Tests of SensL ArraySM-4 with 4ch AiT readout

Two stacked and shifted 1.5mm pitch and 10mm thick LYSO arrays

Gamma beam from top (scintillator side)

Gamma beam from bottom (SiPM side)
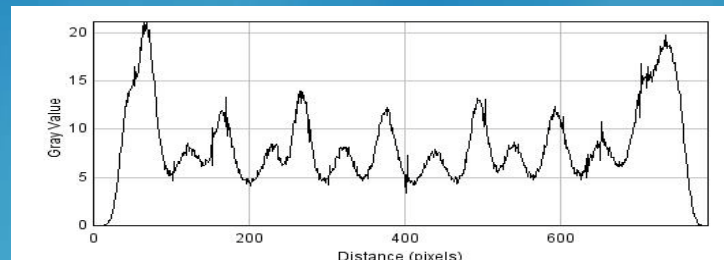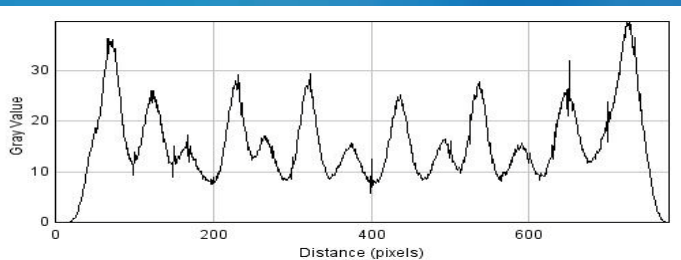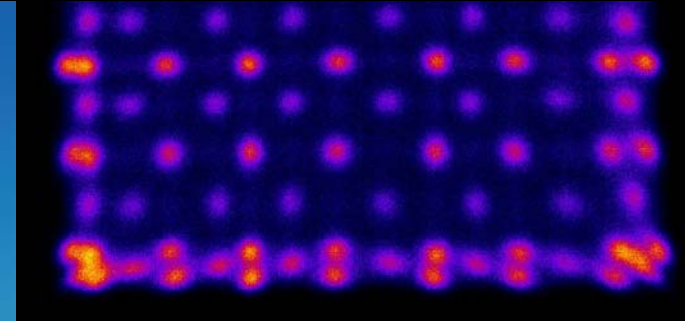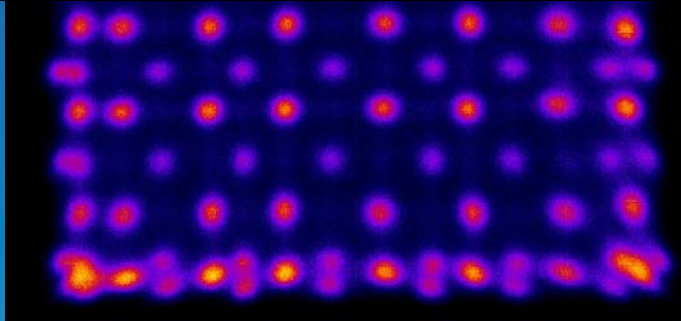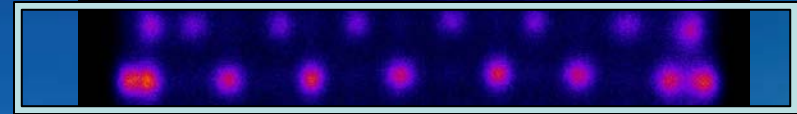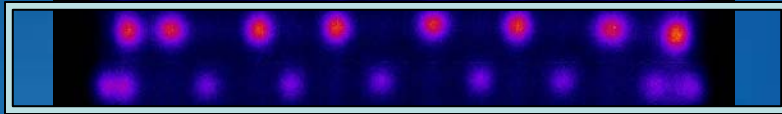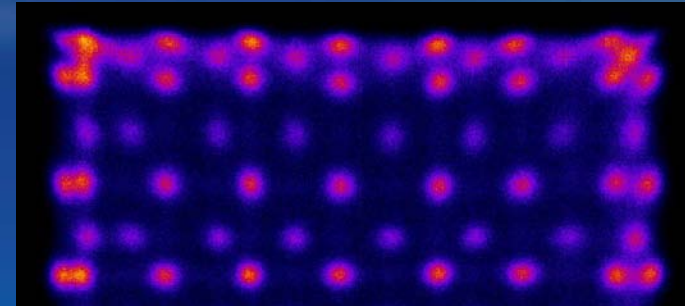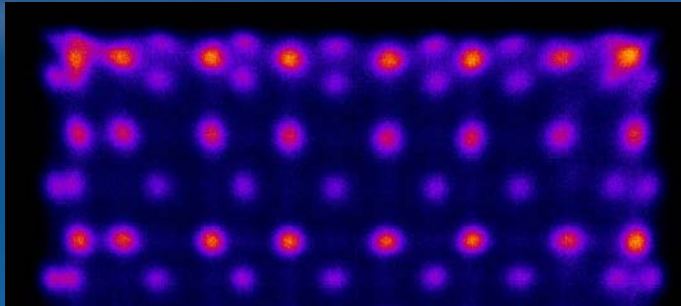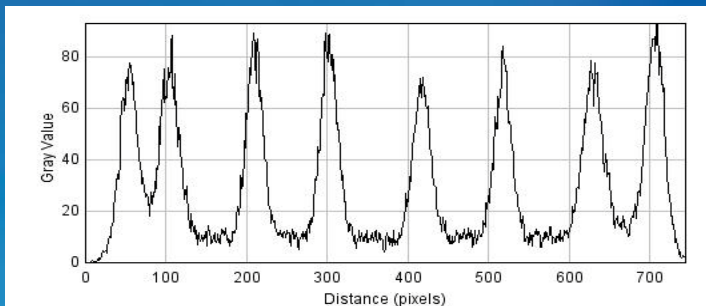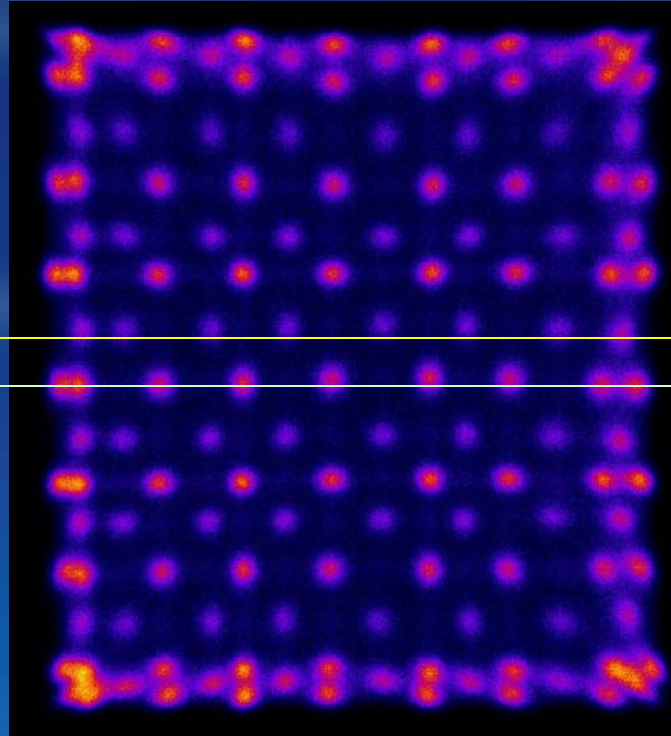

