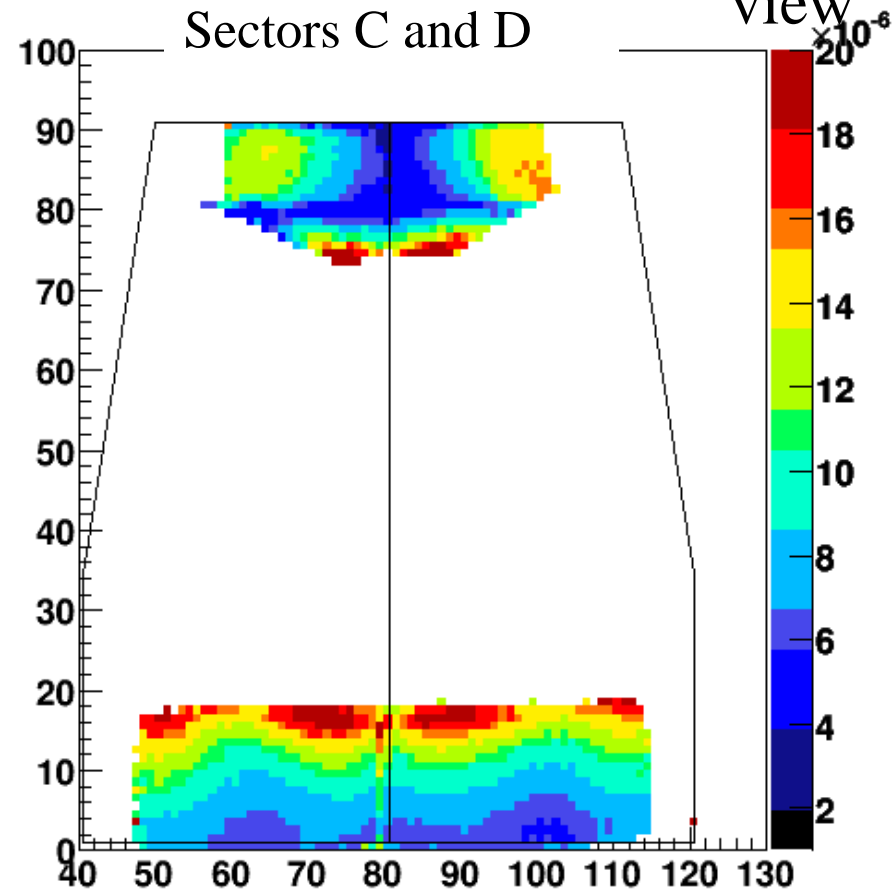
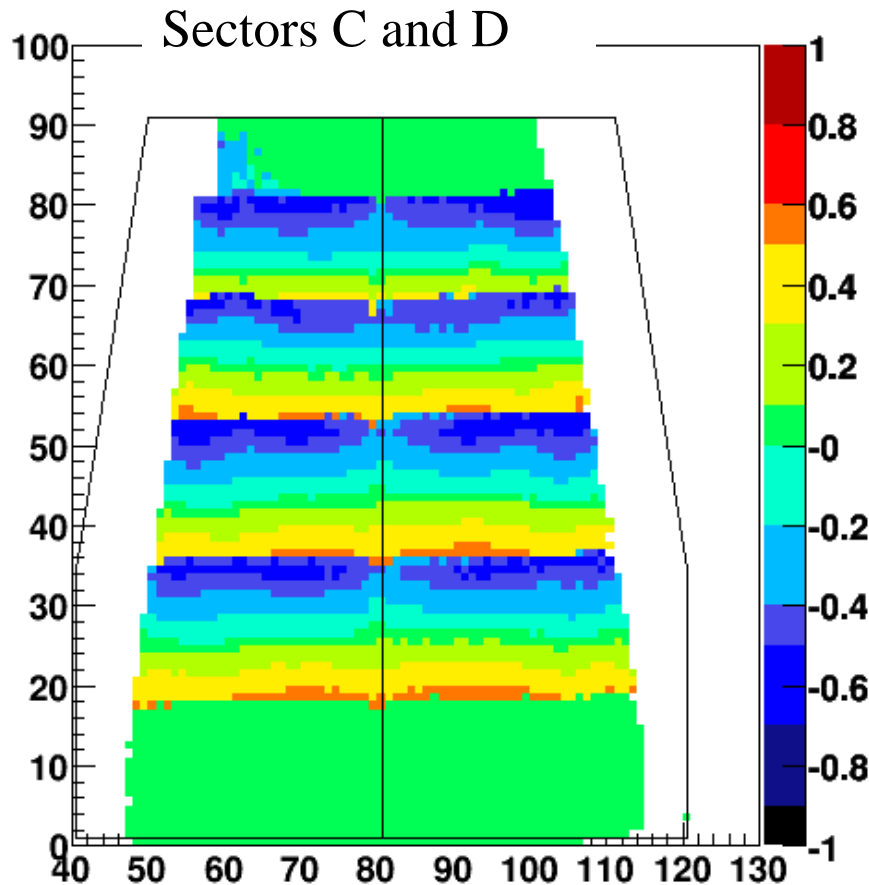
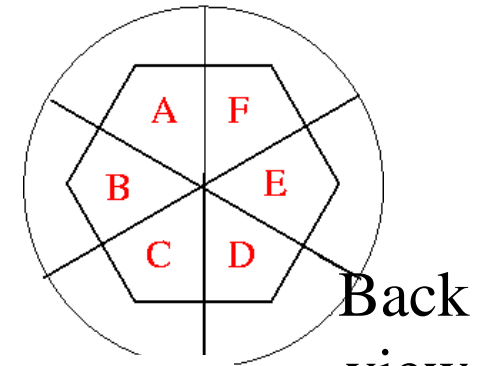
$$ICA = \frac{|A_{\text{anticlockwise}}| - |A_{\text{clockwise}}|}{|A_{\text{anticlockwise}}| + |A_{\text{clockwise}}|}$$



