

The ANL Silicon Array and DAQ

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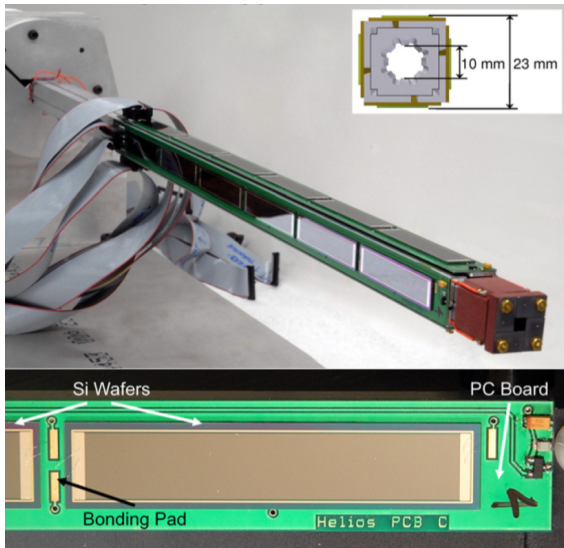
March 24, 2017



- 1 The ANL Silicon Array and Analog DAQ
- 2 Silicon Upgrade: Progress towards a six-sided array
- 3 Digital DAQ
- 4 Conclusion/Future Outlook



The ANL Silicon Array and Analog DAQ



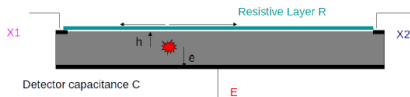
- Vendor: Canberra
- Active area: 9 mm x 50.5 mm
- Thickness: $700 \pm 15 \mu\text{m}$
- Resistive layer: Boron ($\approx 17 \text{ k}\Omega$)
- Aluminum contacts
- Guard ring
- 24x3 signals (72)
- Readout with CAMAC controlled ADCs/TDCs

Wuosmaa *et al.*, NIM A 580,97 (2007)
Lighthall *et al.*, NIM A 622,97 (2010)

The ANL Silicon Array and Analog DAQ



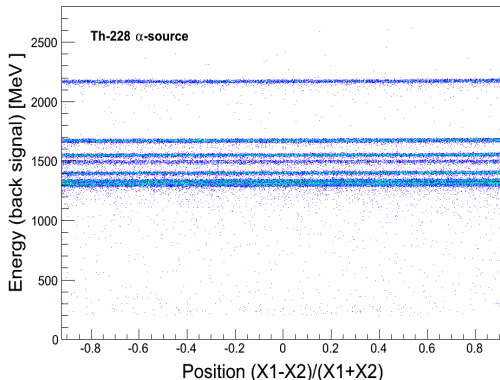
How a PSD works



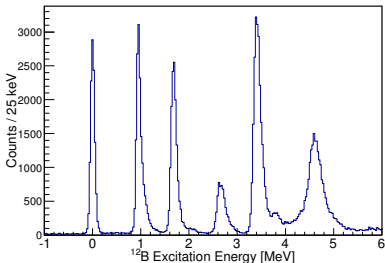
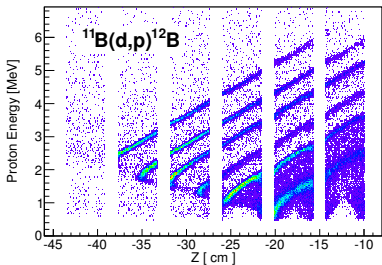
- Measured position resolution ≤ 1.17 mm (FWHM) for $E \geq 2$ MeV.

- Measured energy resolution $\delta E \approx 50$ keV (FWHM).