Raw flood images and profile examples. Spreader window 0.96mm. COG truncation factor 0.175. ADC gate width 195ns. Bias at 30.3 V.
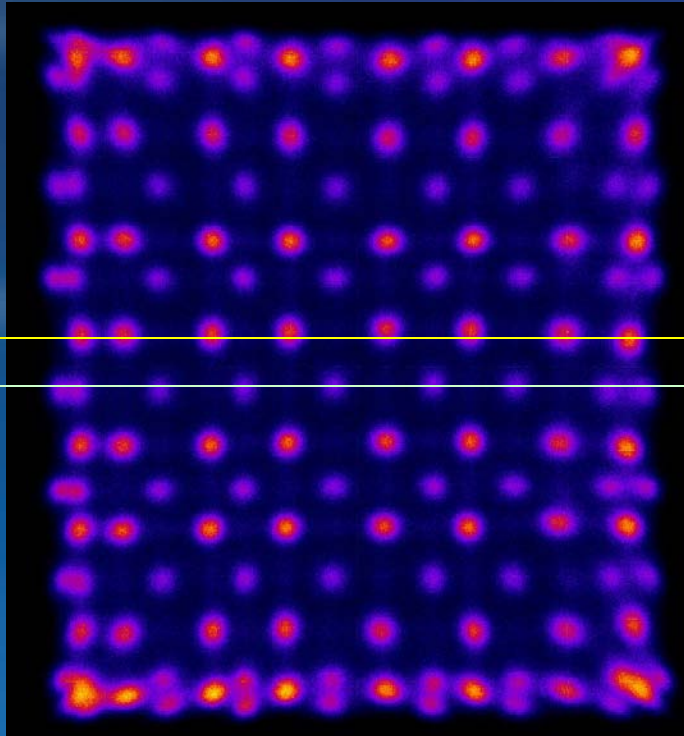
Top array row
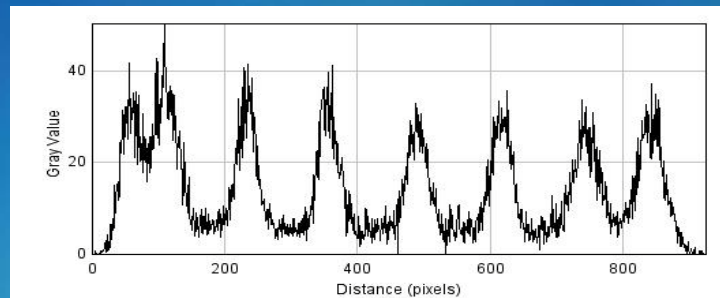
Bottom array row
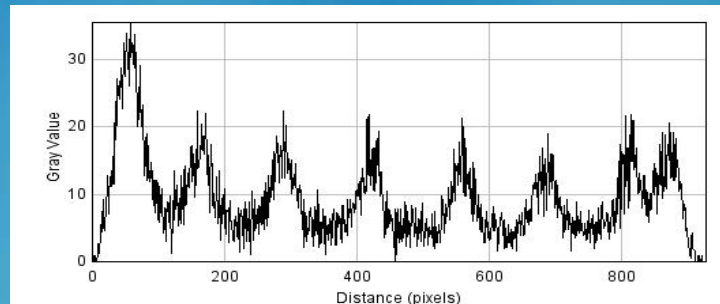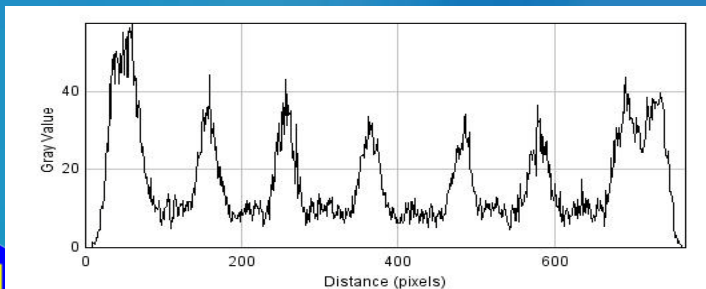
Continued from the previous page. Left: top beam. Right: bottom beam.

Gamma beam from top (scintillator side)

ROI region:
4
1
5
2
3

15.8%
16.4%
23.3%
19.3%
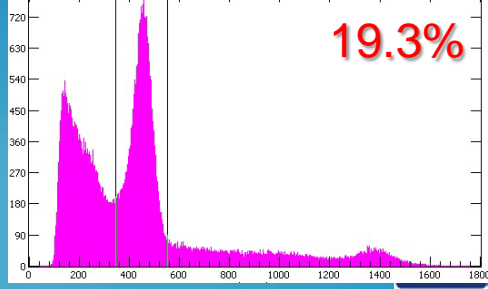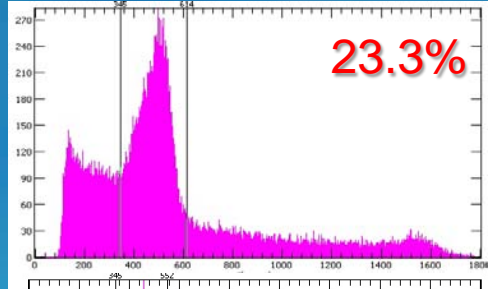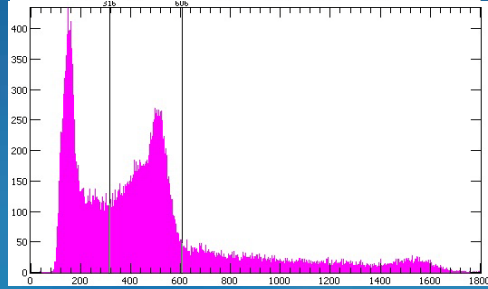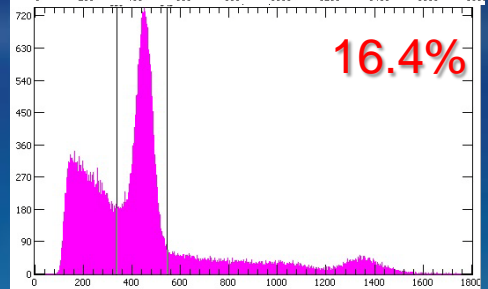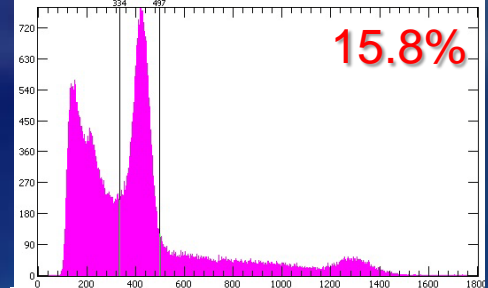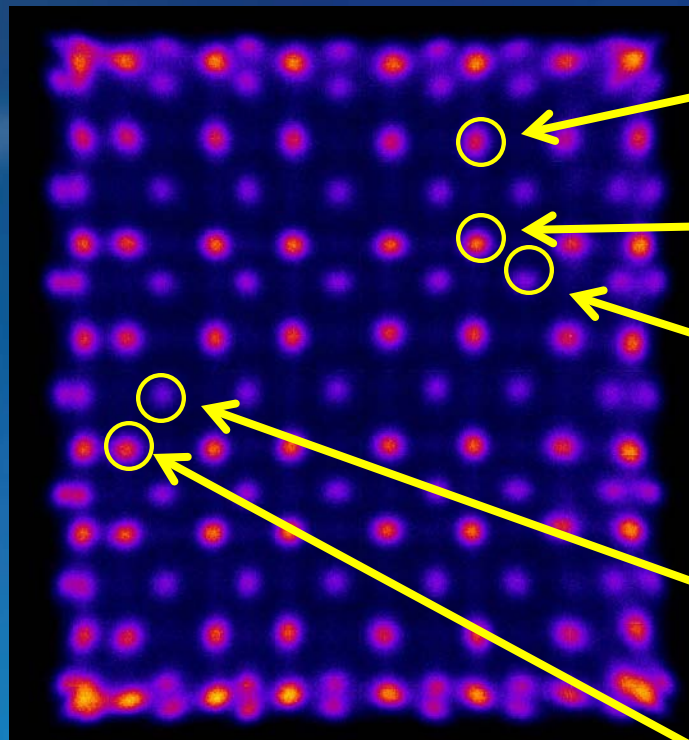
Continued from the previous page. Energy spectra for selected five pixels. FWHM values @ 511 keV.

Gamma beam from bottom (SiPM side)

ROI region:

