

**Introduction:**

- HALO-1kT is a proposed supernova detector to be built at LNGS in Gran Sasso, Italy
- Next generation of the Helium and Lead Observatory
- 1kT of lead as the neutrino target
- 4.3km of He<sup>3</sup> proportional counters
- A low background counter
- In the full 4.3km we want 0.5Hz of background
- Internal radioactivity goal is 0.05Hz

**Methods:**

- Four 2m prototype stainless steel counters were provided
- Started by taking base background measurements at SNOLAB attached to the HALO test stands
- Took data(see table)
- Took 3 days of calibration data with the HALO neutron source

Counter	One	Two	Three	Four
Full Run Length	119d 17h 56m 17s	119d 17h 56m 17s	119d 17h 56m 17s	97d 26m 40s
Gasses	He3,CF4, He4	He3, He4, CF4	He3, He4, CF4	He3, He4, Ar, CO2
Pressure	2.5atm	1.5atm	2.5atm	2.5atm
Recommended Voltage	1450V to 1700V	925V to 1475V	1225V to 1850V	900V to 1425V
Run Voltage	1335V	965V	1255V	840V
Full Run (551KeV to 1000KeV)	128.60 Events / day	102.02 Events / day	280.12 Events / day	89.090 Events / day
Calibration minus Full run (551KeV to 1000KeV)	2111.9 Events / day	817.6 Events / day	2151.91 Events / day	895.73 Events / day
Full run above 1MeV	609.93 Events / day	310.87 Events / day	2044.1 Events / day	520.86 Events / day

Above table shows prototype counter details and initial results

## Low Background Neutron Counters for HALO-1KT

Esther Weima  
Laurentian University  
HALO

**Results:**

- Initial results show prototype counters have backgrounds that are 50 times too high
- For 100 Events/day in neutron window (551KeV to 1000KeV)
- 100 Eventsx4300m / 2m = 215 000 Events / day
- 215 000 [Events/day] / (24[hrs/day]x3600[s/hr]) = 2.5Hz

**Current work:**

- Counting bulk material of counters one and three
- Counters have had a hole drilled into them and clamps and Swagelok attached so they can be attach to a radon counter
- Covid has delayed this work