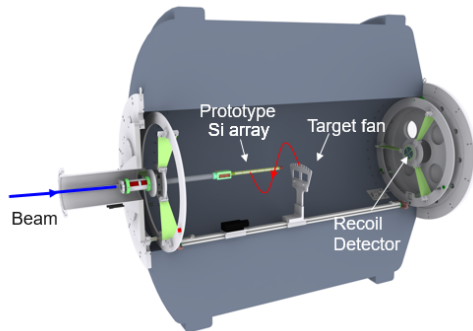
Lighthall *et al.*, NIM A 622,97 (2010)



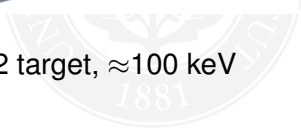
Upstream Configuration: (d,p), (t,p), (^6Li ,d), (^3He ,d)



Three weeks ago: $^{11}\text{B}(\text{d},\text{p})^{12}\text{B}$, 2.85T, $8 < \theta_{\text{cm}} < 45$, 1 hour at 10^8 pps



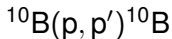
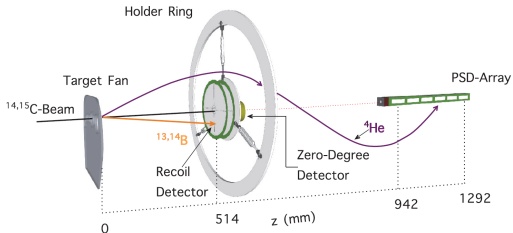
$100 \mu\text{g}/\text{cm}^2$ CD2 target, ≈ 100 keV resolution



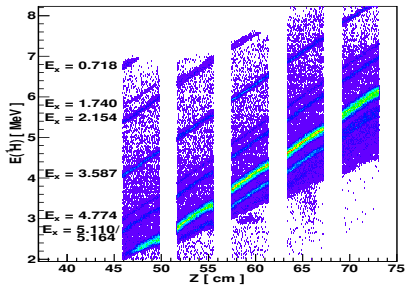
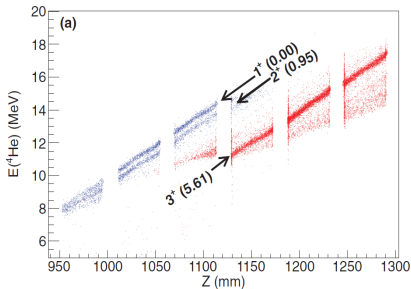
Downstream Configuration: (p,p'), (d,³He), (d,α), (d,t)



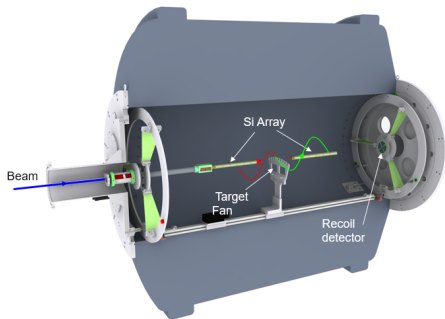
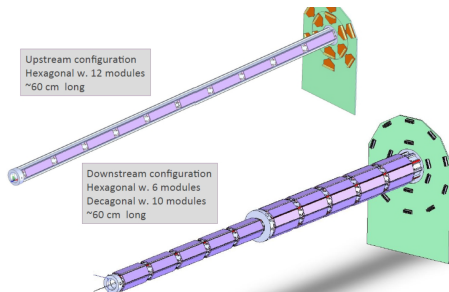
Wuosmaa *et al.*, Phys. Rev. C 90, 061301(R) (2014)



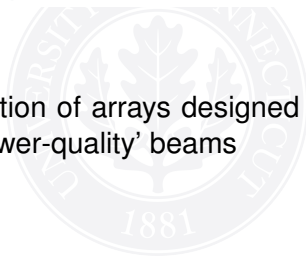
Kuvin *et al.*, Publication in preparation.