4
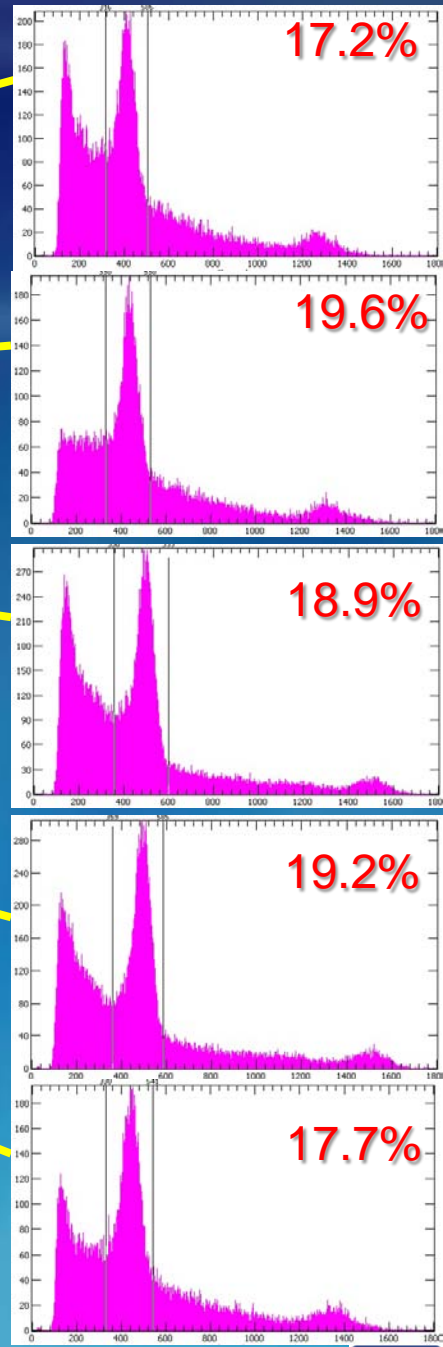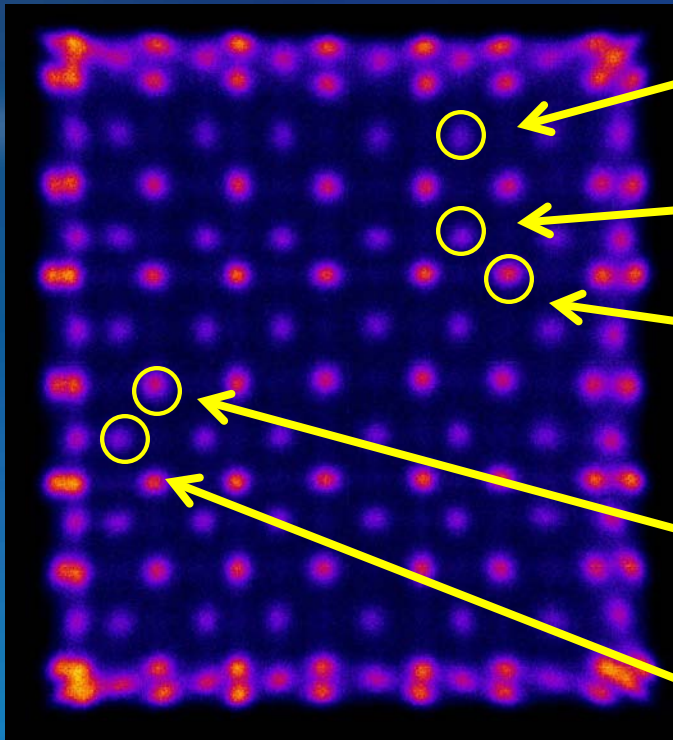
1

5

2

3

17.2%

19.6%

18.9%

19.2%

17.7%

Continued from the previous page. Energy spectra for selected pixels. FWHM values @ 511 keV.

Gamma beam from the bottom (SiPM side)

ROI region:

↓
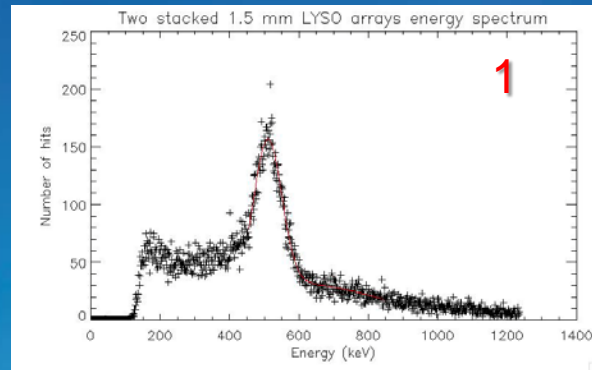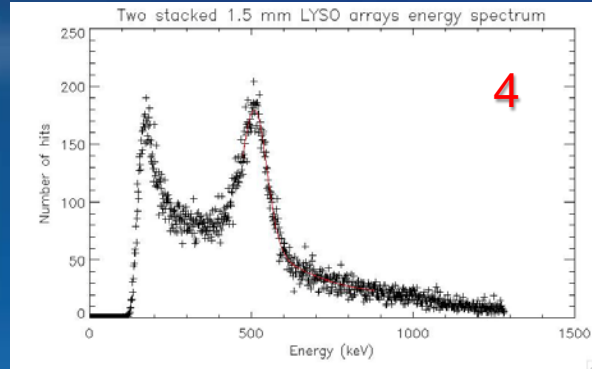
1 - 18.3%
2 - 17.5%
3 - 17.1%
4 - 16.9%
5 - 15.5%
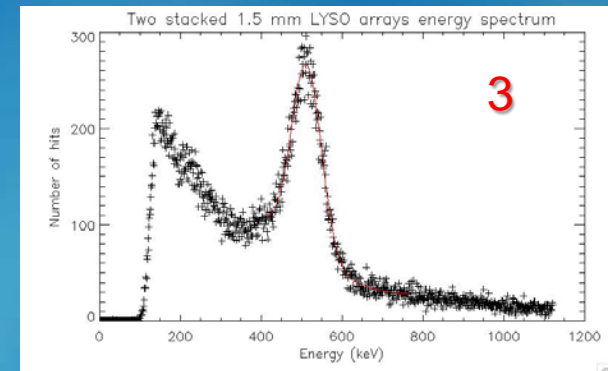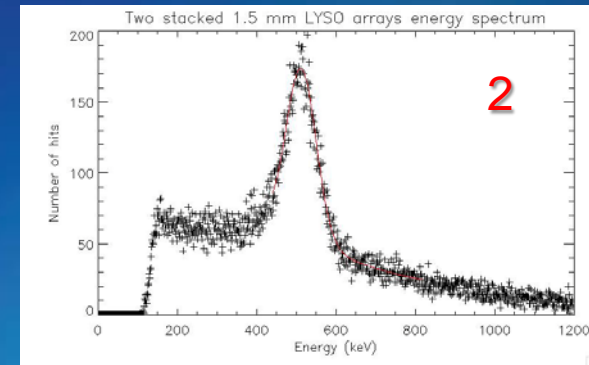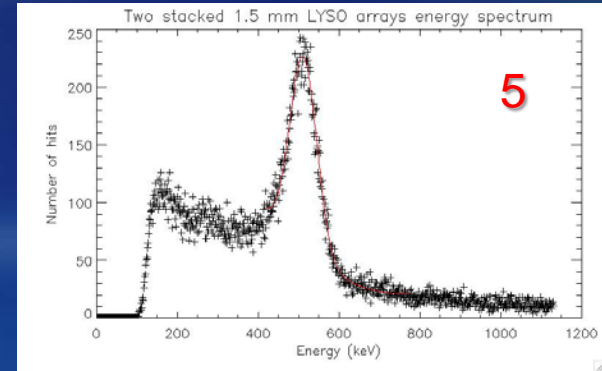
Continued from the previous page. Energy spectra for selected pixels. FWHM values @ 511 keV obtained using Gaussian and polynomial fit.

Tests of SensL ArraySM-4 with 4ch AiT readout

Measurements with 1mm pitch 10mm thick LYSO array (selected for bottom array)

