



# Studies with ArrayB-30035-144P-PCB (selection of results)

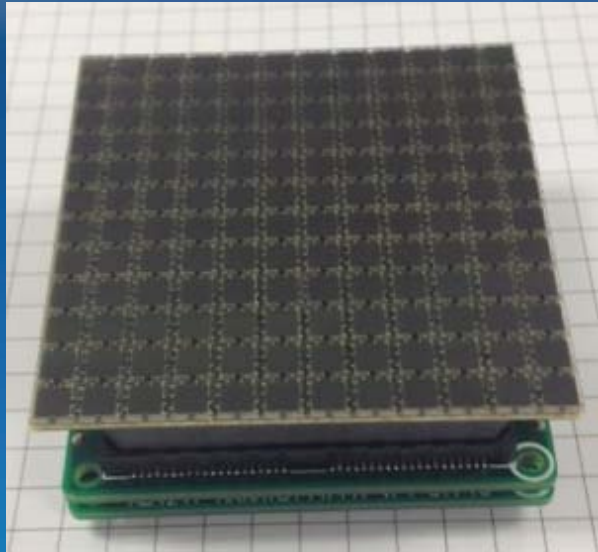
Study of the single gamma operation using  
NaI(Tl) arrays:

- Effect of temperature
- Effect of bias voltage
- Effect of integration gate width to ADC





# Studies with the ArrayB-30035-144P-PCB



4ch  
readout

12ch columns

12ch rows

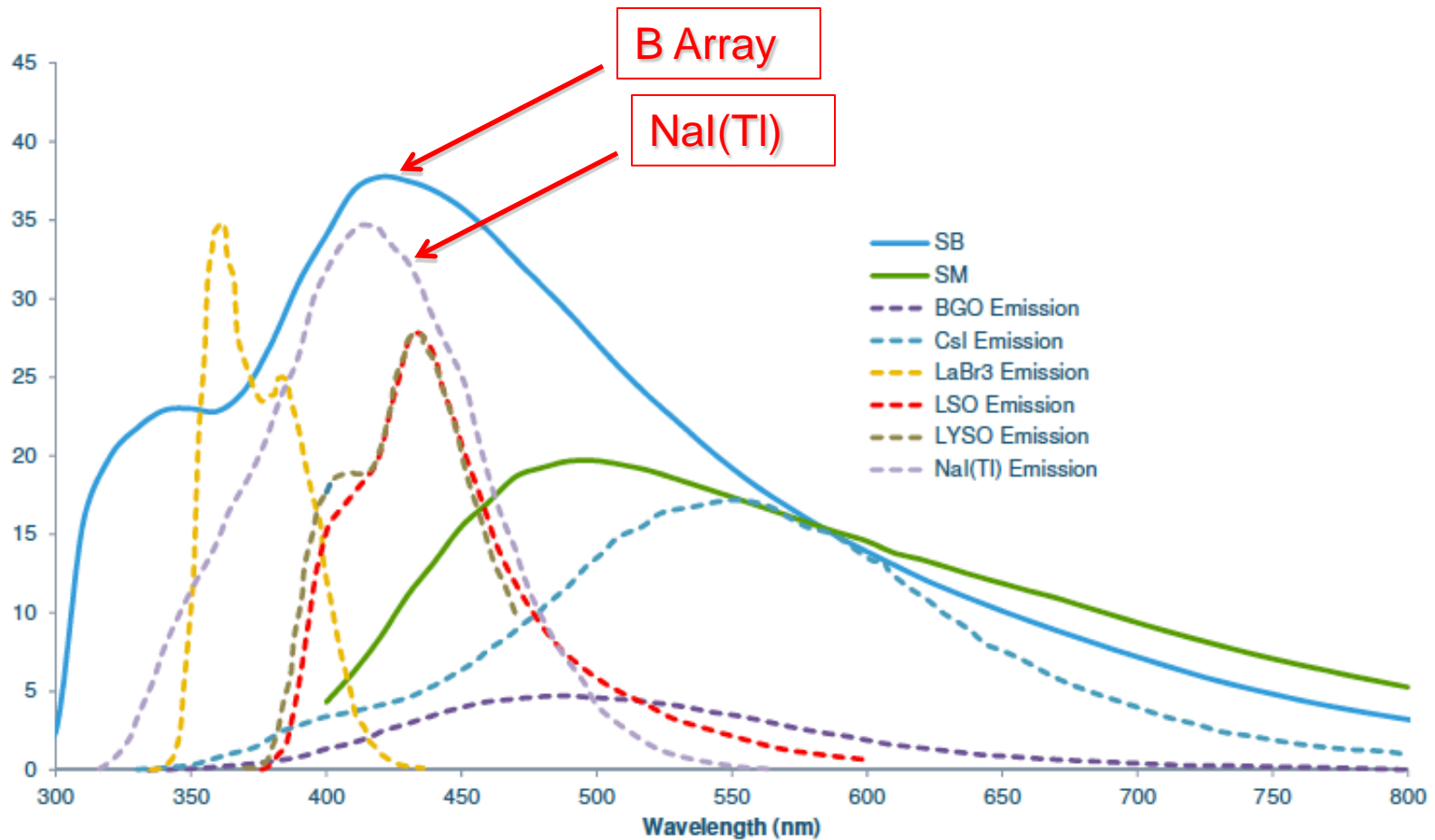
Hybrid readout board from AiT Instruments with the row-and-column cables at the bottom and the 4ch readout cable (top connector) used to provide bias voltage.