Upgraded Array: Upstream and Downstream



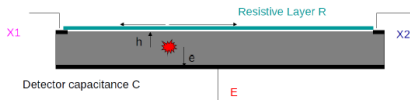
Next generation of arrays designed to accept 'lower-quality' beams



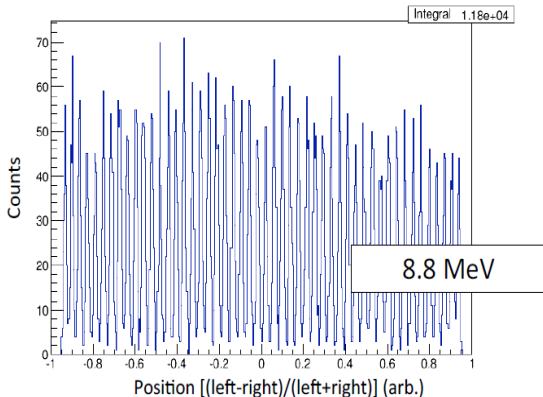
Barcelona Detectors



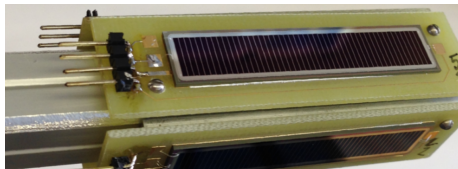
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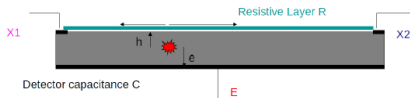
- New Vendor
- 9mm x 50.5mm
- Resistive strip:
polysilicon ($\approx 7 \text{ k}\Omega$)



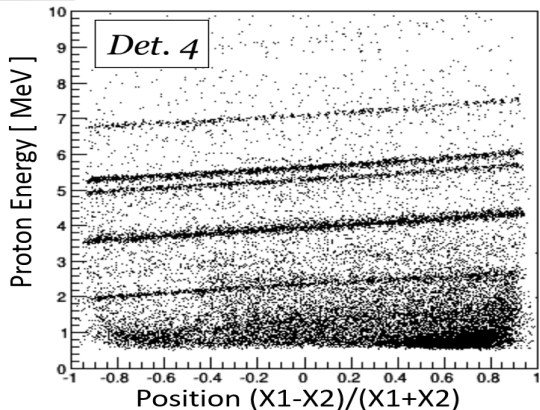
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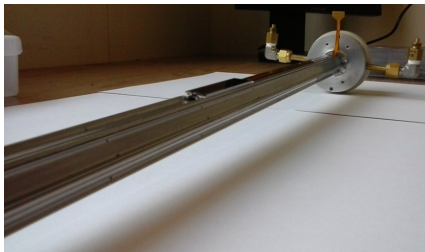
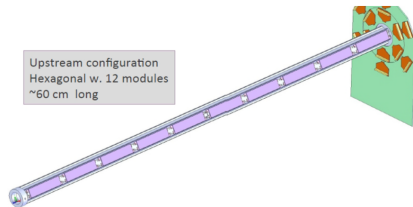


- New Vendor
- 9mm x 50.5mm
- Resistive strip: polysilicon ($\approx 7 \text{ k}\Omega$)
- Tested via $^{17}\text{O}(d,p)$ with analog DAQ



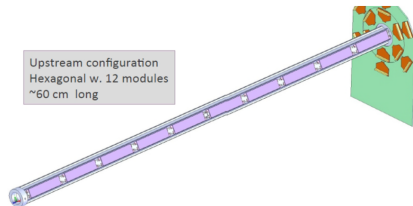
Silicon Upgrade: Progress towards a six-sided array

- Assembled structure tested for leaks under vacuum.
- Preliminary cooling tests completed.
- Single detector tested with flex-to-ribbon board.
- First complete module (5 detectors) mounted and wirebonded.
- Tasks remaining:
 - Mount and wirebond remaining 25 detectors.
 - Minor modification to chamber to accommodate feedthrough board.