ROI region:
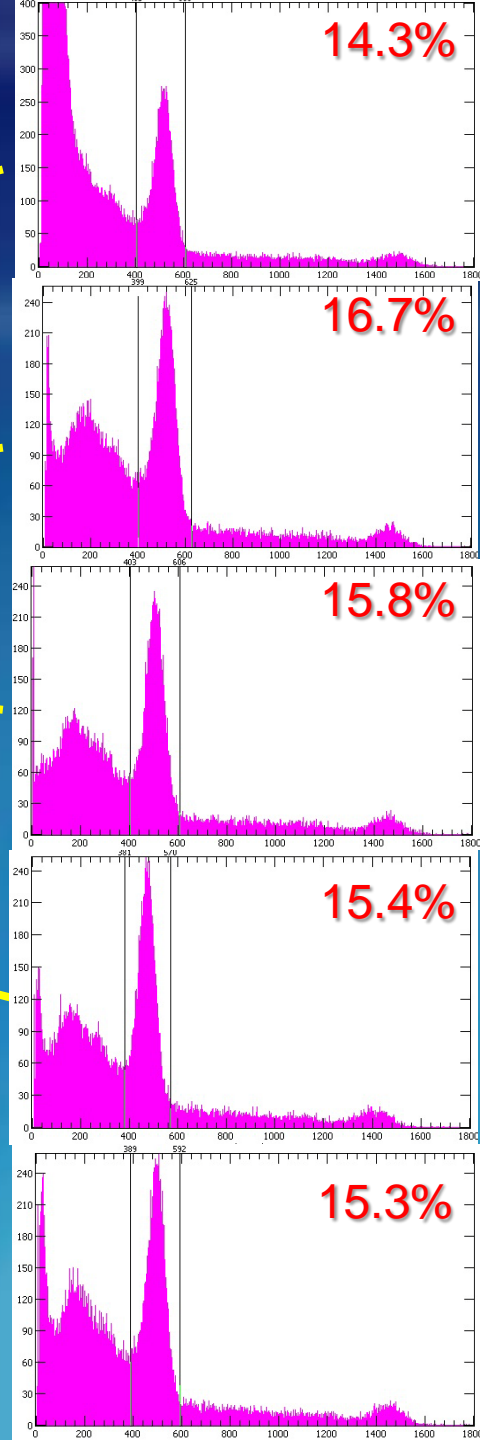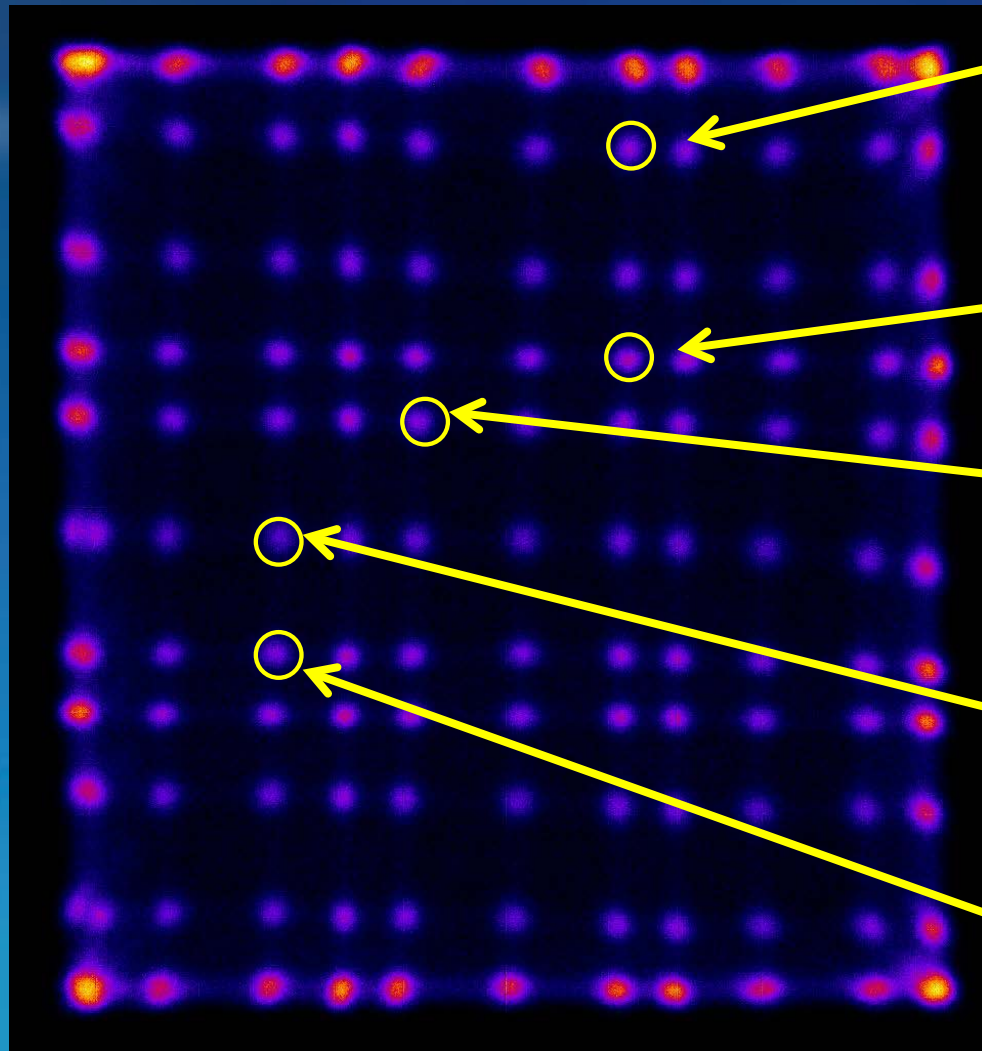
4

1

5

2

3

14.3%

16.7%

15.8%

15.4%

15.3%

Raw flood image and energy spectra for five selected pixels. FWHM values @511 keV. Spreader window 0.96mm. COG truncation factor 0.2. ADC gate width 195ns. Bias at 30.3 V.

Two stacked and 0.5mm x-y shifted 1.0mm pitch, 5mm (top) and 10mm (bottom) thick LYSO arrays

10mm array (left)
5mm array (right)

Raw flood images and profiles through four selected pixel rows. Spreader window 0.96mm. COG truncation factor 0.2. ADC gate width 195ns. Bias at 30.3 V.

Tests of SensL ArraySM-4 with 4ch AiT readout

Two stacked and 0.5mm x-y shifted 1.0mm pitch, 5mm (top) and 10mm (bottom) thick LYSO arrays. Beam from top.

20.1%

4   **Top 5mm**

15.5%

1   **Top 5mm**

16.6%

5   **Bottom 10mm**

19.1%

2   **Bottom 10mm**

18.1%

3   **Top 5mm**
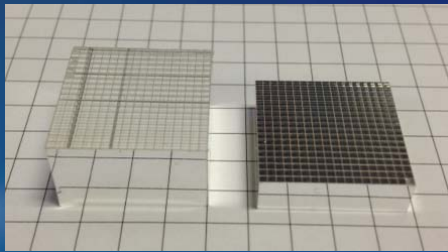
Raw flood image and energy spectra for five selected pixels. FWHM values @511 keV. Spreader window 0.96mm. COG truncation factor 0.2. ADC gate width 195ns. Bias at 30.3 V.

Tests of SensL ArraySM-4 with 4ch AiT readout

Two stacked and 0.5mm x-y shifted 1.0mm pitch, 5mm (top) and 10mm (bottom) thick LYSO arrays. Beam from bottom.

4 — **Top 5mm** — 29.4%

1 — **Top 5mm** — 22.5%

5 — **Bottom 10mm** — 17.2%

2 — **Bottom 10mm** — 14.9%

3 — **Top 5mm** — 26.0%

Raw flood image and energy spectra for five selected pixels. FWHM values @511 keV. Spreader window 0.96mm. COG truncation factor 0.2. ADC gate width 195ns. Bias at 30.3 V.
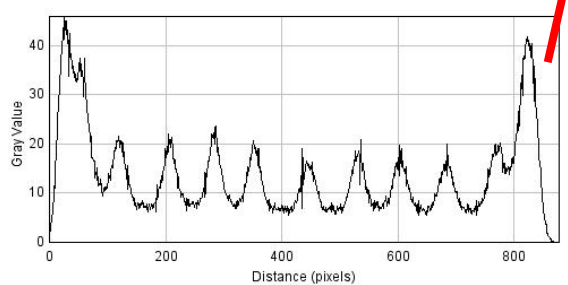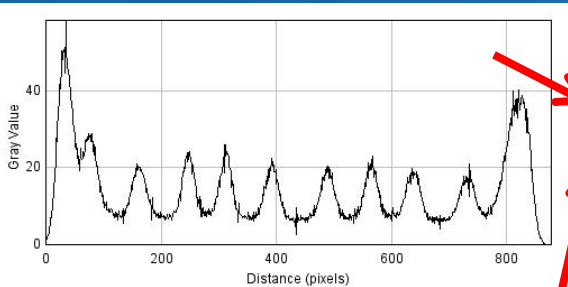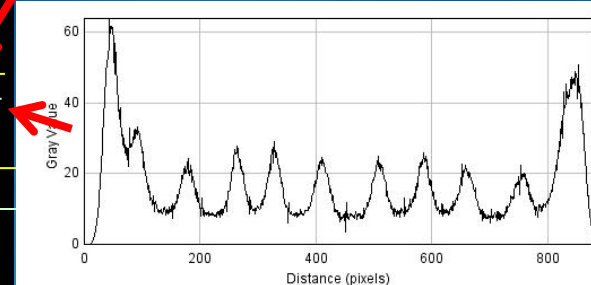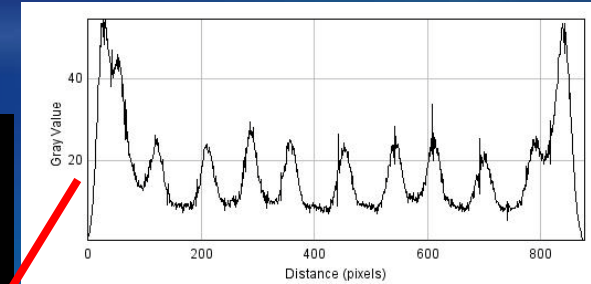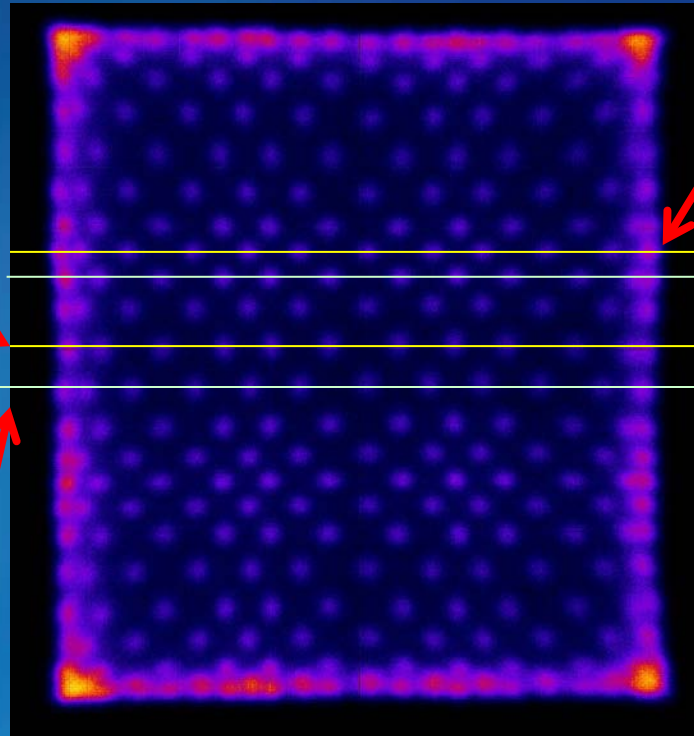
Tests of SensL ArraySM-4 with 4ch AiT readout

