Results from GOAT: Ar-CH_4 operation at 1 to 10 Bar

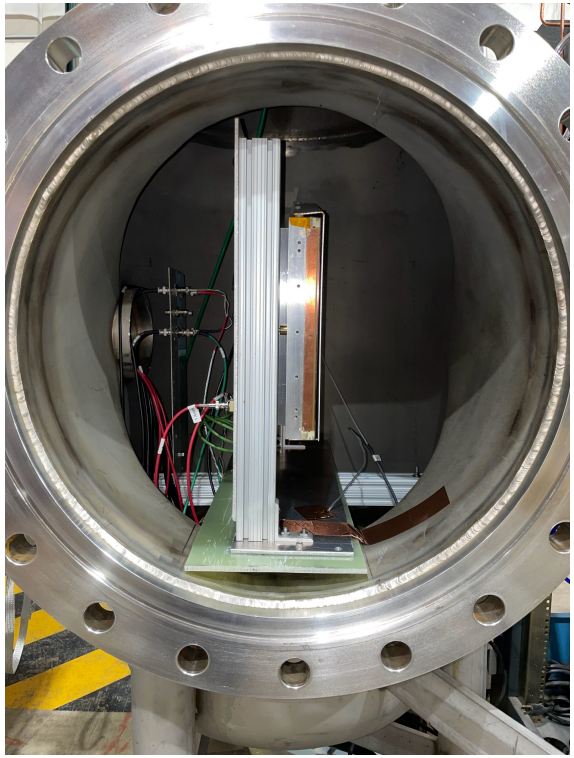
AB

ND-GAr weekly meeting

14th March, 2023

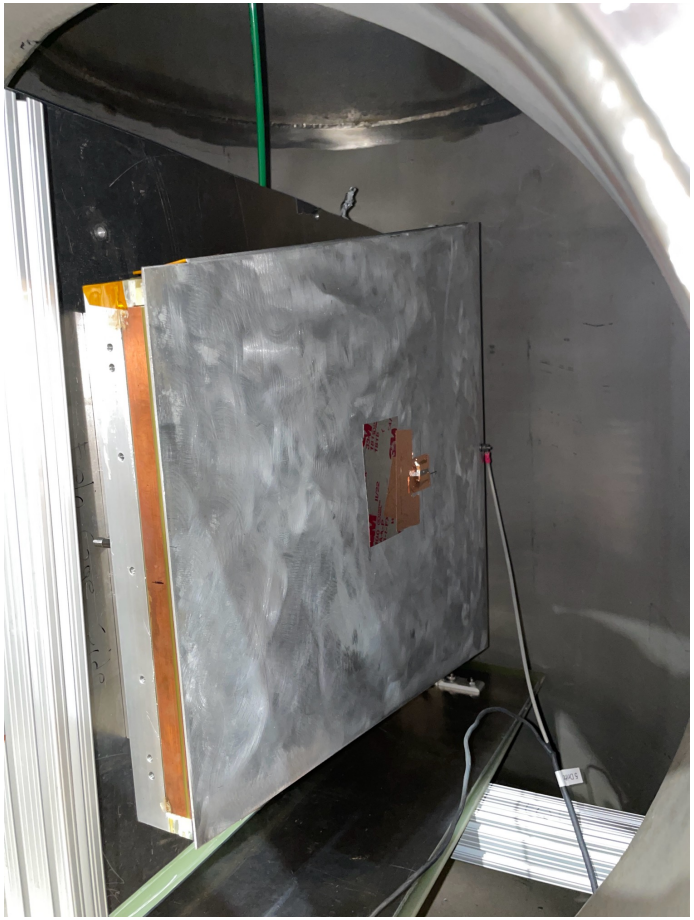
GOAT overview

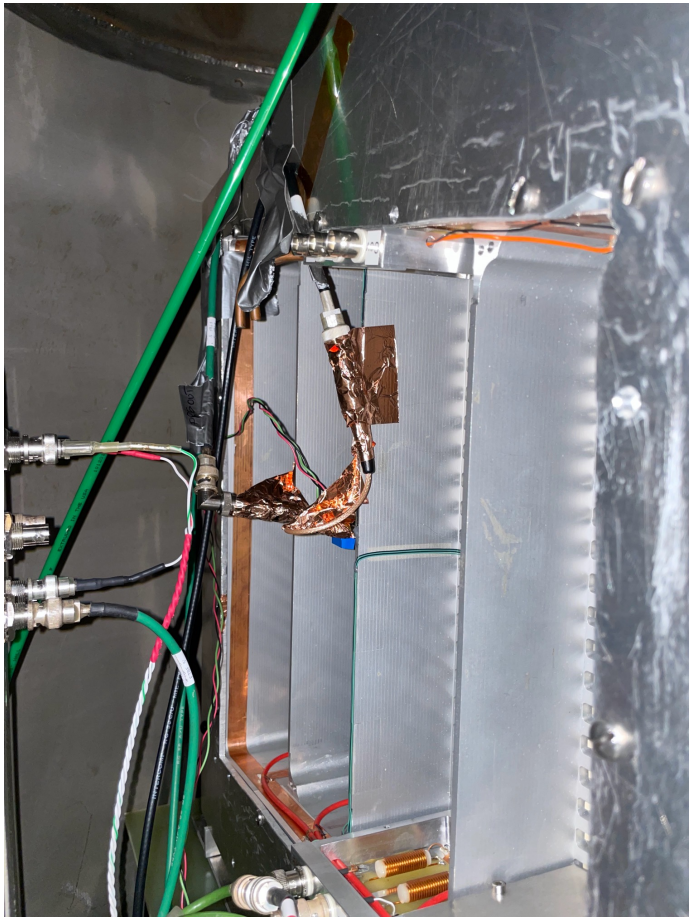
- Large enough to test IROCs
- Up to 10 Bar operation
- ^{55}Fe source to measure gain
- Readout