The B-type 144 (12x12) 3mm pixel array from SensL was tested with the 3mm and 1.5mm NaI(Tl) arrays. Diode circuitry based readout from AiT Instruments was used.





# Common Scintillators & SensL SiPMs



sensL  
sense light

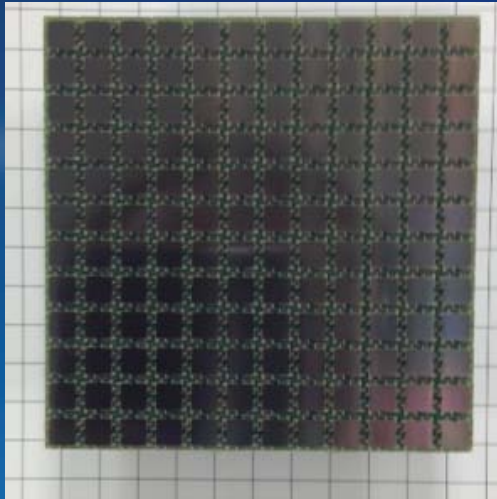
Good spectral match between NaI(Tl) emission and B array spectral response.





# Studies with the ArrayB-30035-144P-PCB

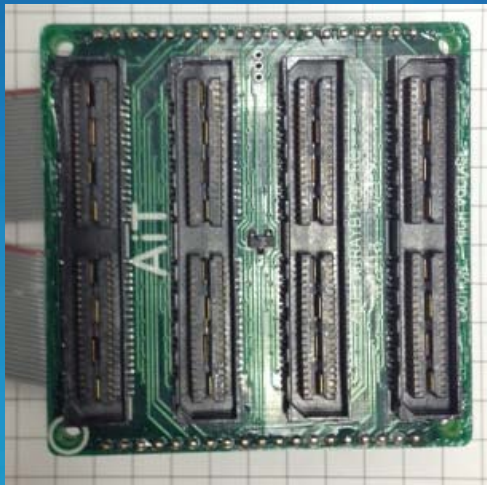
Top view



Top view