Two stacked and 0.5mm x-y shifted 1.0mm pitch, 5mm (top) and 10mm (bottom) thick LYSO arrays

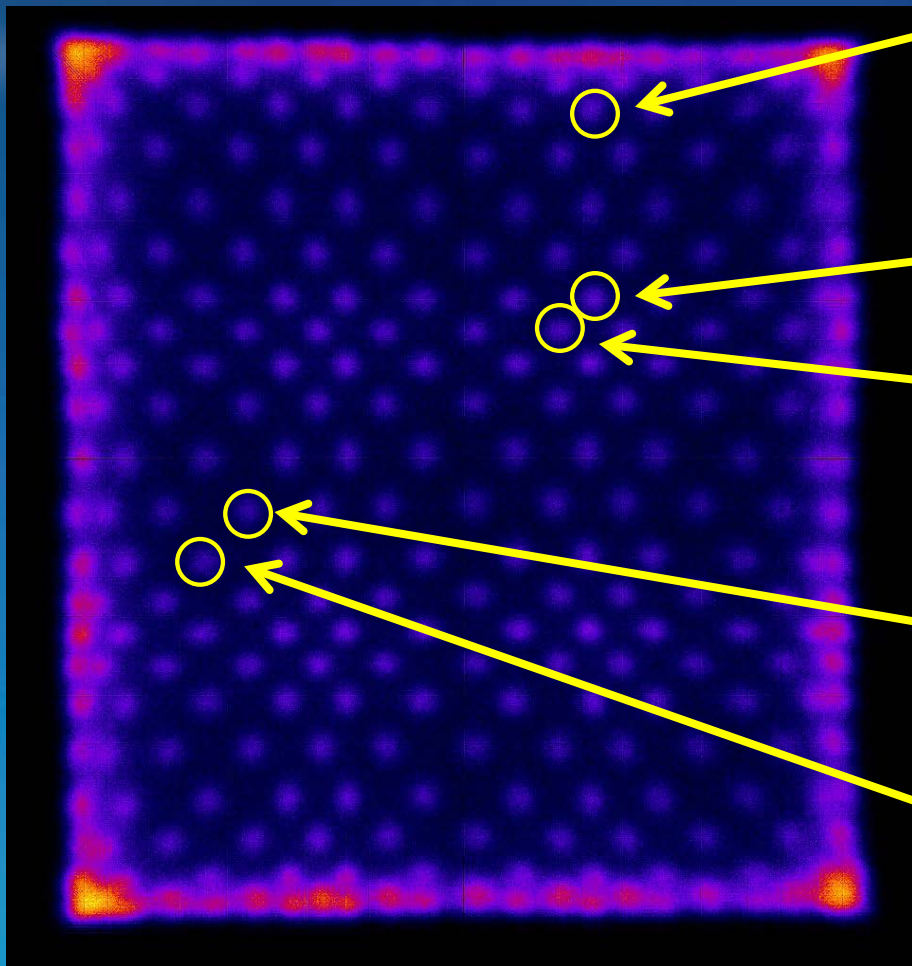**Gamma beam entering from top (scintillator side)**

Gamma beam entering from bottom (SiPM side)

Gamma beam entering from top (scintillator side)

Raw flood images for gamma beams entering from top (scintillator side) and bottom (SiPM side). Spreader window 0.96mm. ADC gate width 195ns. Bias at 30.3 V. Left and center images obtained with COG truncation factor 0.2. Right image with COG truncation factor 0.0.

Tests of SensL ArraySM-4 with 4ch AiT readout

Two stacked and 0.5mm x-y shifted 1.0mm pitch, 5mm (top) and 10mm (bottom) thick LYSO arrays. Beam from top.
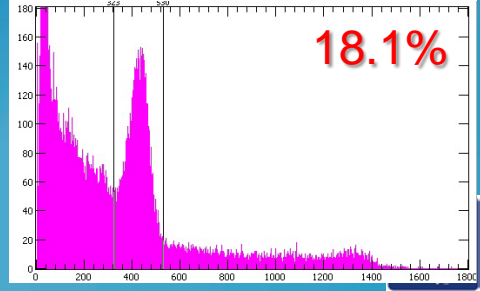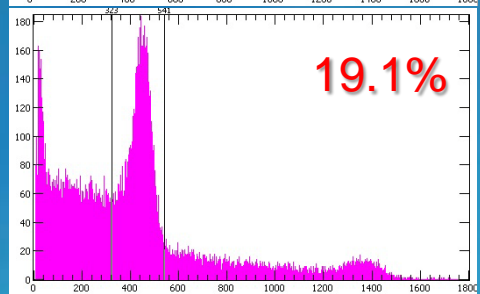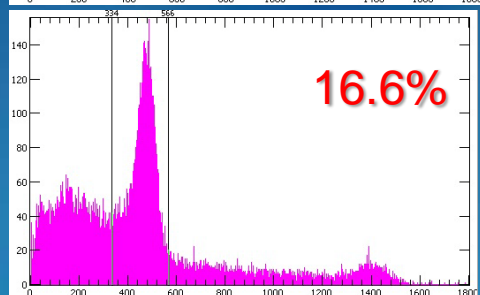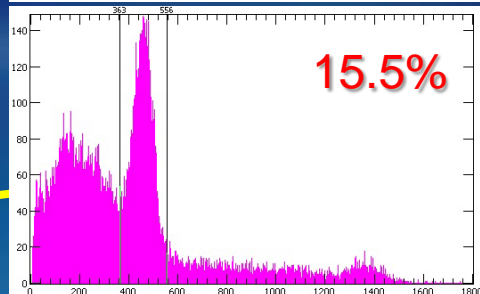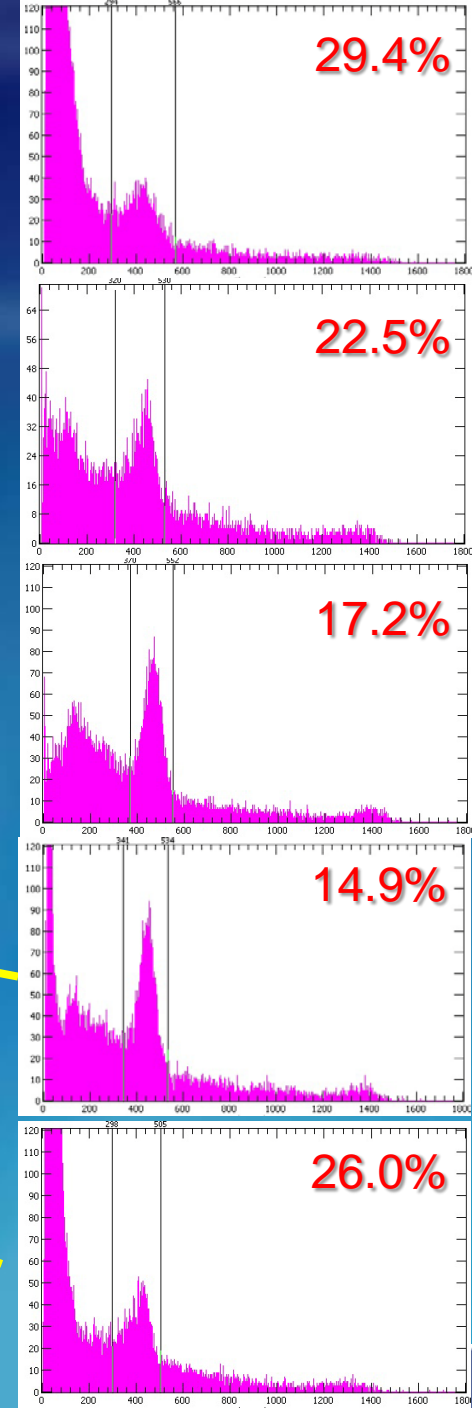