  - 12 pads ganged together
  - Cremat preamp card
    - 250 e^- noise floor after 672
  - Ortec 672 shaper amp
    - Gain 5-200
    - 3 μsec gaussian shaping
    - Pile-up rejection and baseline restoration
  - Ortec EasyMCA
    - 8000 channel



GOAT

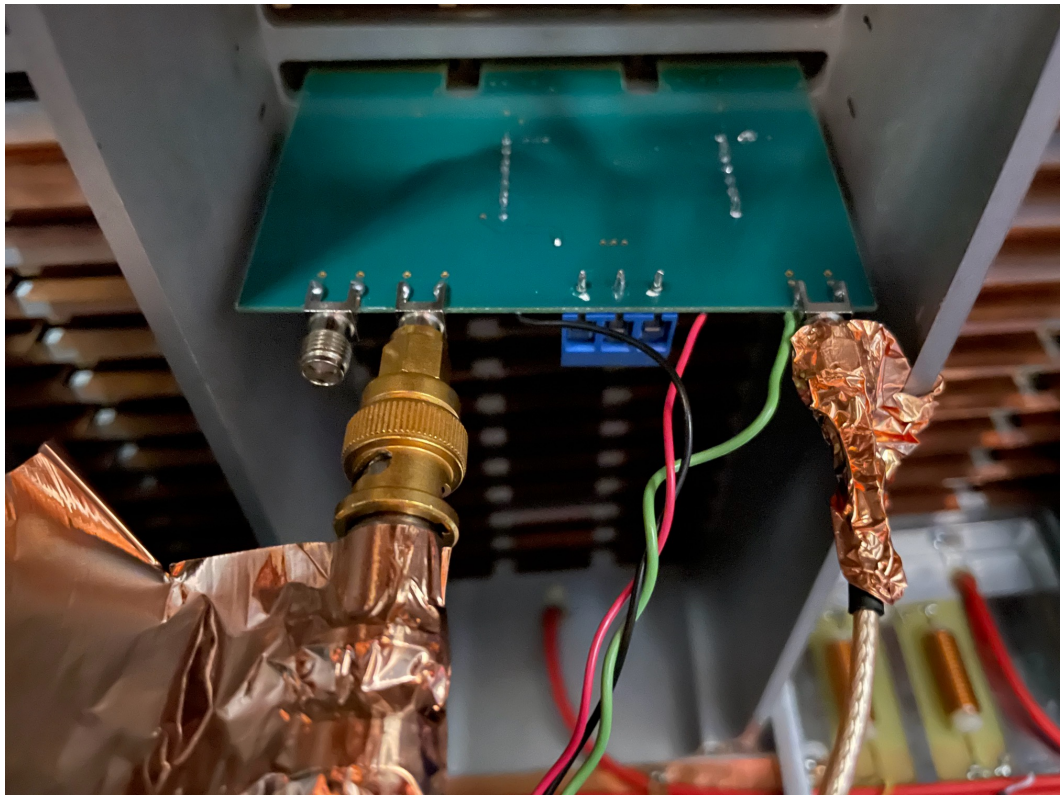
- Cover plate used as drift cathode
  - -400V
- Drift ~ 1.5 cm