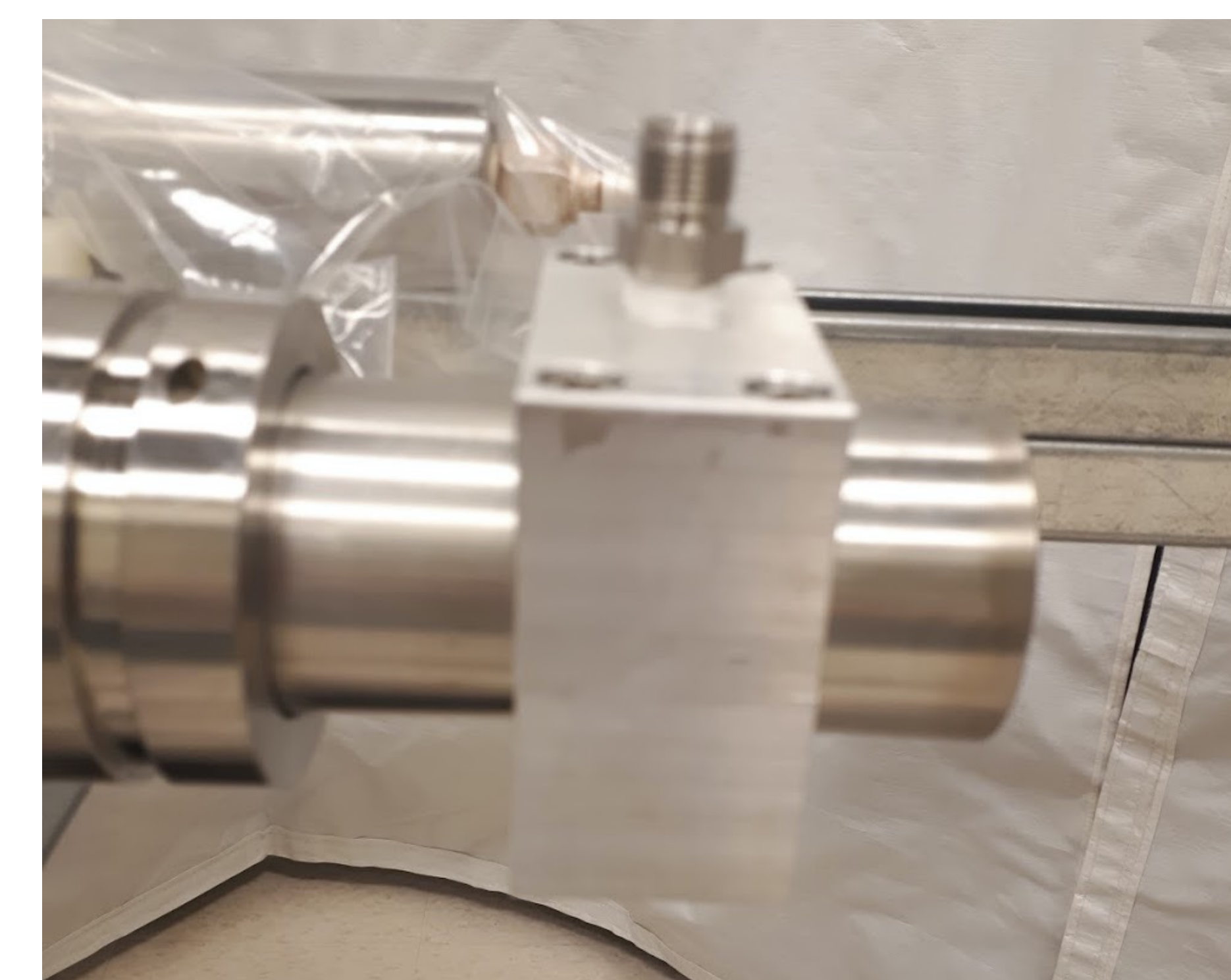
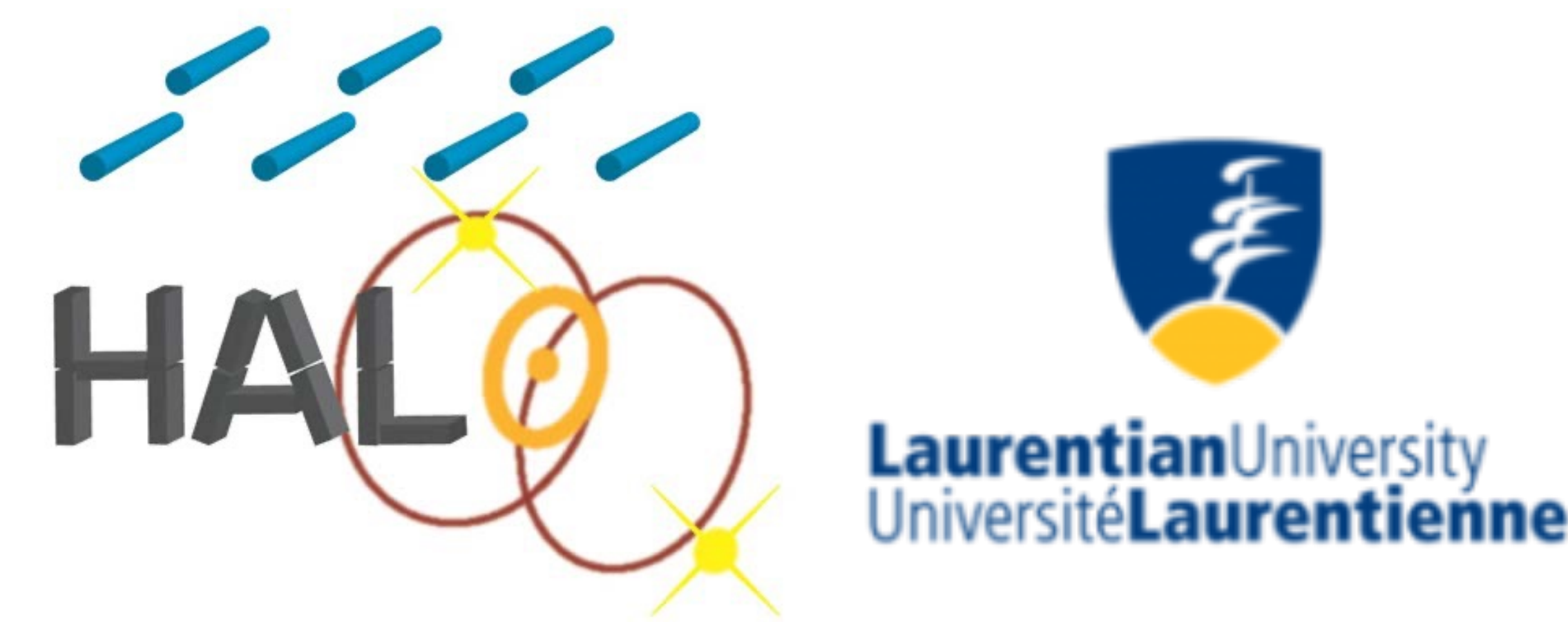
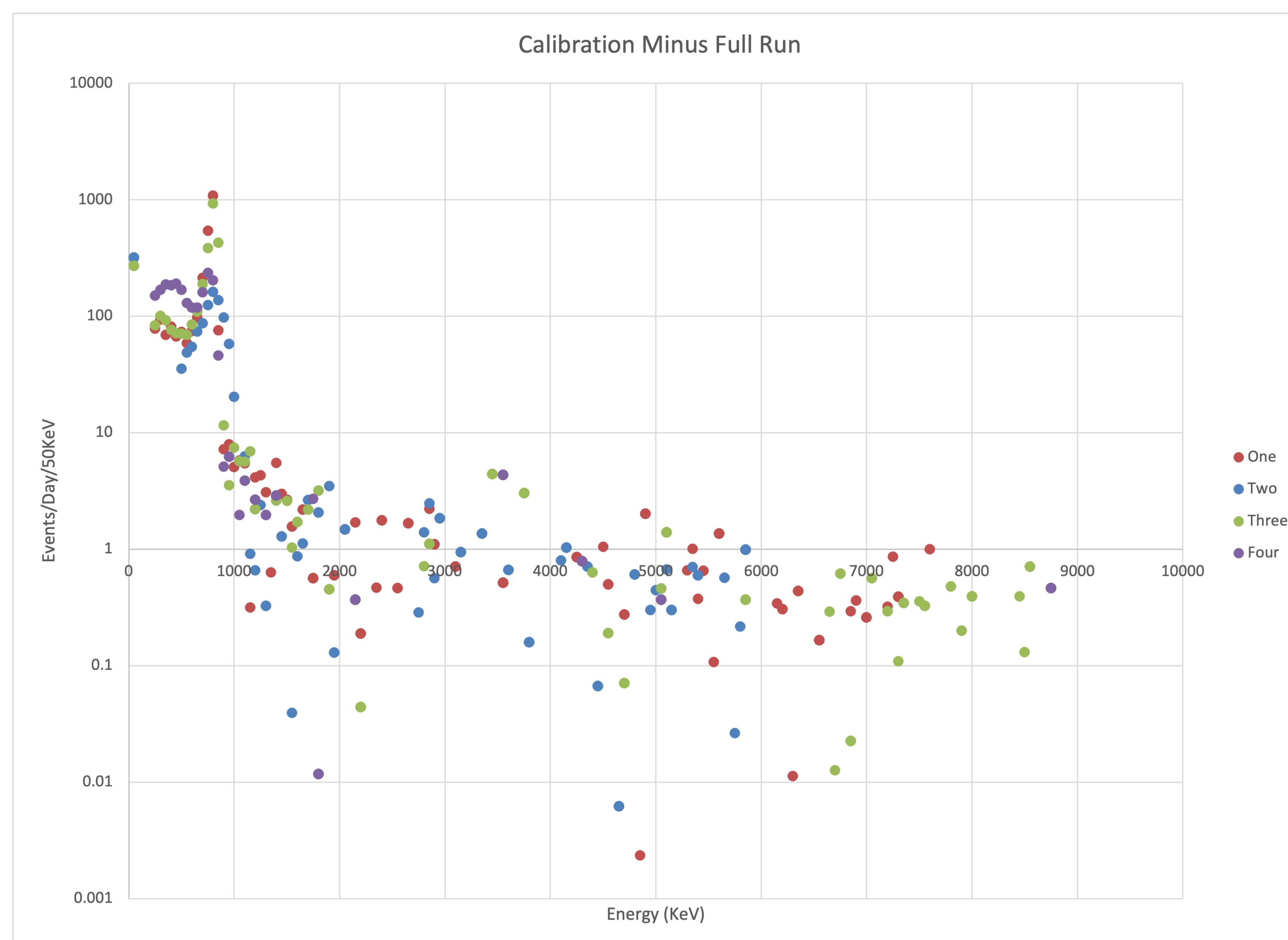


Photo: counter with clamp attached, threading to go to Swagelok. Swagelok will go to radon counter



Graph shows the counters all have a distinct neutron peak, although counter One and counter Three have the best peaks

**Conclusions:**

- It is clear from the initial research the backgrounds need to be reduced
- Background options include:
  - Copper plating
  - More pure materials

**Future work:**

- Cut off and count end caps/electronics
- Count anode wire