Depth Information

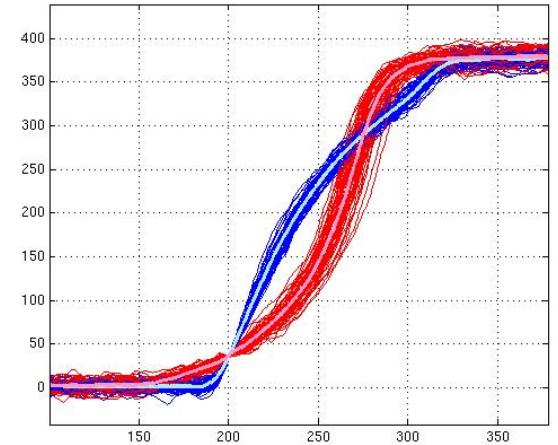
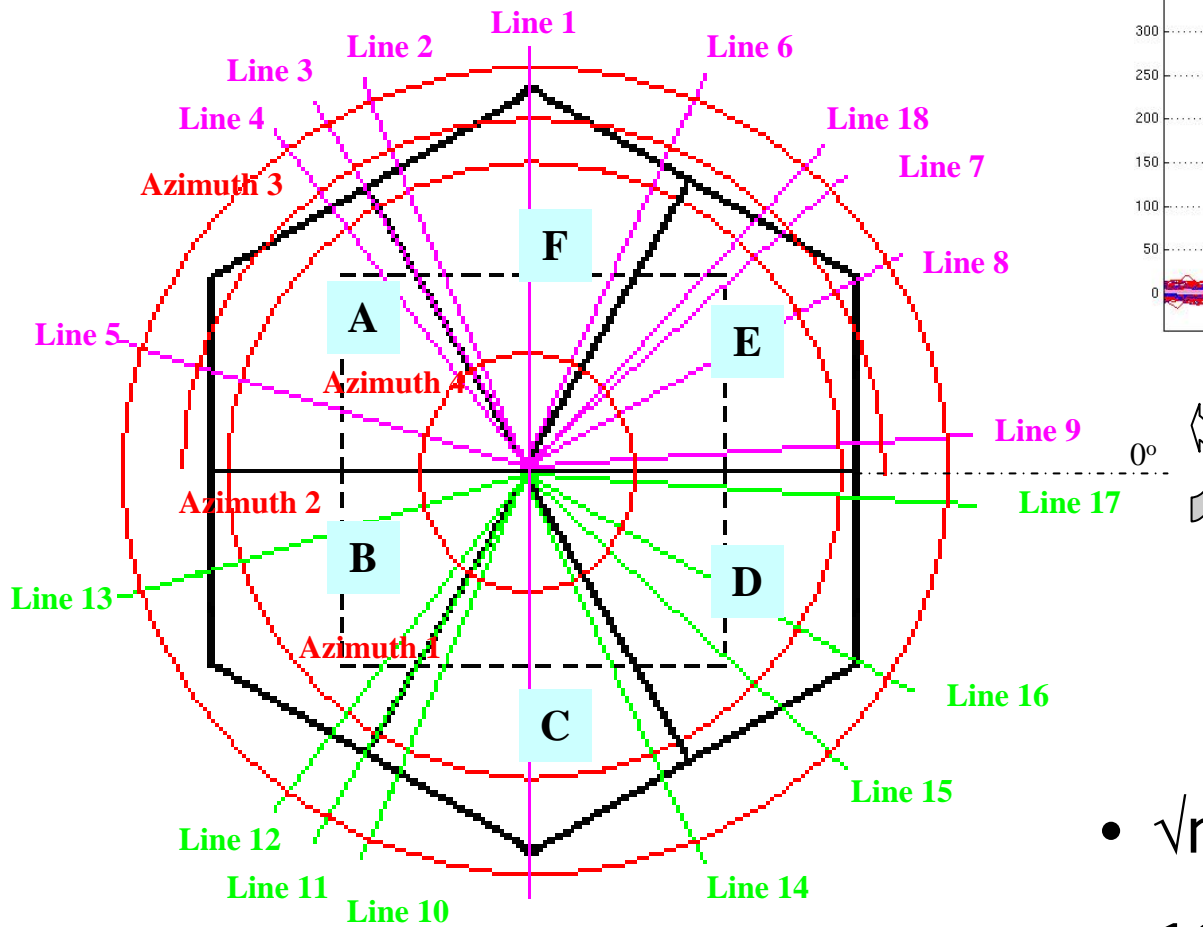
* Vertical Image Charge Asymmetry

