The silicon detectors and electronics

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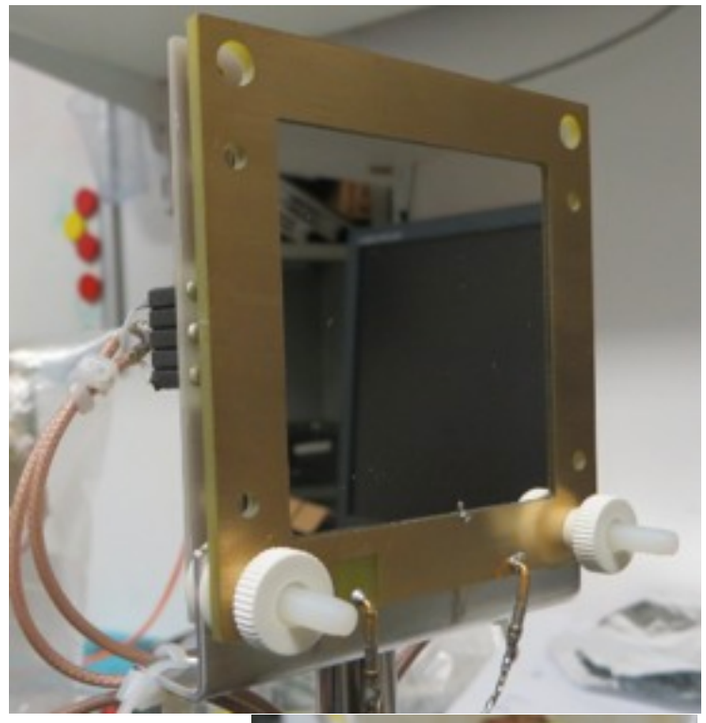
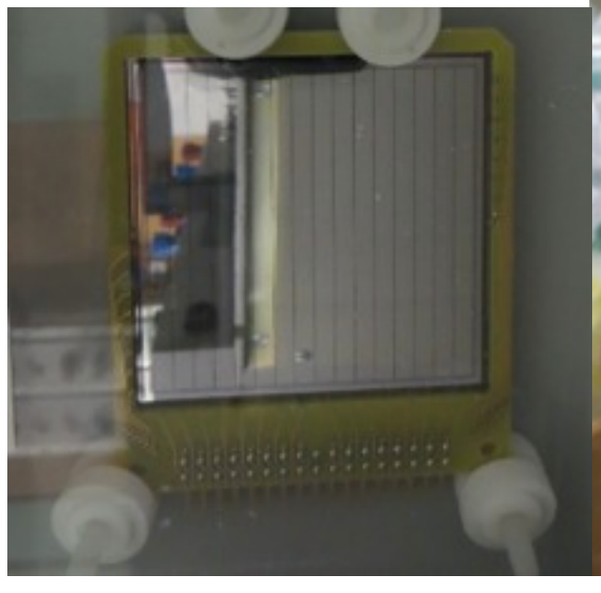
Outline

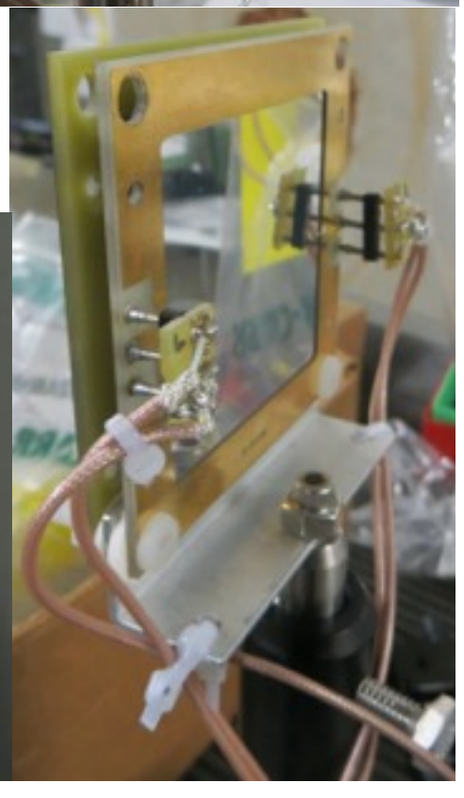
- Set up
- Lessons learned
- Calibrations

Set up

- Main detectors: 2 Si packages, each consists of:
    - thin silicon: 65 um (MSQ), 4 readout channels
    - thick silicon: 1500 um (MSX), 1 readout channel
- Additional detector: 16-strip detector





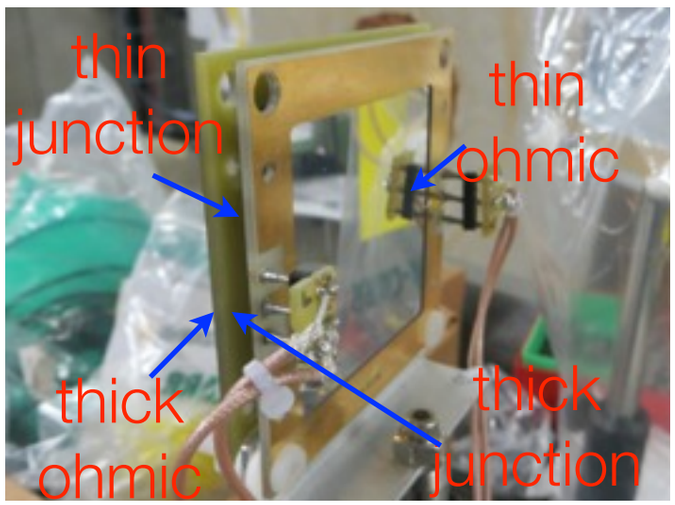


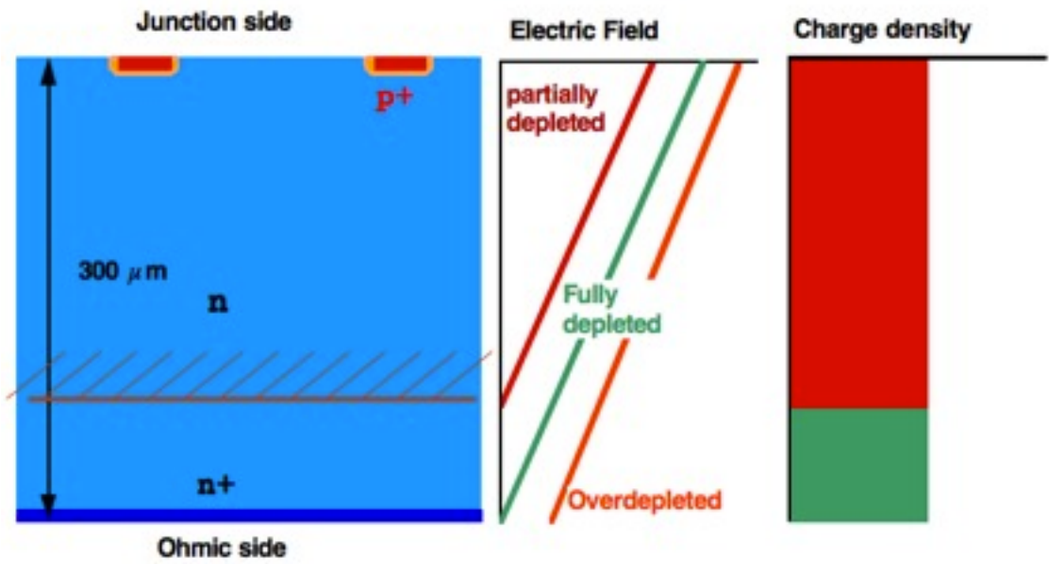
Lessons learned

- Ohmic side and junction side
- Bias
- Vacuum
- Preamps/grounding

Ohmic/junction sides

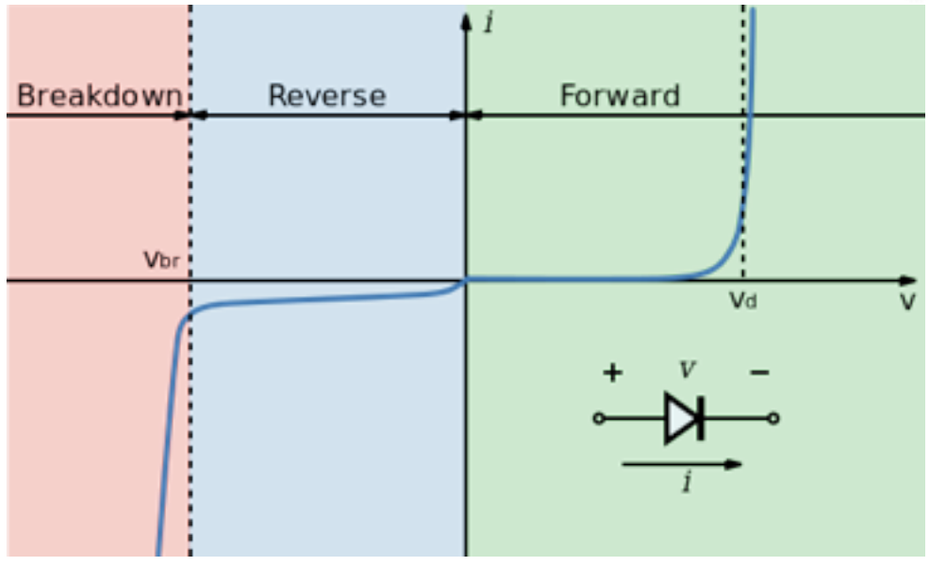
- Typical structure of a silicon detector:
    - junction side should face heavy charged particles
- Our set up: minimize distance between two detectors

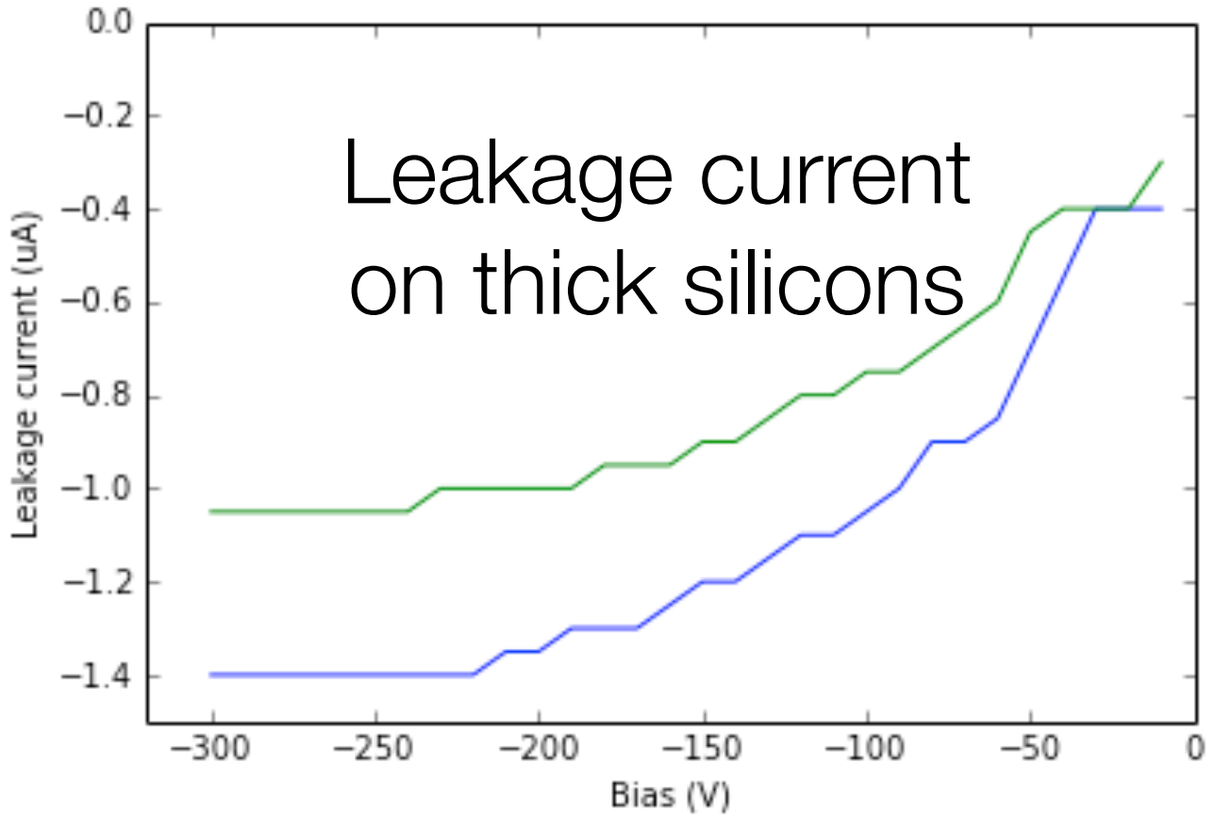




Bias

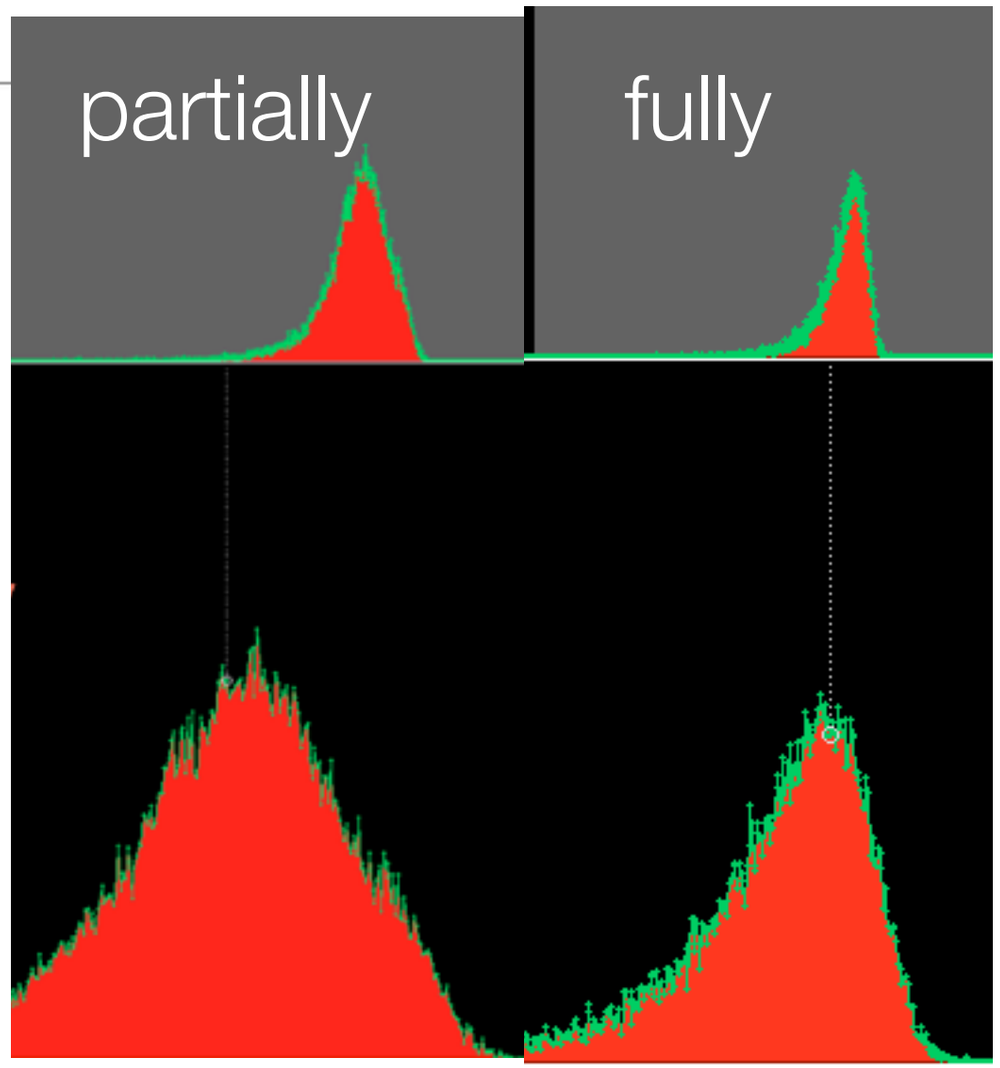
- Typical numbers: -300 V for thick, -10 V for thin
  - in the final set up with ORTEC 142 preamp, bias on SiR2 was 420 V
- Leakage currents:
  - thick Si: <1.5 μA
  - thin Si: <0.02 μA

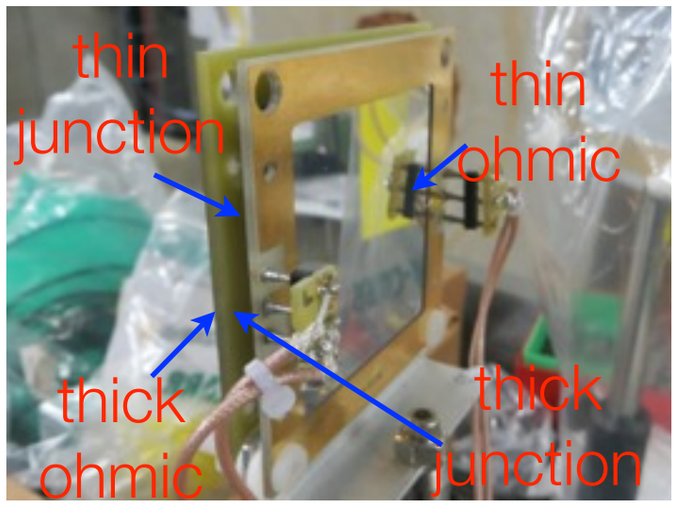


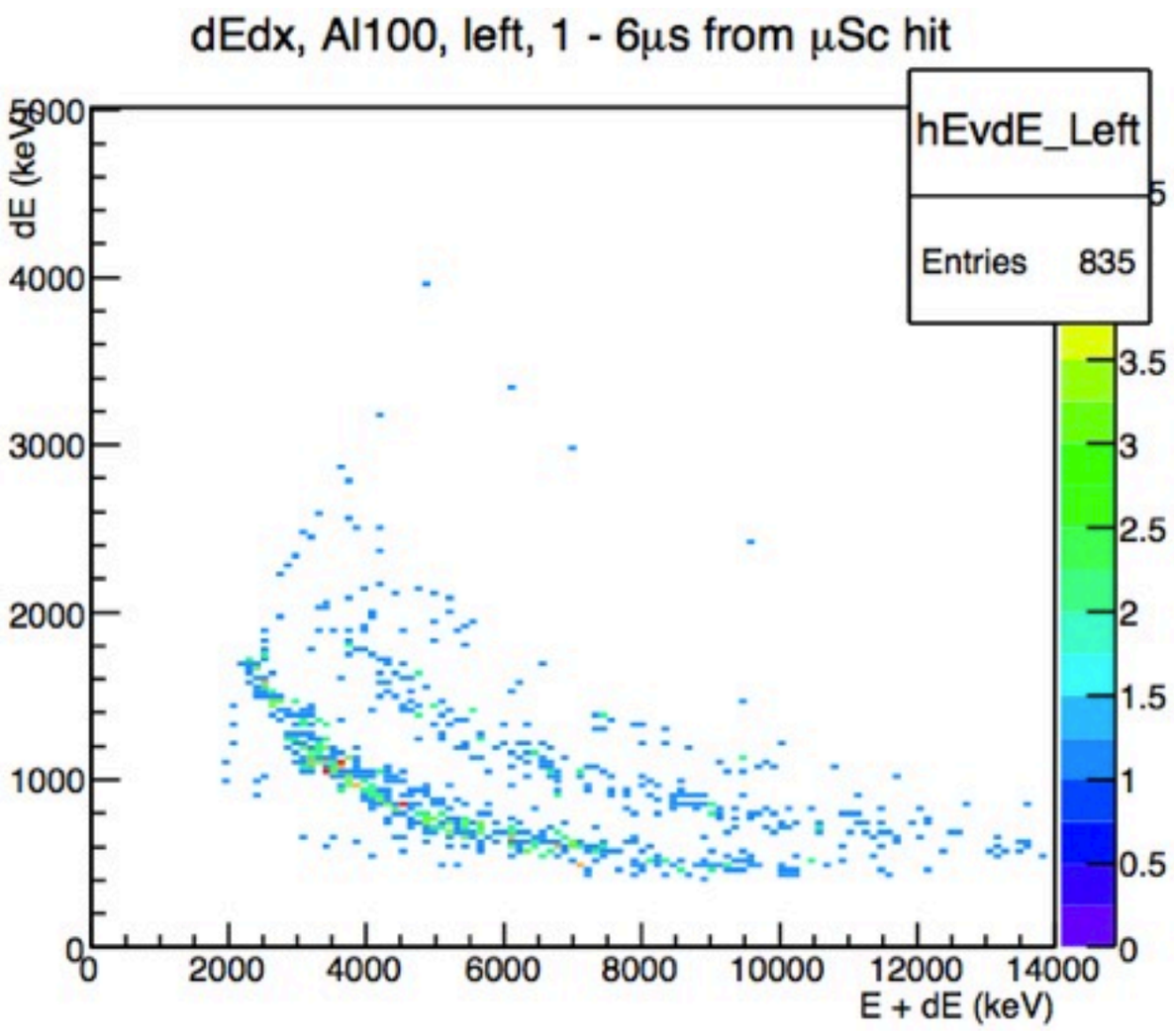


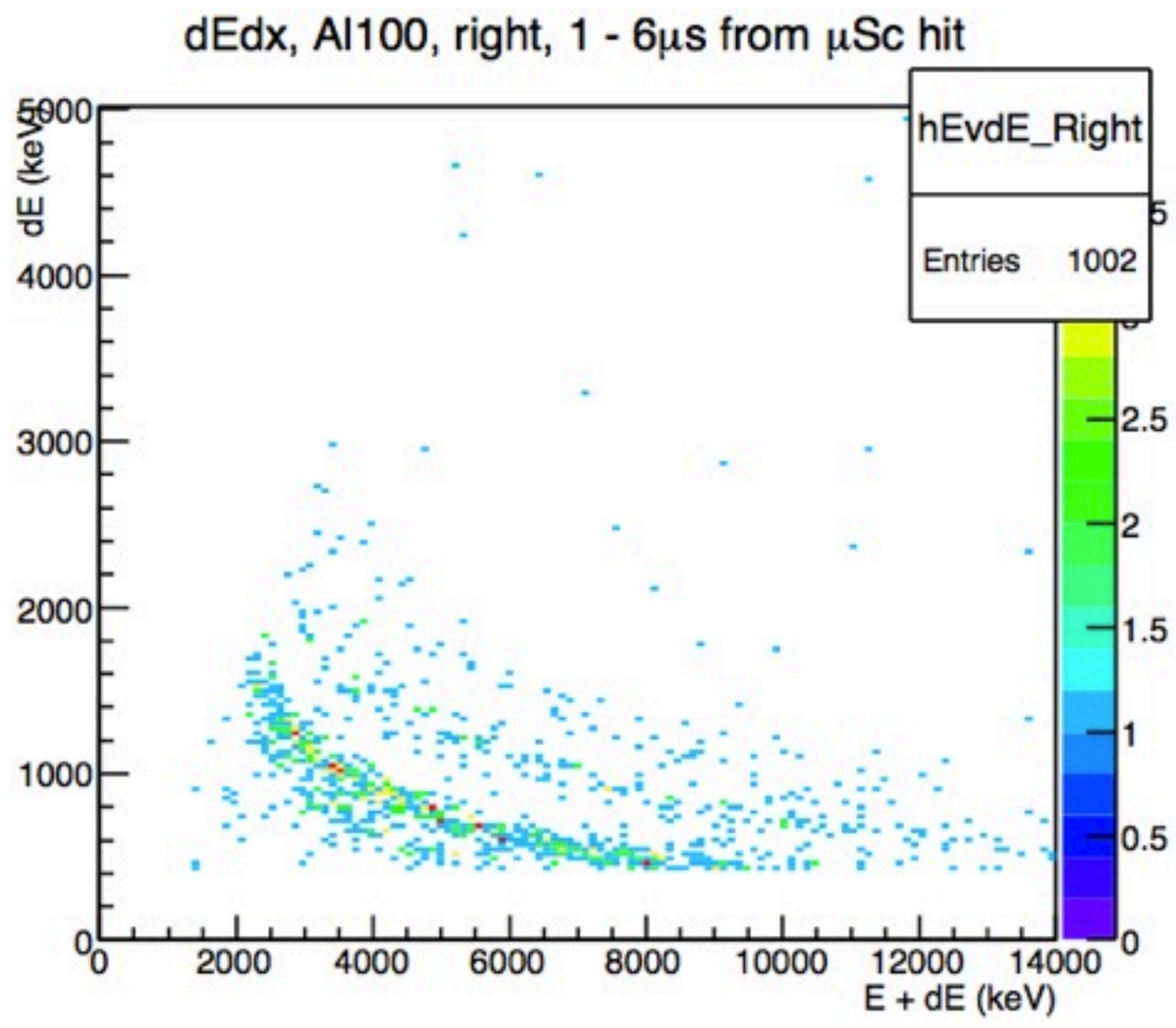
Bias

- Partially/fully depleted, the case of SiR2 (elog 637):
  - α peak was not seen from the ohmic side at its working voltage (310 V)
  - the peak appeared when bias is increased
  - impact: not much
    - the depleted depth was ~1280 um, this is sufficient for protons with KE < 14 MeV
    - we lost some resolution (16% worse)






dEdx, Al100, left, 1 - 6μs from μSc hit
hEvdE_Left
Entries 835
dE (keV)
E + dE (keV)
0
1000
2000
3000
4000
5000
0
2000
4000
6000
8000
10000
12000
14000
0
0.5
1
1.5
2
2.5
3
3.5


dEdx, Al100, right, 1 - 6μs from μSc hit
hEvdE_Right
Entries 1002
dE (keV)
E + dE (keV)
0
1000
2000
3000
4000
5000
0
2000
4000
6000
8000
10000
12000
14000
0
0.5
1
1.5
2
2.5

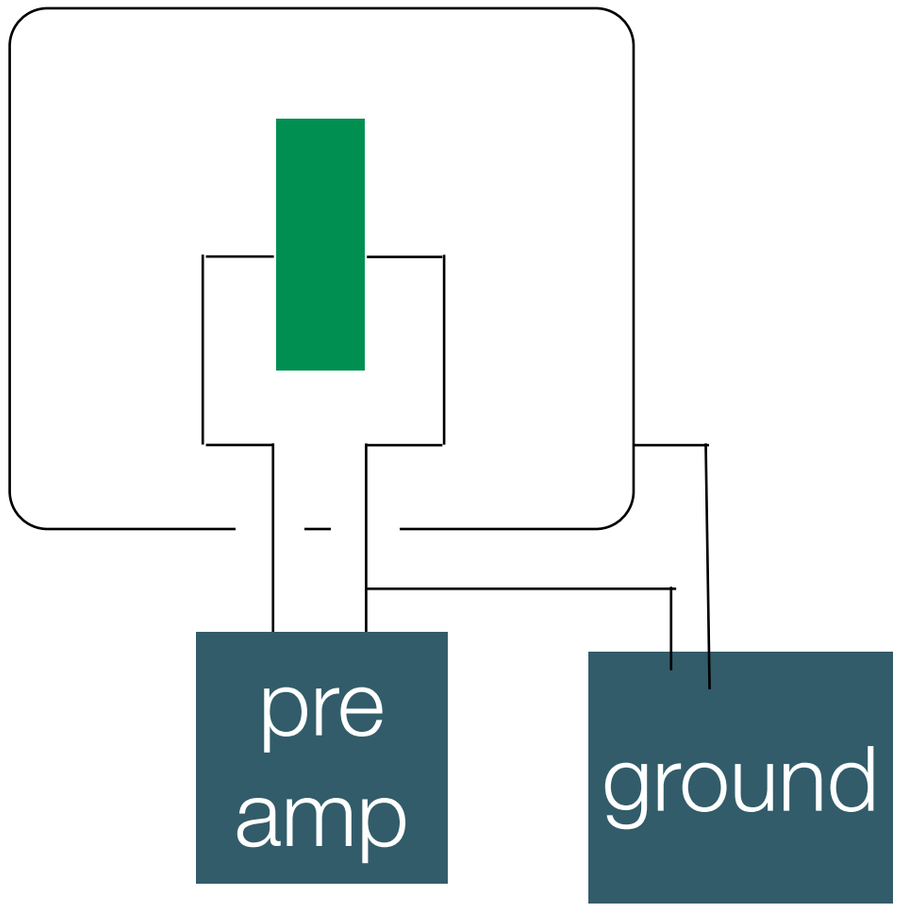
Vacuum

- Safe vacuum level: ~10^{-4} mbar

- Interlock system: disable bias in the 100 - $3x10^{-4}$ mbar (elog: RunPSI2013/195)

Grounding and preamps

- Tried several configurations with different feed throughs:
    - ACCU glass; isolated channels, always work well with MSXs
    - Osaka feedthrough:
        - common ground for all channels,
        - used for MSQs
        - work best when the whole feedthrough is isolated from the chamber



Calibrations (elog 637, 479)

- Am-241, main alpha: 5.484 MeV (85.2%), 5.442 MeV (12.5%)

- MIPs on thick silicon:
  - 1500 µm thick silicon, 90 deg: 466 keV
  - 1500 µm thick silicon, 45 deg: 630 keV

- Pulser: 66 mV input - 1 MeV response

Performance

Detector		Slope	Constant	Resolution (keV)	Peaks used
SiL2		7.93	-116.33	100	α, MIP
SiR2		8.06	-192.70	115	α, MIP
SiL1	1	2.66	-117.34	106	α, 1 MeV pulser
	2	2.56	-44.45	105	α, 1 MeV pulser
	3	2.68	-129.73	110	α, 1 MeV pulser
	4	2.58	-85.48	152	α, 1 MeV pulser
SiR1	1	2.57	-87.96	113	α, 1 MeV pulser
	2	2.72	-292.15	111	α, 1 MeV pulser
	3	2.52	-30.19	146	α, 1 MeV pulser
	4	2.57	-103.67	166	α, 1 MeV pulser