4 — Top 5mm

1 — Top 5mm

5 — Bottom 10mm

2 — Bottom 10mm

3 — Top 5mm

17.1% — Peak ch. 804.9

16.2% — Peak ch. 855.2

16.1% — Peak ch. 887.3

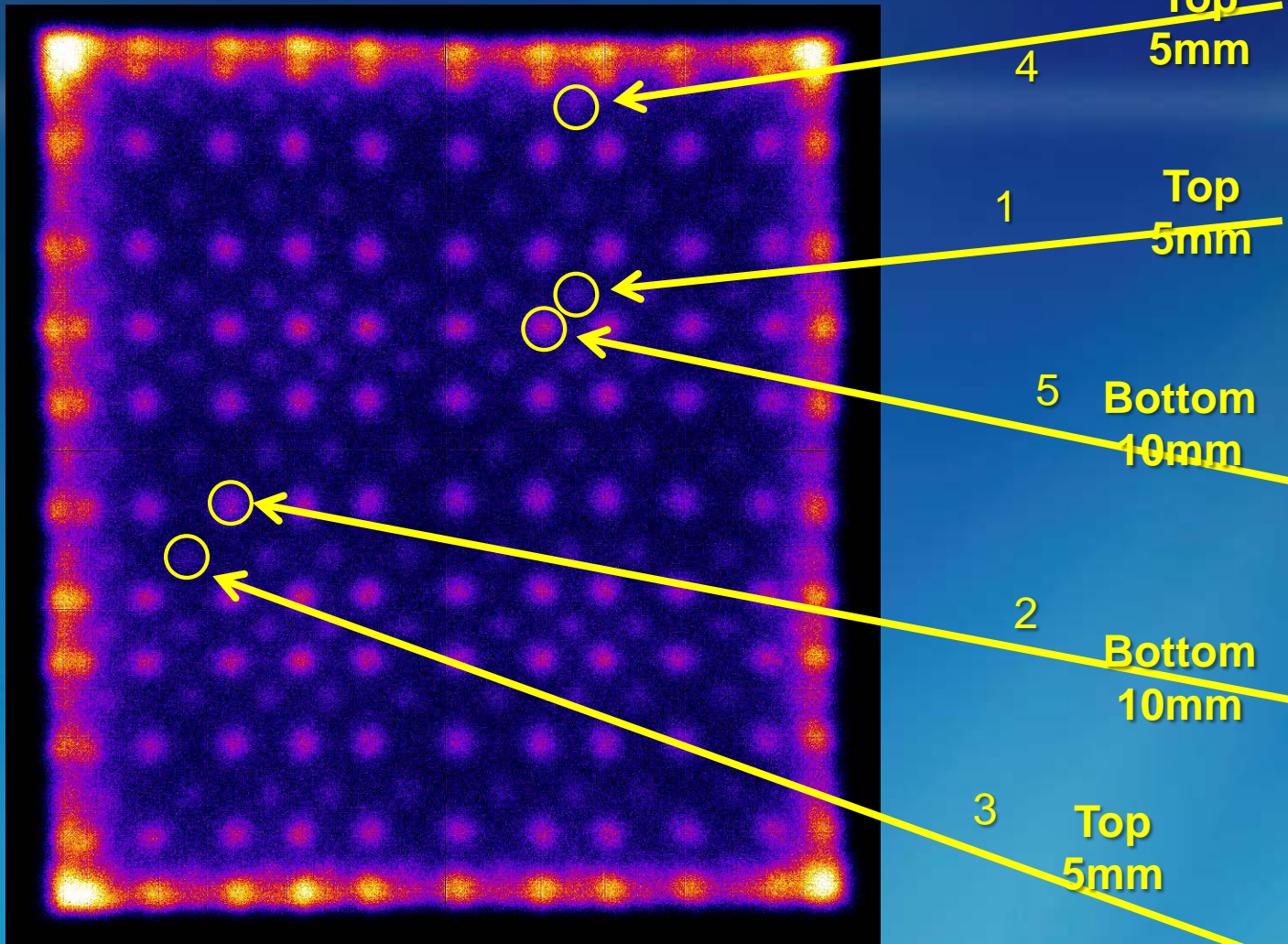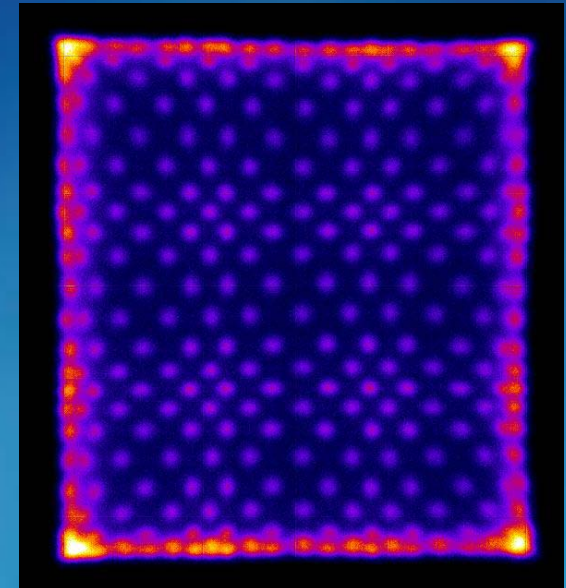**18.9%** — Peak ch. 843.6

19.7% — Peak ch. 798.0

Raw flood image and energy spectra for five selected pixels. FWHM snd peak ch. values @511 keV. Spreader window 0.96mm. COG truncation factor 0.2. ADC gate width 195ns. **Bias at 31.0 V.**

(Cont'd from previous page)

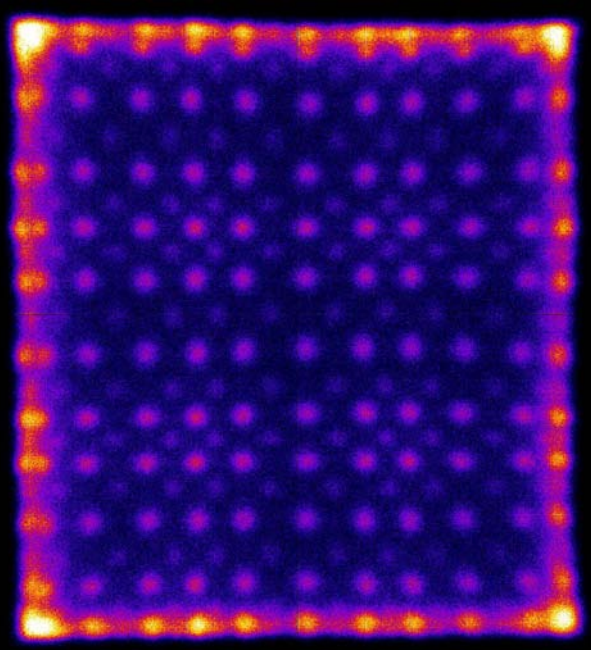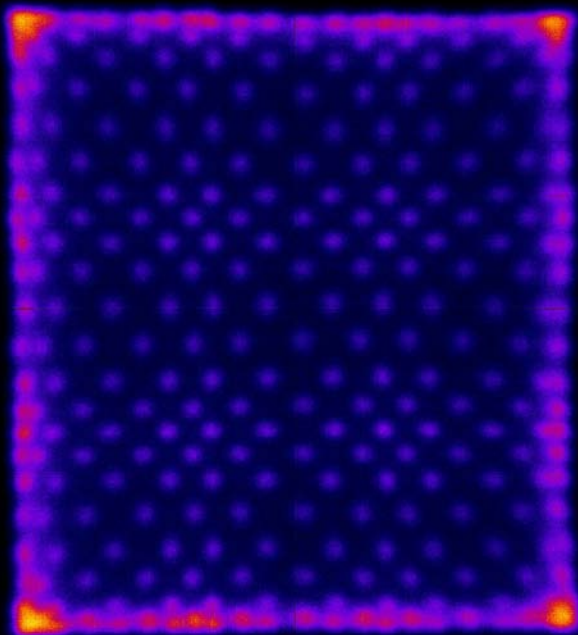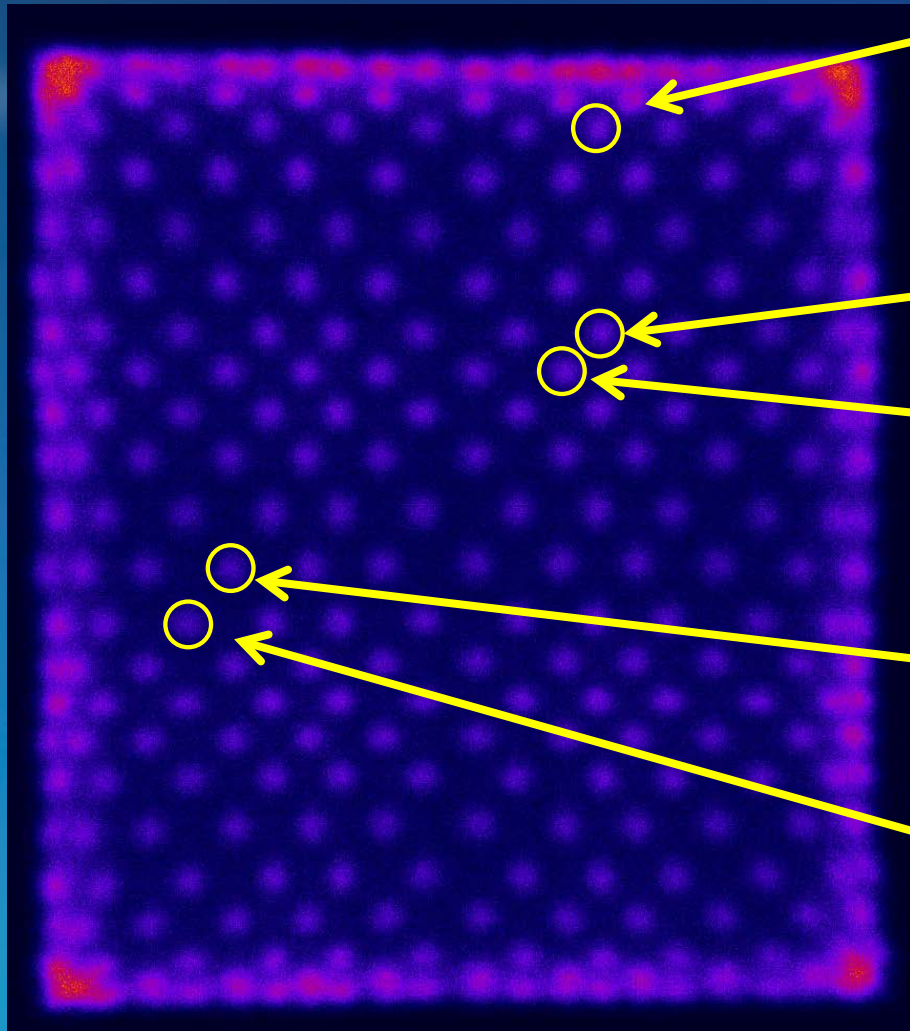**Raw flood image and plots through four selected pixel rows.**