Bottom view



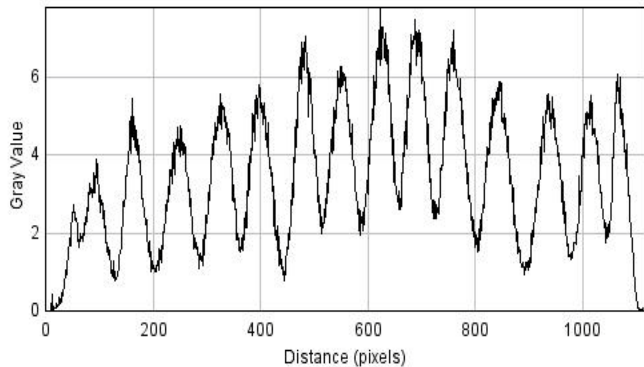
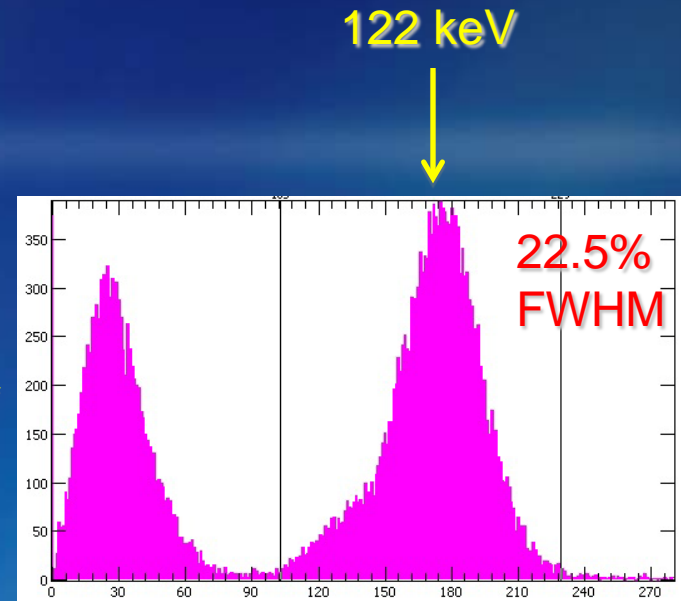
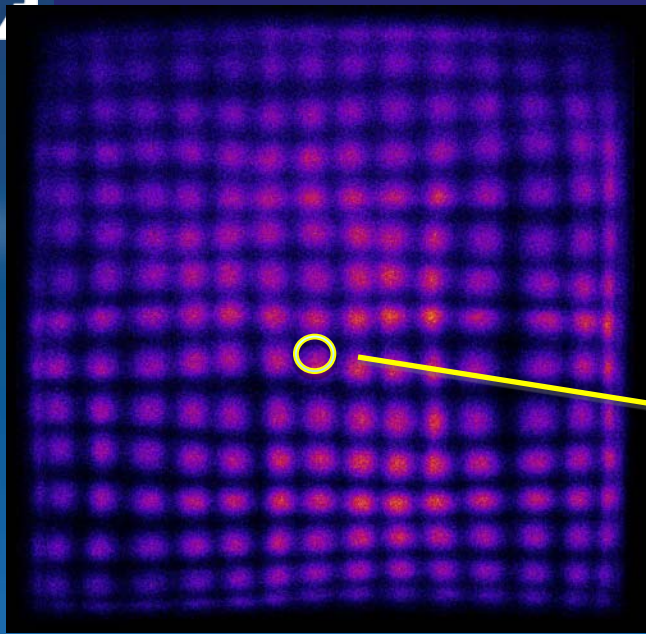
Bottom view



Pictures of the SensL SiPM array (left), the AiT readout board (center) and one of the tested 1.5mm pixel NaI(Tl) arrays (right) from Saint Gobain.



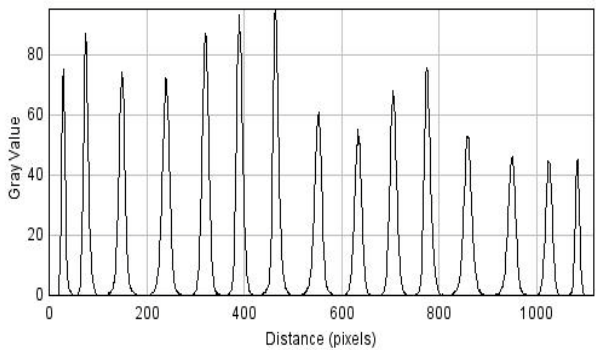
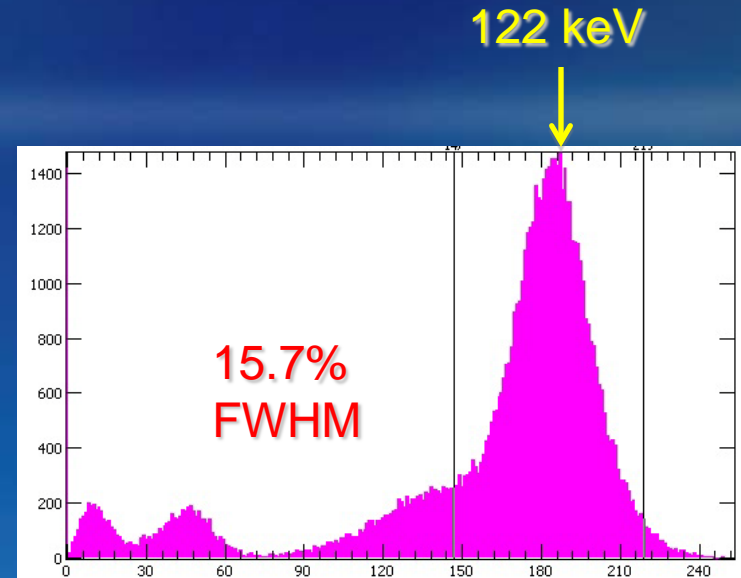
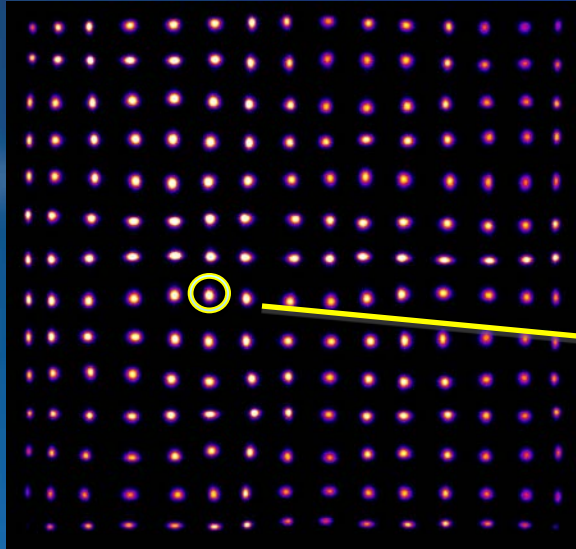
# Studies with the ArrayB-30035-144P-PCB