$$ICA = \frac{|A_{\text{above}}| - |A_{\text{below}}|}{|A_{\text{above}}| + |A_{\text{below}}|}$$



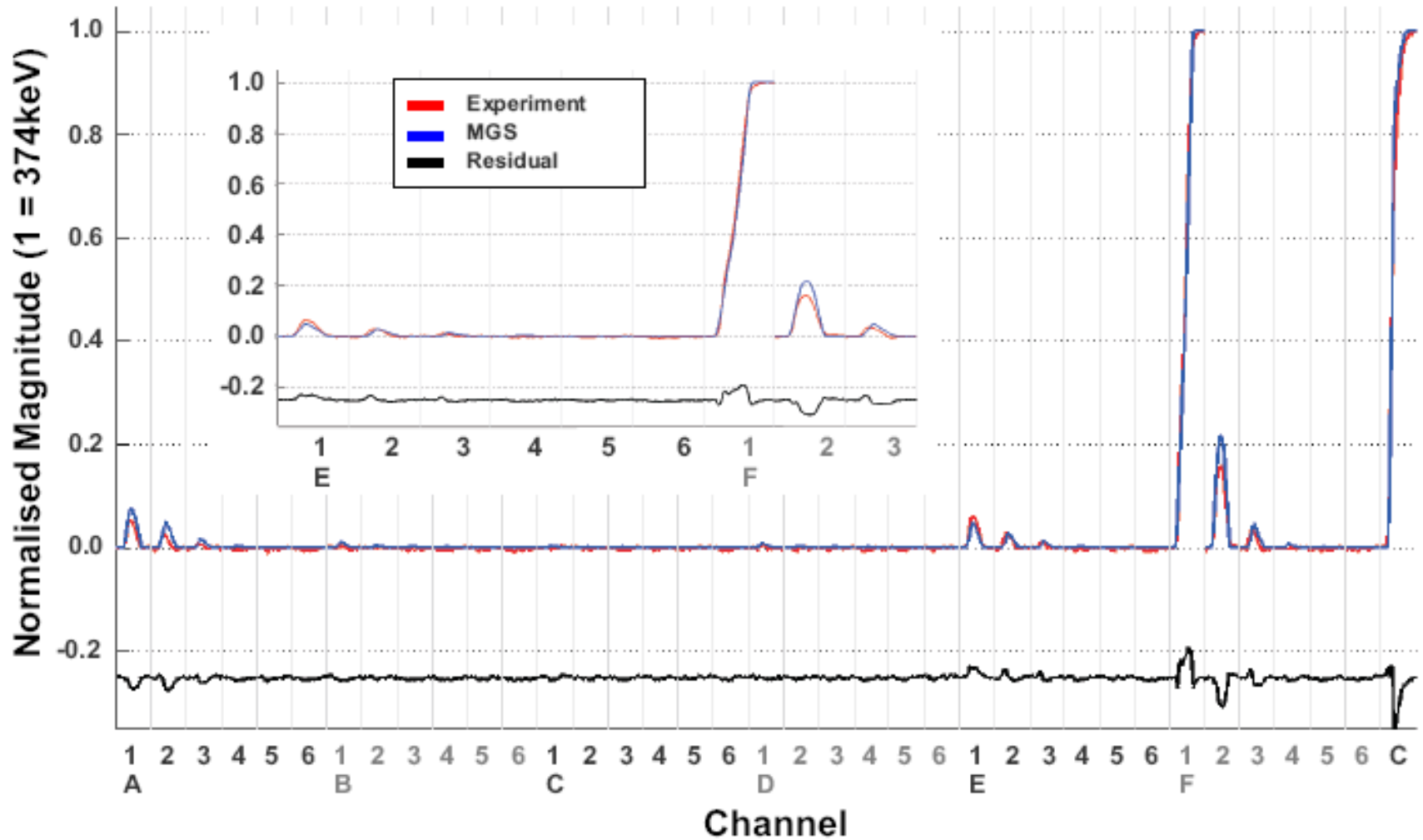
AGATA Coincidence scanning