Tests of SensL ArraySM-4 with 4ch AiT readout

Two stacked and 0.5mm x-y shifted 1.0mm pitch, 5mm (top) and 10mm (bottom) thick LYSO arrays. Beam from top.
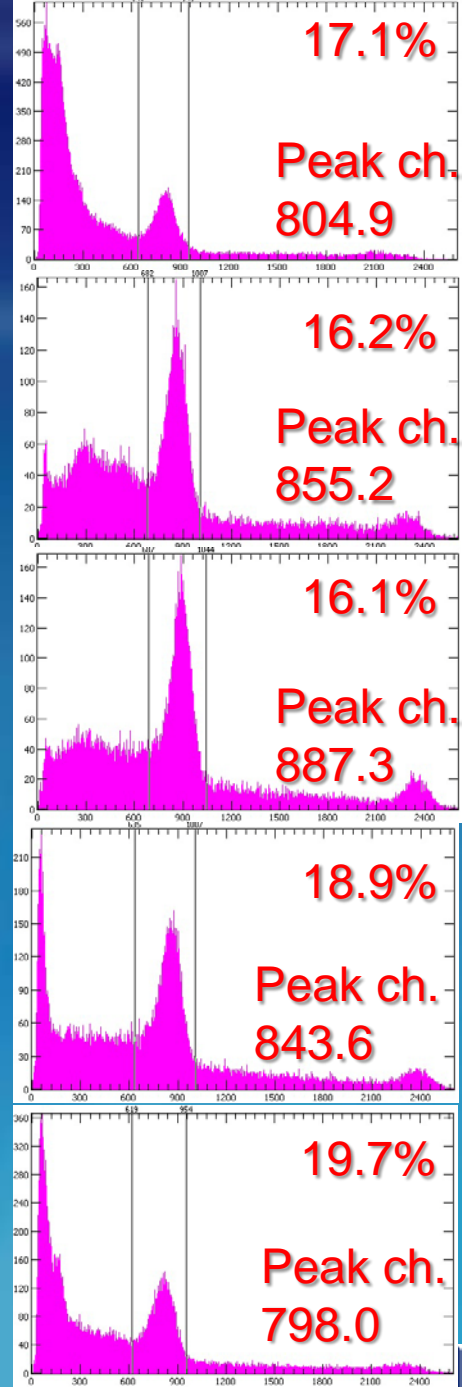