Results with NaI(Tl) array (from Saint Gobain) of 3x3x6 mm pixels coupled to the SiPM module through 6.5mm glass window. Bias 30.7V. 27 deg C. 300ns signal integration gate. F factor 0.115. Example of a Co-57 energy spectrum from a single 3x3x6mm NaI(Tl) pixel. FWHM energy resolution @122 keV is ~20-25%.



# Studies with the ArrayB-30035-144P-PCB

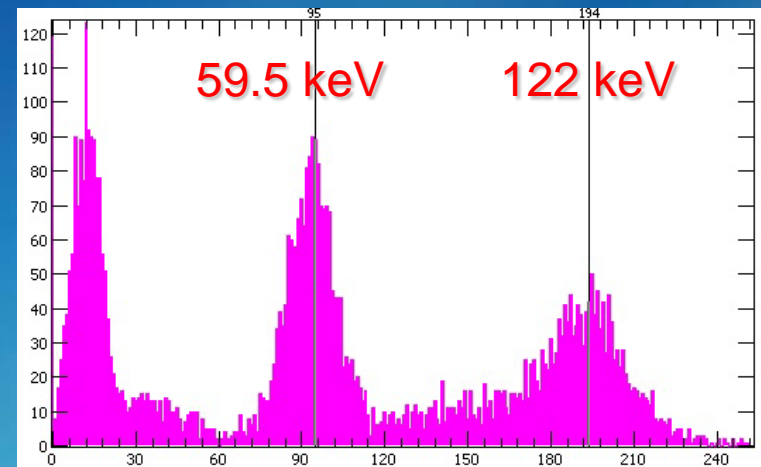
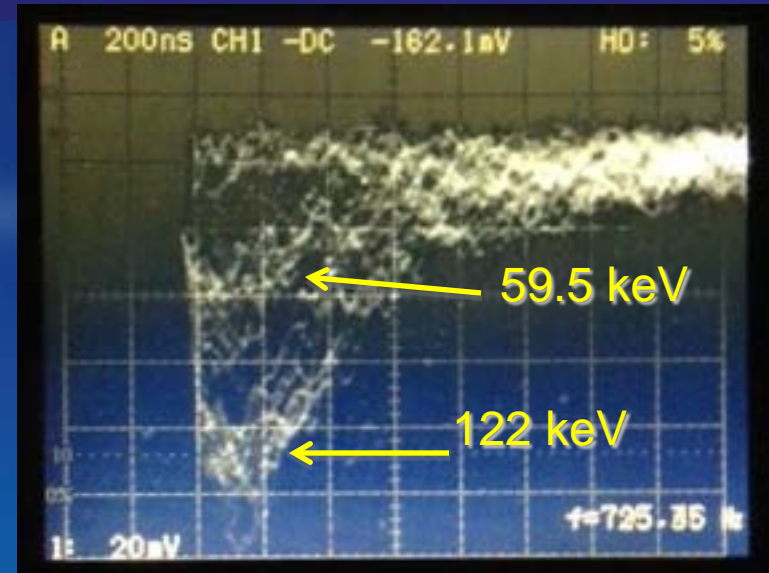
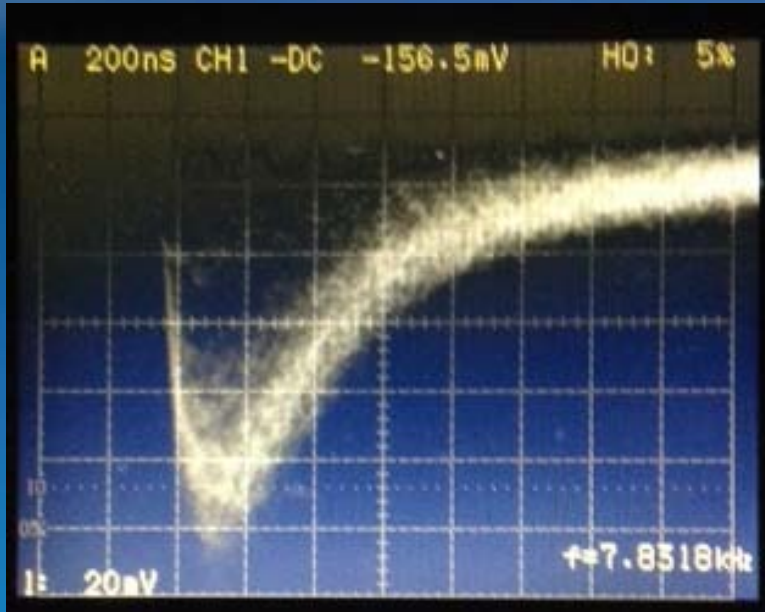