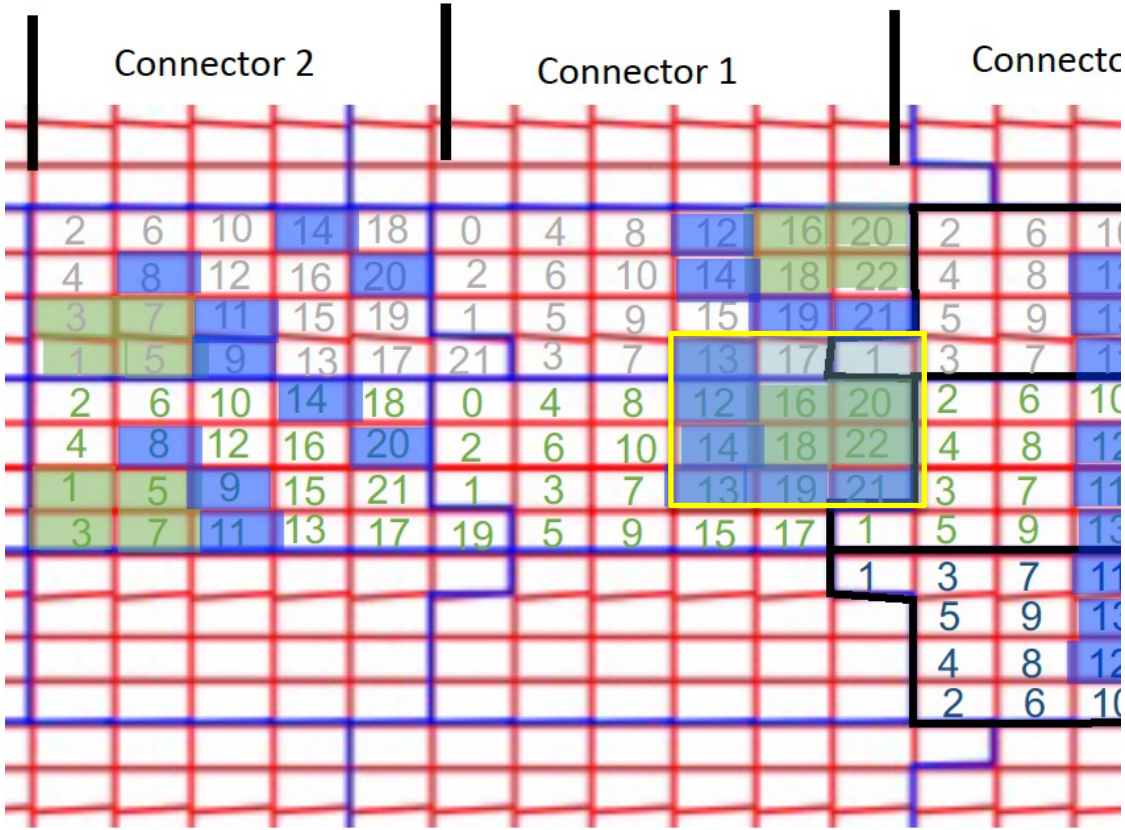


Cremat

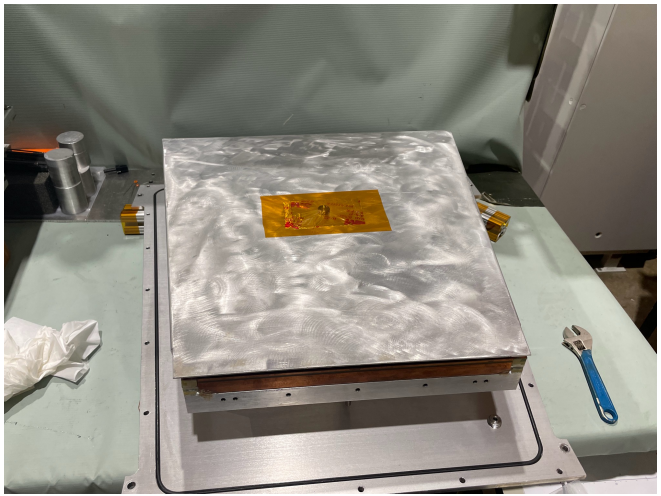
- 2 channels – only using 1
- Output on right
- Pulse on left
  - 5 mV into 12 pF == 60 fC
  - Corresponds to equivalent gain of 2k for ^{55}Fe
- Lots of Cu tape