14.8%

15.3%

13.8%

16.0%

18.7%
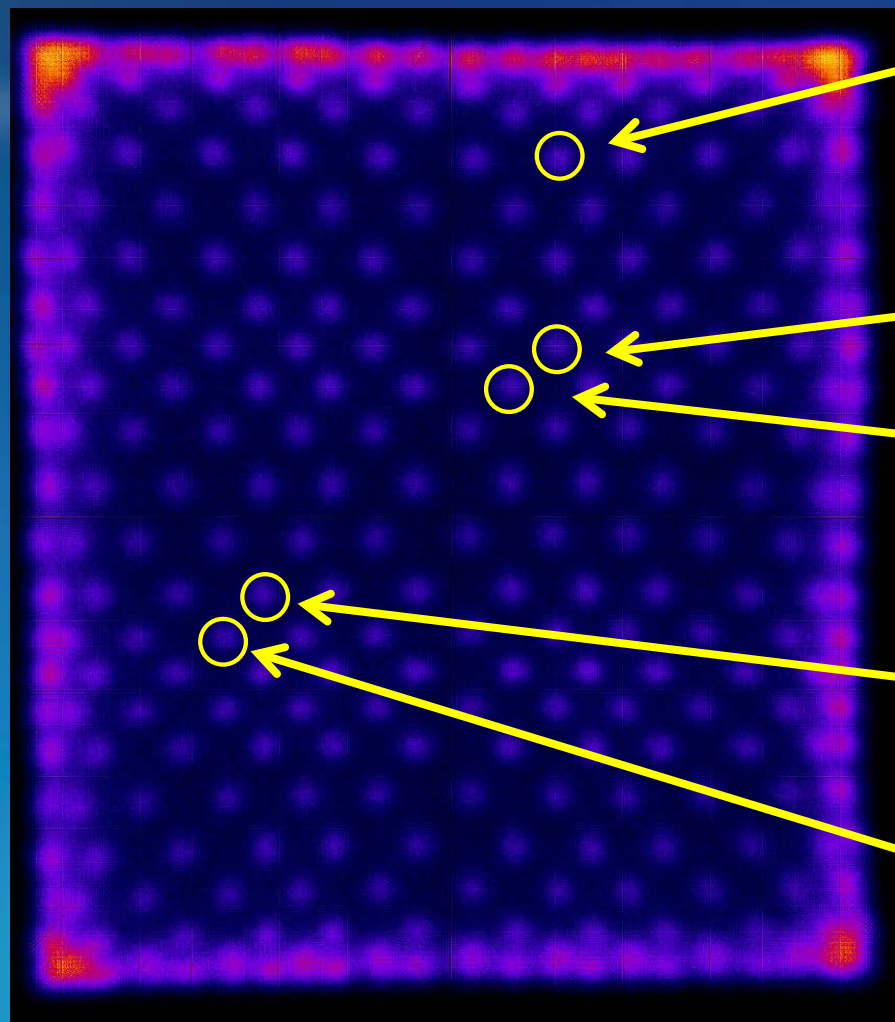
4 — **Bottom 5mm**
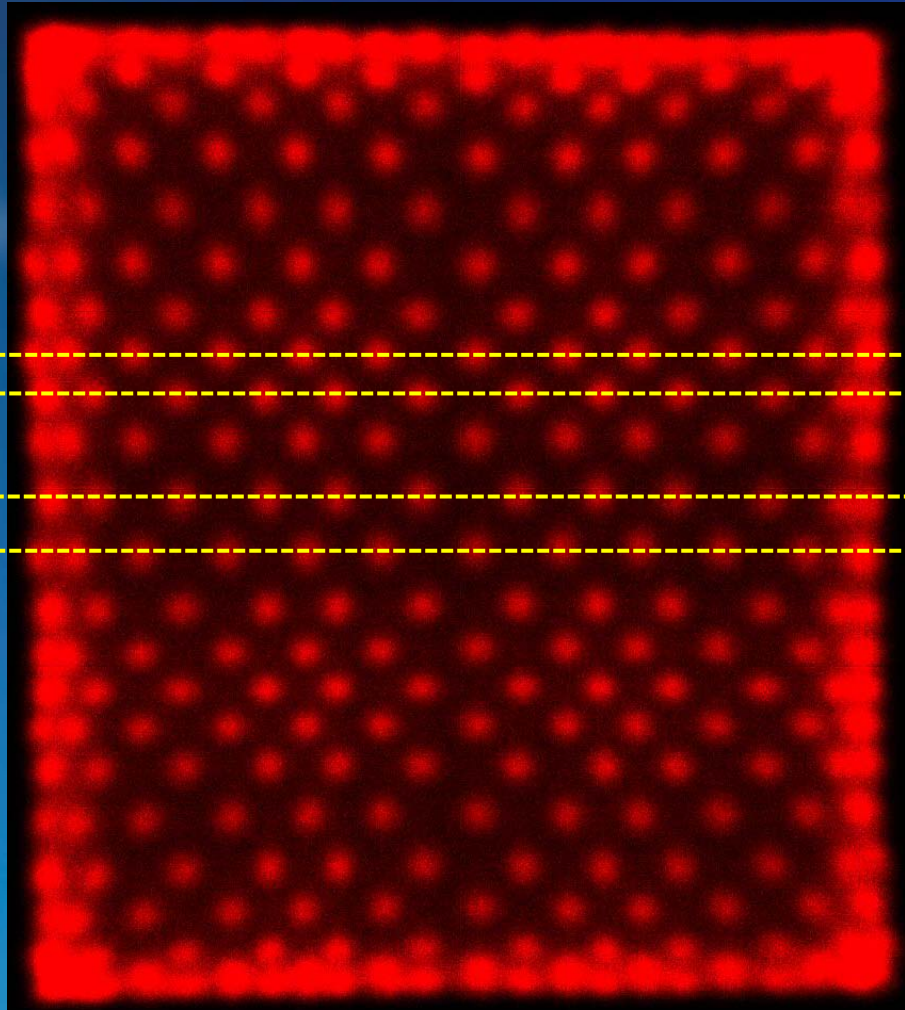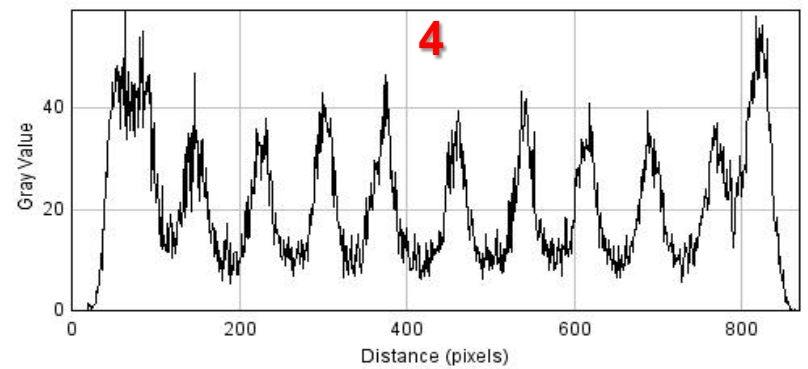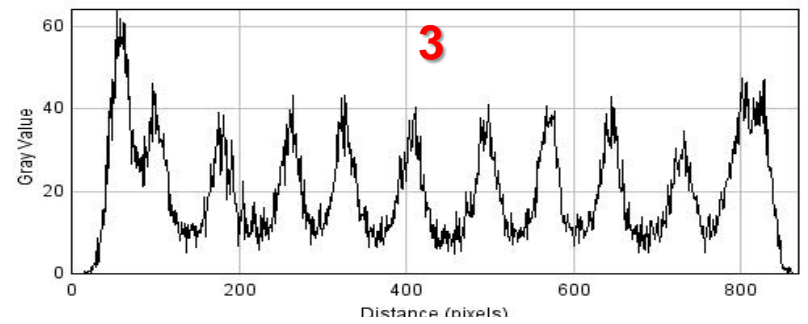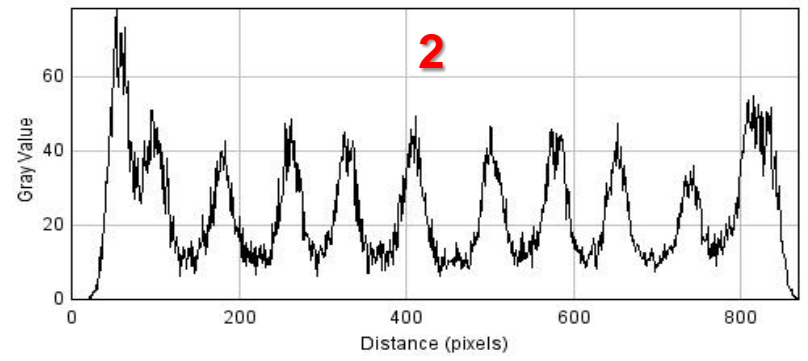
1 — **Bottom 5mm**

5 — **Top 10mm**

2 — **Top 10mm**

3 — **Bottom 5mm**

Raw flood image and energy spectra for five selected pixels. FWHM values @511 keV. Spreader window 0.96mm. COG truncation factor 0.2. ADC gate width 270ns. Bias at 31.0 V.
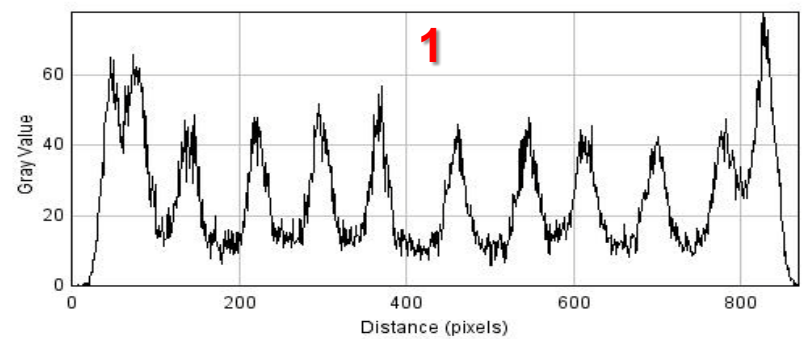
Conclusions (preliminary):

- Good operation with stacked/shifted pixellated LYSO array structure (arrays produced by Proteus) down to 1mm pitch
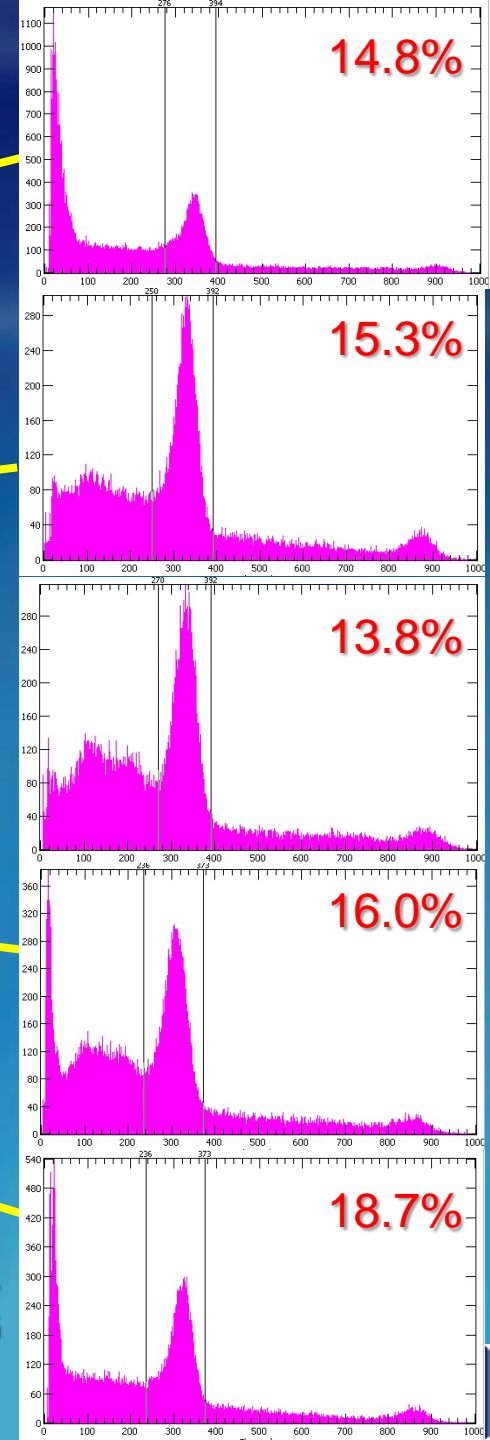
- Uniform signal response across the whole SiPM array (ArraySM-4 on loan from AiT)

- Scintillation signals and energy resolutions from the top and bottom arrays are approximately equal

- Variation of energy resolution primarily depends on the origin of the scintillation light (worse if more light goes into the crack(s) between individual 3mm SiPMs)

- Observation: 5mm /10mm LYSO array thickness split offers approximately equal 511 keV top/bottom signal contributions