Results with the 5x5 cm NaI(Tl) array (from Saint Gobain) of 3x3x6 mm pixels coupled to the SiPM module through ~2mm glass and 1mm acrylic window. Bias 31.7V. 10.3 deg C. 800ns signal integration gate. F factor 0.085. Example of a Co-57 energy spectrum from a single 3x3x6mm NaI(Tl) pixel. FWHM energy resolution @122 keV is 15.7%.





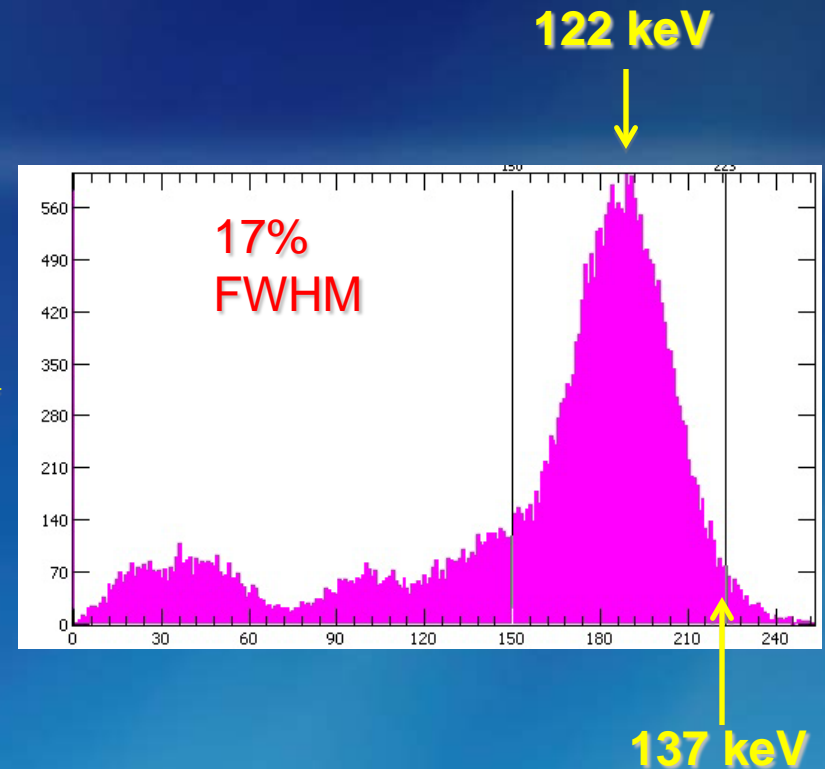
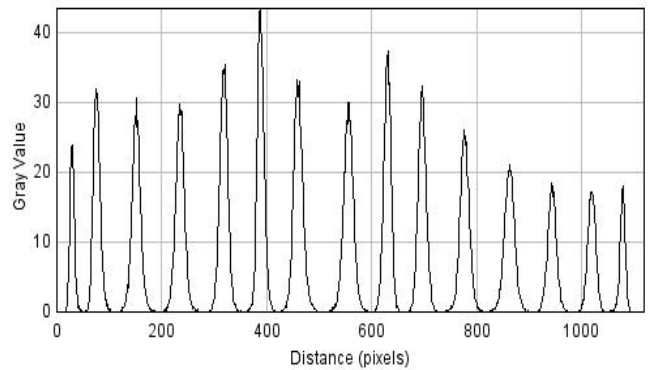
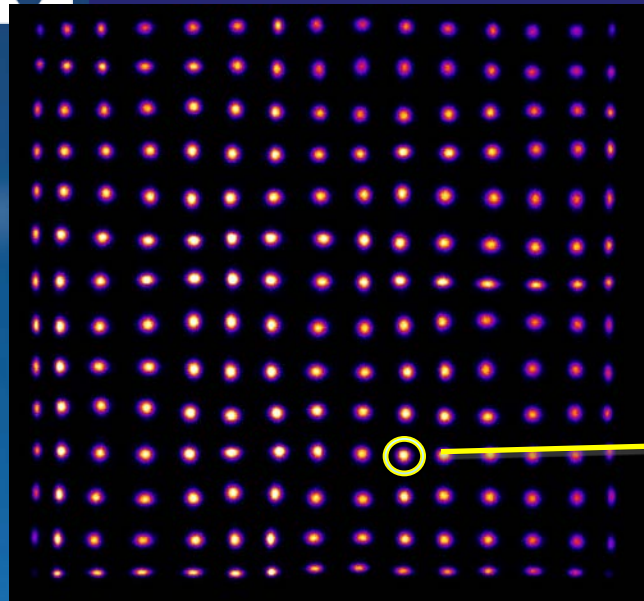
# Studies with the ArrayB-30035-144P-PCB