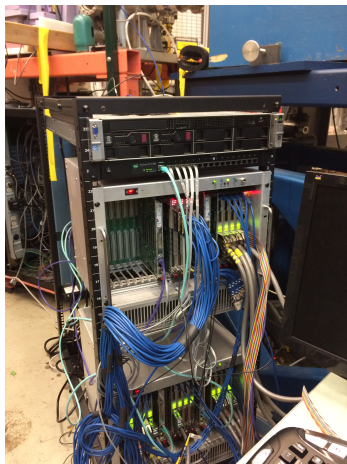
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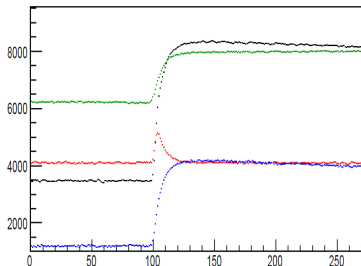
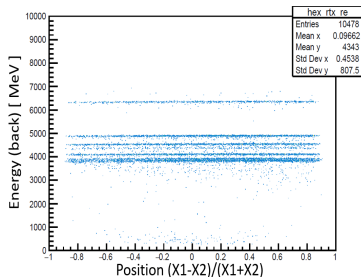
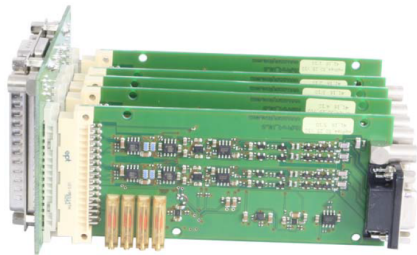
Digital DAQ

- 16 GRETINA/DGS digitizer boards, 1 ANL master trigger module and 2 ANL router boards.
- 120 channels for current state of upgrade (30 detectors).
- New preamps purchased from Mesytec (140 channels).
- Local expertise and support: John Anderson (HEP), Mike Carpenter, Torben Lauritsen, Shaofei Zhu, Darek Seweryniak.

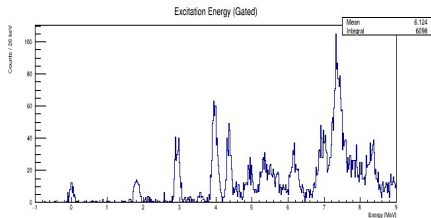
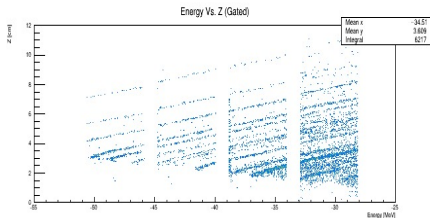
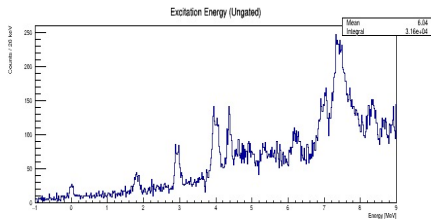
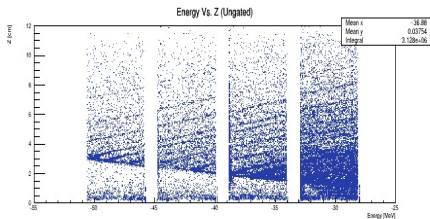


New Mesytec Preamps

- One Detector(E,X1,X2,Guard Ring) per preamp Module (4 Channels) with HV input
- Individual offsets
- Two digitizers per set of 5 preamp modules.



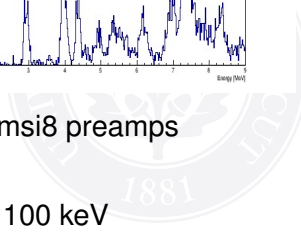
Digital DAQ Test: $^{25}\text{Mg}(d, p)^{26}\text{Al}$ Feb. 20, 2017



File Name: 18_11592_28_2017

File Name: 18_1128_08_2017

- Test: 80 digitizer channels + 4-sided array + msi8 preamps
- 1.5 hour run, showing one side of array
- Individual detector resolutions all better than 100 keV



Conclusion/Future Outlook

- Position sensitive silicon detectors are a cost-effective yet adequate solution (RIB beams with relatively thick targets) for HELIOS.
- Under construction (and proposed) downstream and upstream silicon arrays provide improved angular coverage and are better suited for in-flight production beams.
- Commissioning of the “short” 6-sided array expected during the Summer.
- First RIB experiment using the digital DAQ (and 4-sided array) scheduled for April 12th.
- Plan to implement prototype array (or similar) in the ISS device at CERN later in 2017 or early 2018