Readout



- 12 pads ganged together
- ^{55}Fe centered on the array
  - 1 mm aperture

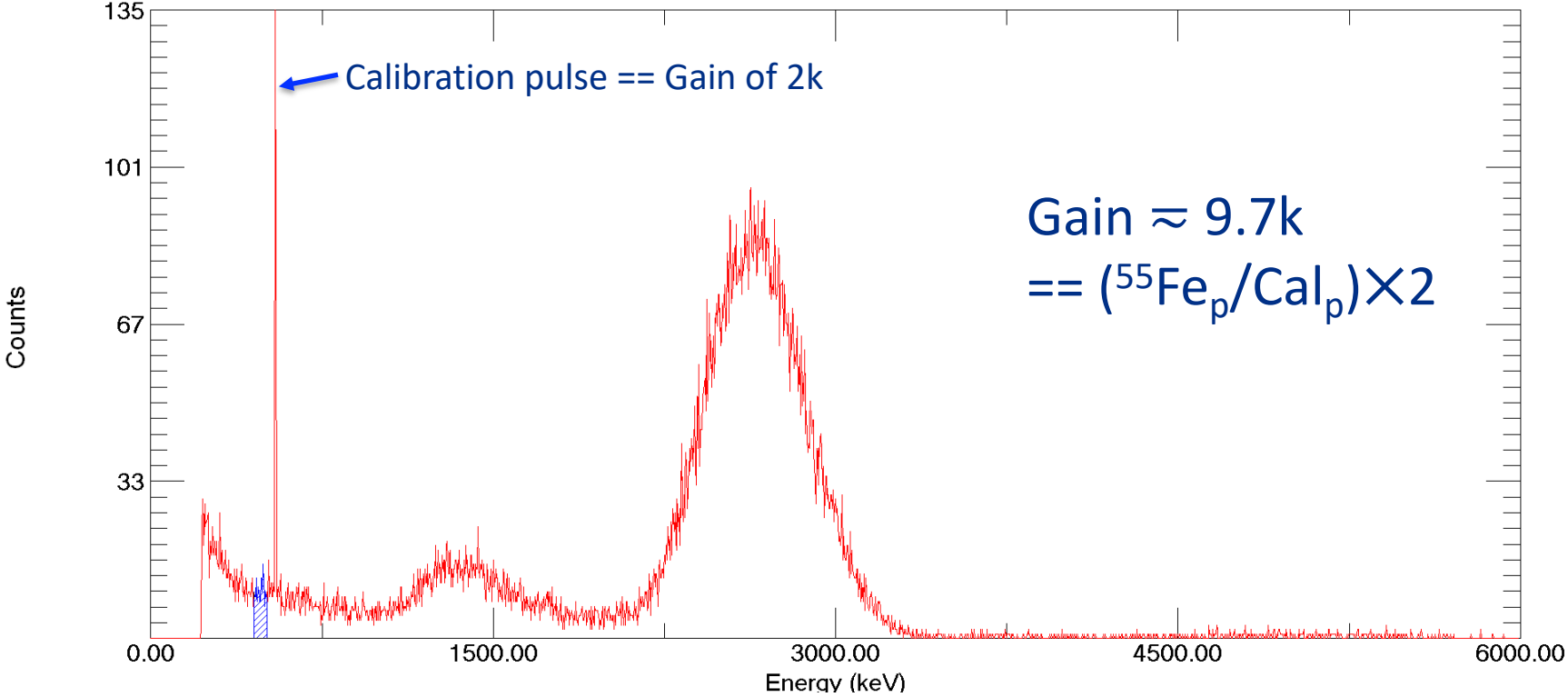


Fermilab

Pump and purge