Small 3mm NaI(Tl) array. Row sum output @ 31.7V bias. Left:  $^{60}\text{Co}$  source (122 keV). Right: low intensity gamma mix of 122 keV (from  $^{60}\text{Co}$ ) and 59.5 keV (from  $^{241}\text{Am}$ ). Energy spectrum from one 3mm pixel at bottom right.



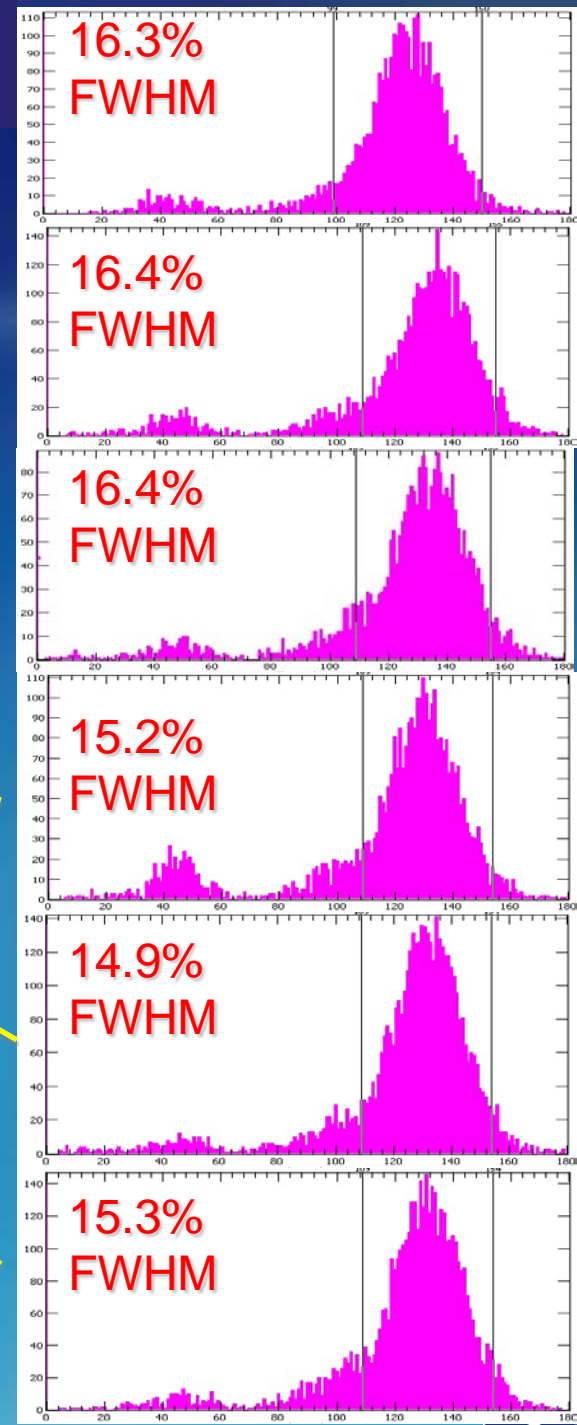
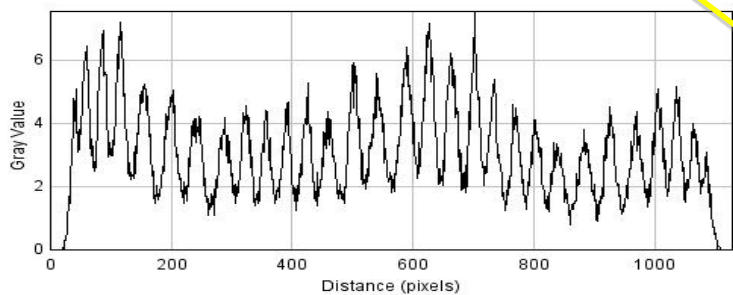
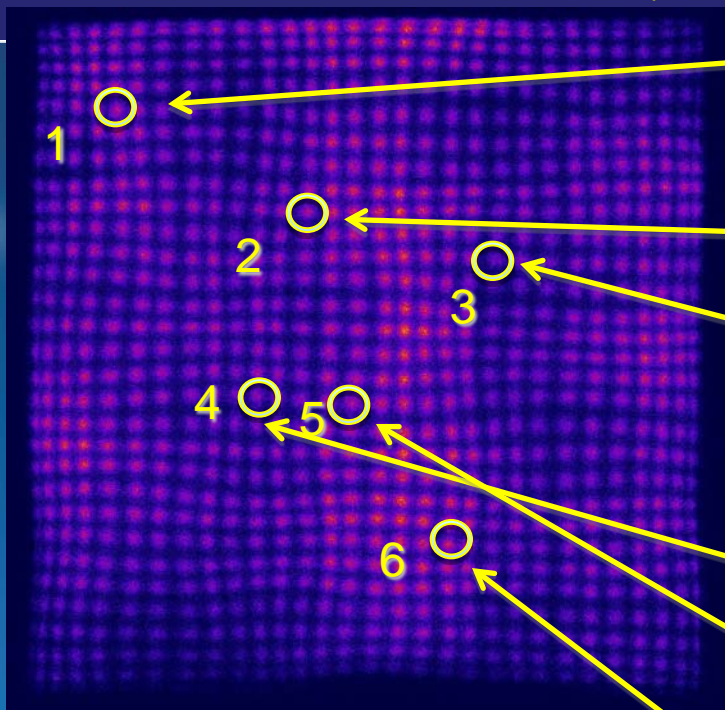
# Studies with the ArrayB-30035-144P-PCB



Results with the 5x5 cm NaI(Tl) array of 3x3x6 mm pixels coupled to the SiPM module through a ~2mm glass and 1mm acrylic window. Bias 31.7V. 26.2 deg C. 800ns signal integration gate. F factor 0.085. Example of a Co-57 energy spectrum from a single 3x3x6mm NaI(Tl) pixel. FWHM energy resolution @122 keV is ~17%.



# Studies with the ArrayB-30035-144P-PCB



Results with the 5x5 cm NaI(Tl) array of 1.5x1.5x6 mm pixels coupled to the SiPM module through a ~2mm glass and 2.3mm UV crylic window. Bias 31.7V. 10.9 deg C. 800ns signal integration gate in ADC. F factor 0.085. Examples of Co-57 energy spectra from six 1.5x1.5x6mm NaI(Tl) pixels. Average FWHM energy resolution @122 keV is ~16%.