- 16 radial scans + 4 azimuthal scans



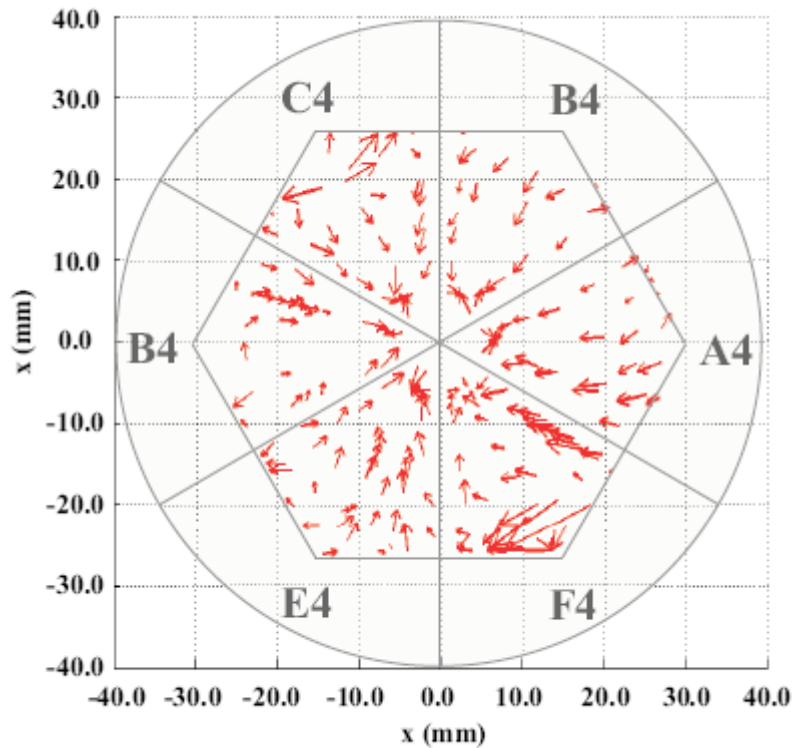
- $\sqrt{r, \theta}$ grid adopted
- 1200 positions

"Superpulse generation"