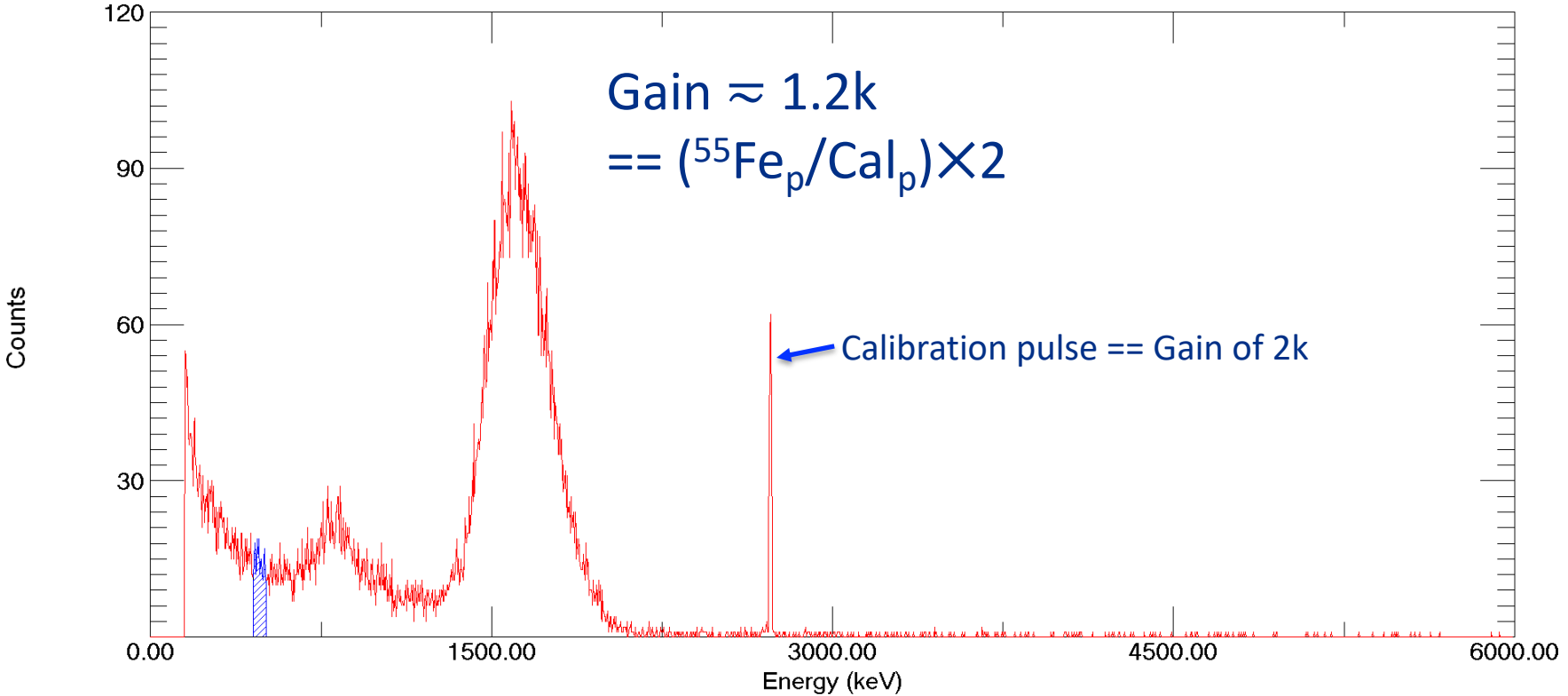
- Went through several pump and purge cycles
  - Got down to ~ 20 mTorr in pump cycles
- After fill, H_2O was not measurable; O_2 ~ 1 ppm