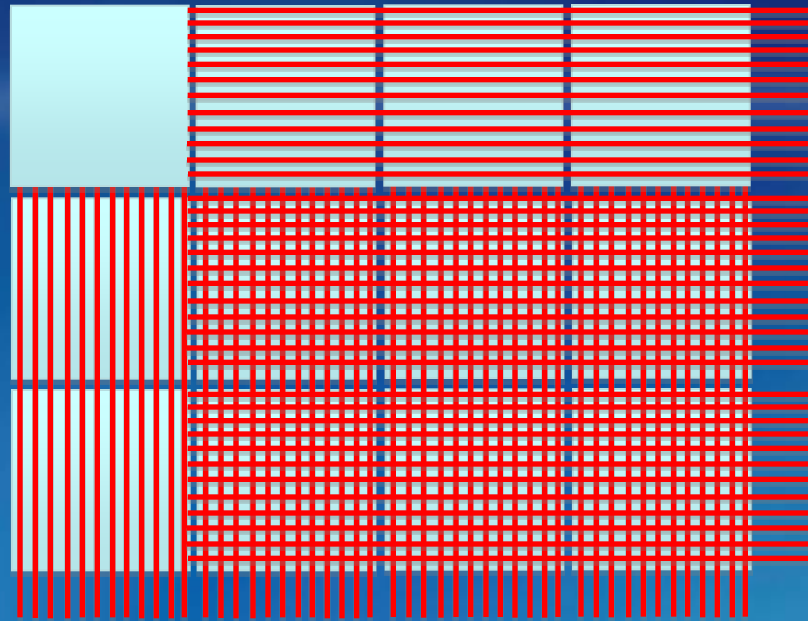
# Summary

- Full separation of pixels in the image for all tested arrays is possible with row-and-column readout
- Energy resolution improves with voltage and is close to 15% FWHM @122 keV at low temperature
- Improving performance through increasing  $S$  and decreasing  $N$  in  $S/N$  is still required to match PSPMT performance
- Better uniformity of response also desired





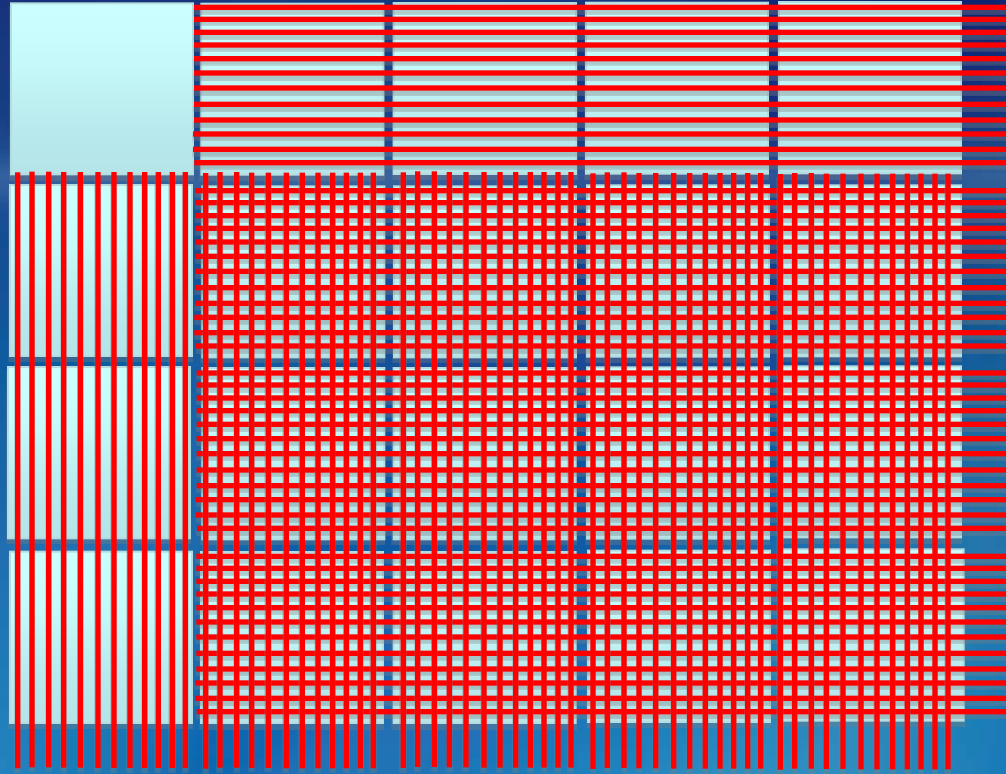
# Multiplexed Row-and-Column (MR&C)



In this schematic example of the 3x4 array of SiPM modules forming ~ 20x15cm detector panel, the corresponding row and column outputs from individual modules are connected together (multiplexed - passively or actively) to form common row and column readout lines for the whole detector panel. For the 144 SiPM modules the initial number of 288 R&C readout channels is reduced to 36 rows and 48 columns = 84 MR&C channels.



# Multiplexed Row-and-Column (MR&C)



In this schematic example of the 4x5 array of SiPM modules forming ~ 25x20cm detector panel, in the 144 SiPM modules the initial number of 480 R&C readout channels is reduced to 48 rows and 60 columns = 108 MR&C channels.