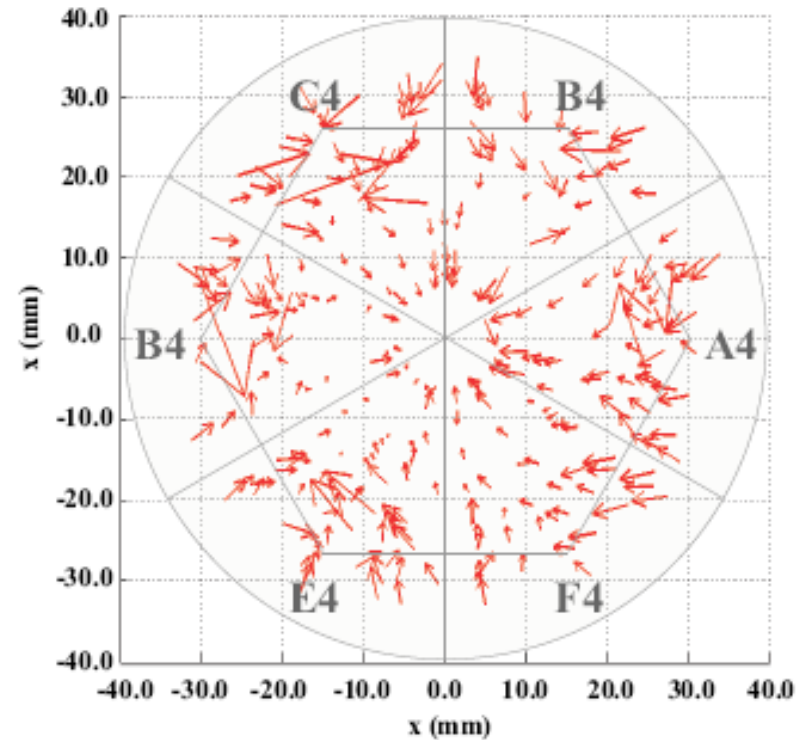


Zone 2, $x = 5.7 \pm 0.7 \text{mm}$, $y = -9.4 \pm 0.7 \text{mm}$, $z = 15.7 \pm 0.3 \text{mm}$.

Experiment vs Theory Performance



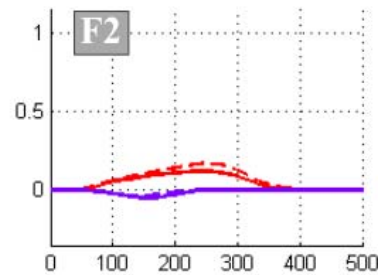
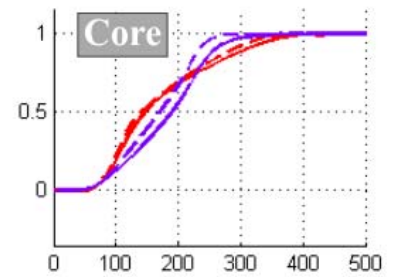
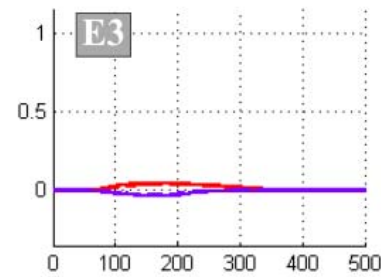
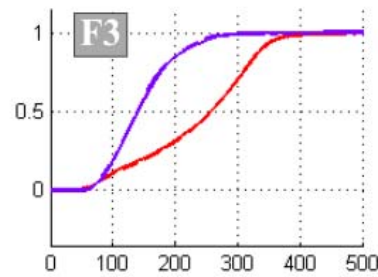
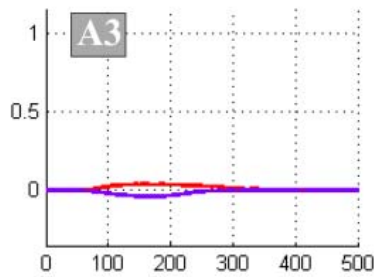
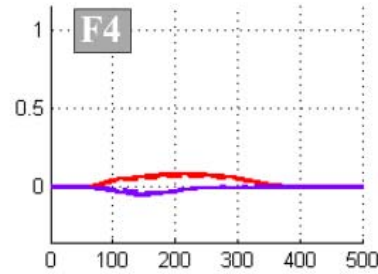
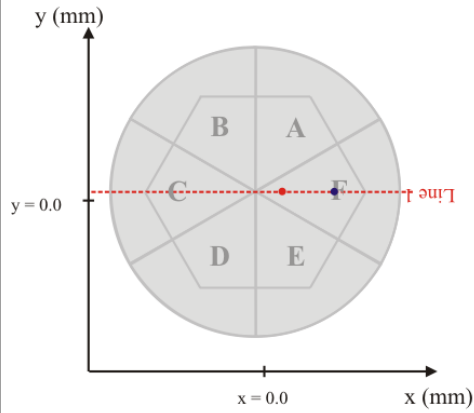
a) Displacement vectors, $z = 4.8 \pm 0.3 \text{ mm}$



a) Displacement vectors, $z = 48.8 \pm 0.9 \text{ mm}$

Depth (mm)	Ring	Min Displacement (mm)	Max Displacement (mm)	<Displacement (mm)>
4.2 ± 0.3	1	0.1 ± 0.4	11.9 ± 0.4	2.2 ± 0.4
15.7 ± 0.3	1	0.2 ± 0.6	17.3 ± 0.6	2.7 ± 0.6
48.8 ± 0.3	4	0.1 ± 0.7	17.0 ± 0.7	2.6 ± 0.7

Reproducibility: S002 and S003



- This work would not have been possible without the BGO detectors.
- Plan for 2008:
 - Coincidence scan of the first asymmetric detector [Liverpool May– August 2008].
 - Provide key PSA database validation.
 - Compare and correct the experimental/simulated signals with MGS and other codes