Data: 1 Bar Ar-CH_4 (92-8), VA = 1400V



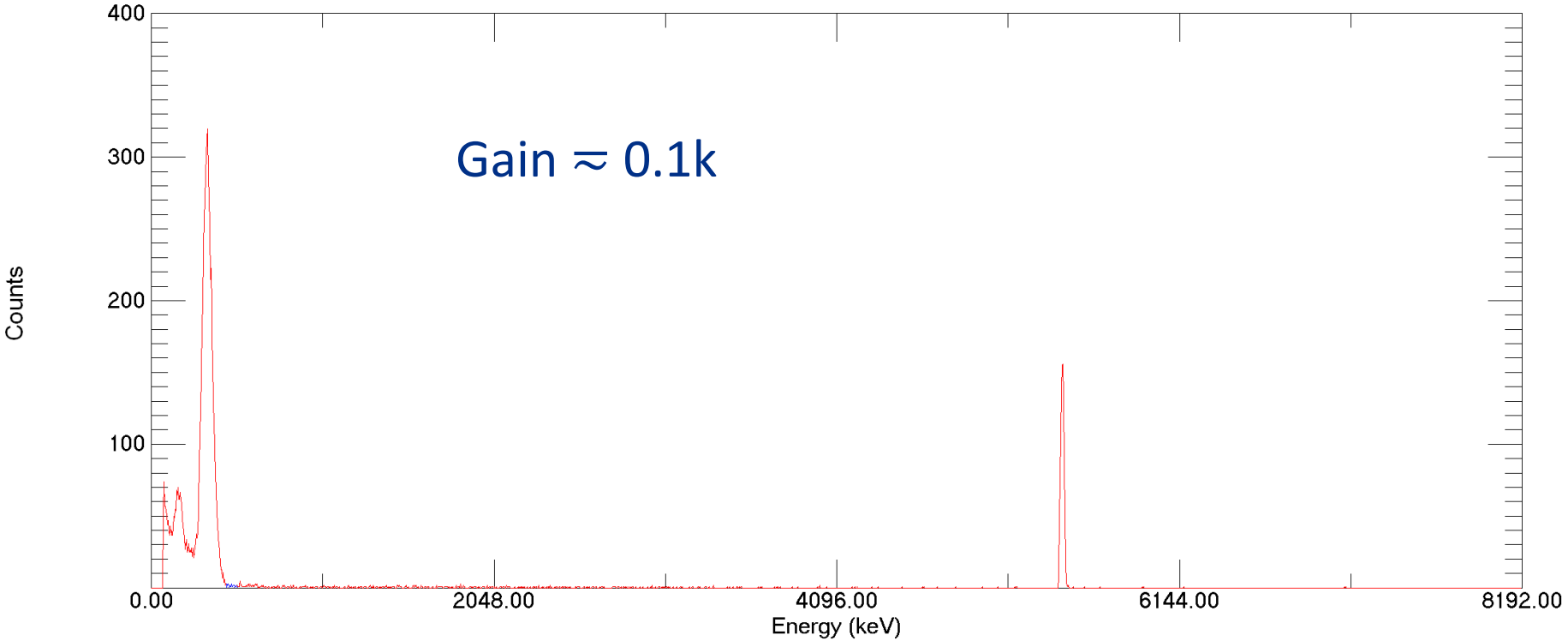
Fermilab

Data: 10 Bar Ar-CH_4 (92-8), V_A = 3150V



Fermilab

Data: 10 Bar Ar-CH_4 (92-8), V_A = 2750V



Fermilab

Gain vs. V_A (Ar-CH_4)

10 Bar

V_A(V)	i_A(nA)	G(k)
3150	1.0	1.2
3050	0.7	0.7
2950	0.6	0.4
2850	0.6	0.2
2750	0.6	0.1

9 Bar

V_A(V)	i_A(nA)	G(k)
3150	1.0	2.8
3050	0.7	1.5
2950	0.5	0.9
2850	0.6	0.5
2750	0.5	0.3

1 Bar

V_A(V)	i_A(nA)	G(k)
1400	0.4	9.7
1350	0.2	5.2
1250	0.1	1.7
1150	0	0.6
1050	0	0.2

Gain vs. V_A (Ar-CO_2)

10 Bar

V_A(V)	i_A(nA)	G(k)
3250	1.7	0.5
3150	1.5	0.3
3050	1.2	0.2
2950	1.1	0.1

Discussion

- Operation of an ALICE IROC at 10 bar with sufficient gain has been demonstrated.
  - Gain 1.2k at 3150V on anode.
  - Leakage current very low at all test V_A
  - Likely can go to significantly higher V_A (3400V?)
- Some additional studies with Ar-CH_4 might be in order
- Soon on to GORG: