

# —PREPAREDNESS—

Metrology for mobile detection of ionising radiation  
following a nuclear or radiological incident.

## Preparedness – WP3: Low-cost spectro-dosimeters

EMPIR Preparedness – Online Stakeholder Workshop

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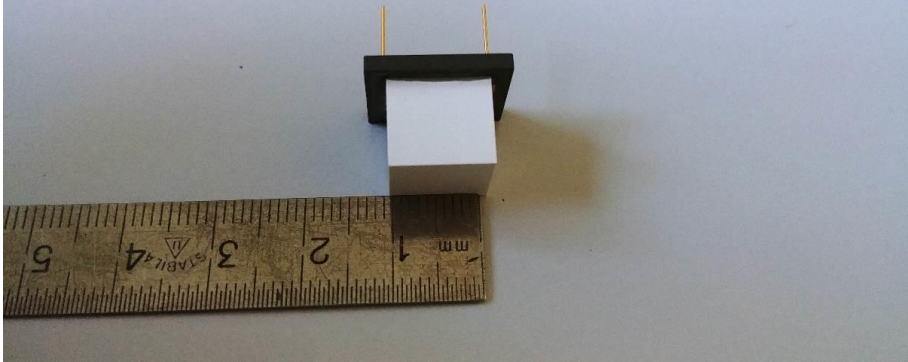
## A3.3.2

### *Development of a low-cost dose rate detector*

Basic design principle for the low-cost detector was to select a material with low but sufficient energy resolution to allow to compensate energy dependent sensitivity.

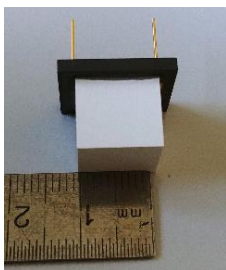
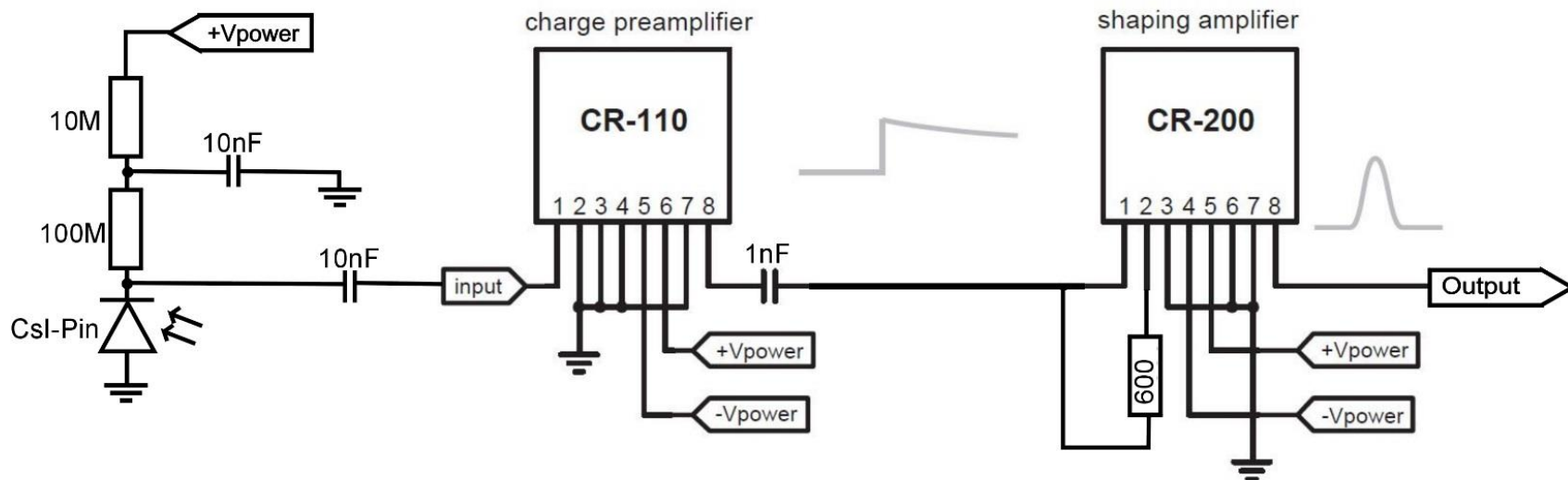
Therefore, the S 12425-10 PIN photodiode with attached 1cm<sup>3</sup> CsI crystal from Hamamatsu was selected.

J. Thoma, C. Feuerstein, U. Stöhlker

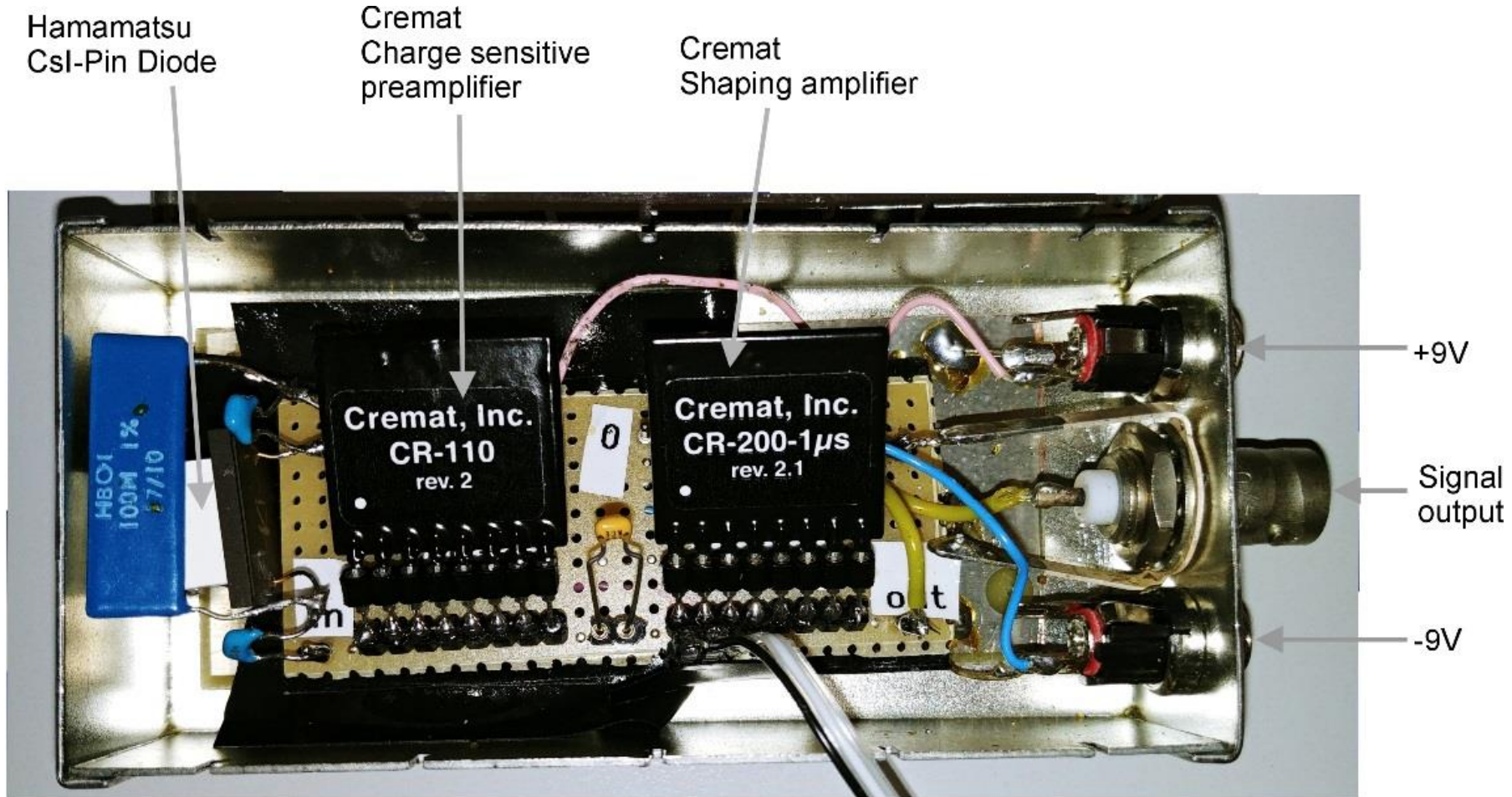


The signal is prepared using an analog amplifier/shaper. The output of the preamplifier is connected to a digital unit which includes 8 comparators, each connected to a counter. Each counter has an I2C interface. A Raspberry Pi is used to read the data from the counters and to calculate an energy compensated dose rate by application of the band method.

# Design of the analog preamplifier/shaper



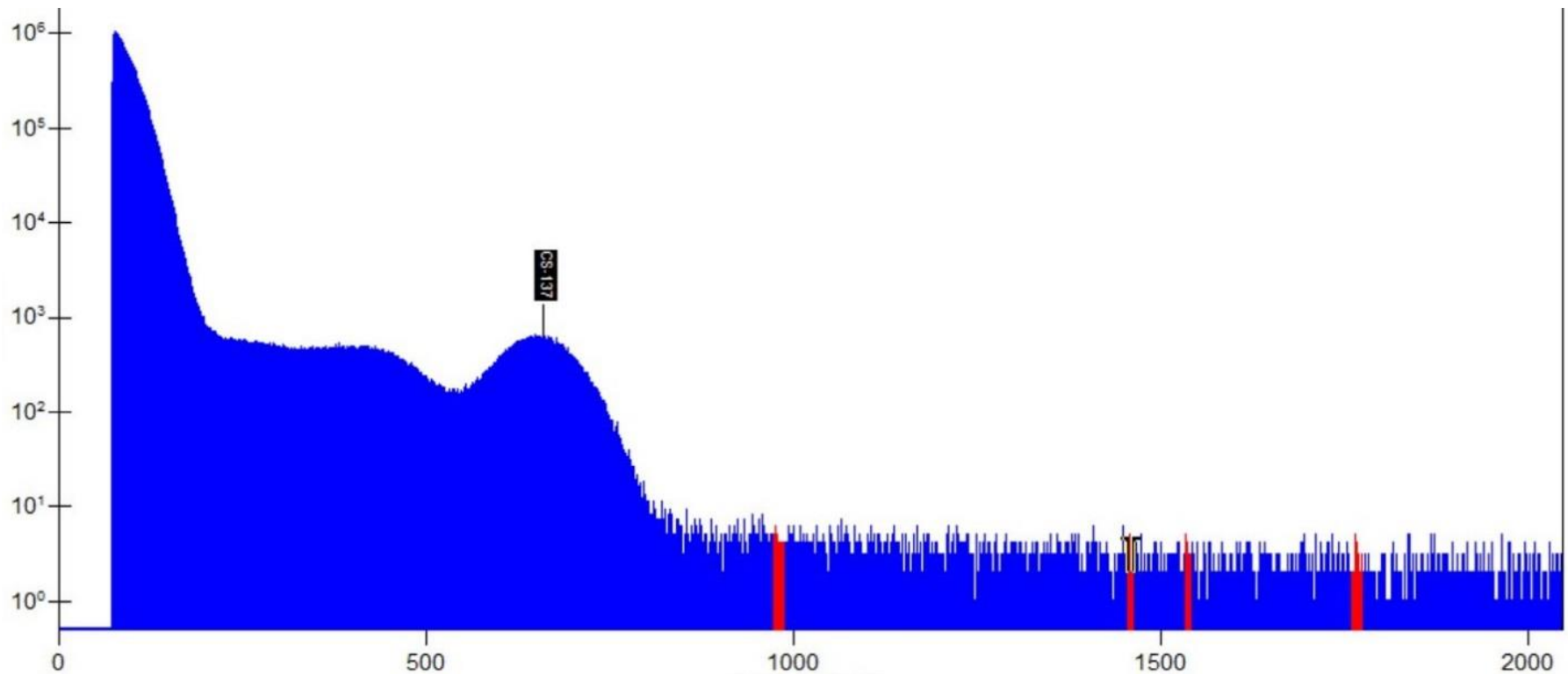
# Analog preamplifier/shaper



# Measurements to characterize the CsI-PIN diode and the preamplifier/shaper

The spectroscopic capabilities of the CsI-PIN diode were investigated using Cs-137, Co60, Eu-152 and Lu-176 sources.

The detector was powered by +9V/-9V and connected to the MCA (Canberra Inspector-1000), spectra were recorded using Genie-2k.





# Kromek D3S

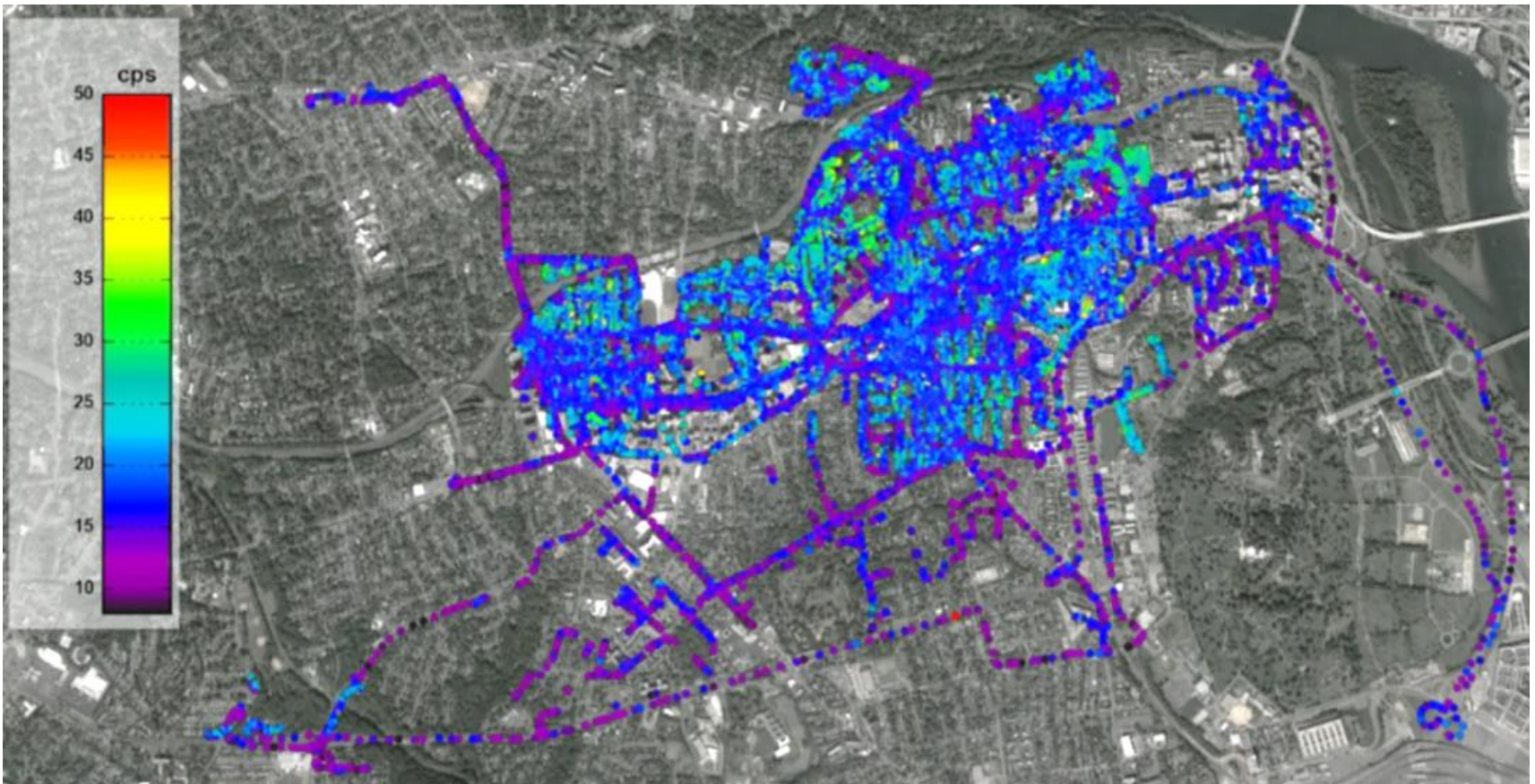
- Dual gamma and neutron detector for homeland security
- Designed to be worn by government employees (police, fire, postal etc) for real-time radiation mapping of urban environment



## Specifications:

Gamma detector :	CsI(Tl)-SiPM, 2" x 1" x 1/2"
Energy resolution:	7% (at 662 keV)
Energy range:	30 to 3,000 keV
Sensitivity:	500 cps/ $\mu$ Sv/h
Dose rate limit:	15 $\mu$ Sv/h (at 662 keV)
Connectivity:	Micro USB, Bluetooth®
Neutron detector:	LiF:ZnS-SiPM, 32 mm $\times$ 100 mm
Count rate limit:	5,000 cps
Size:	132 $\times$ 80 $\times$ 23.5 mm <sup>3</sup>
Weight:	237 g
Battery life:	12 h

# Kromek D3S



Radiological “heat” map of urban area produced by centralised database collecting data from multiple D3S units (DARPA trial, Washington DC)

# Kromek D3M

- Modified version of D3S
- Photodiode used for high dose-rate measurement
- Other improvements:
  - IP65 rating
  - Improved battery life (24 hours)
  - Indoor tracking for GPS denied areas
  - Local display and alert (OLED Screen)
  - Vibrational and Sounder alarm
  - Internal storage (8GB MicroSD card)
  - Improved Linearity and stability for reduced false alarm rates
  - Low Energy Bluetooth (BLE)
- Preliminary dosimetric measurements made at NPL
- D3M will be produced for purchase and use by members of the public

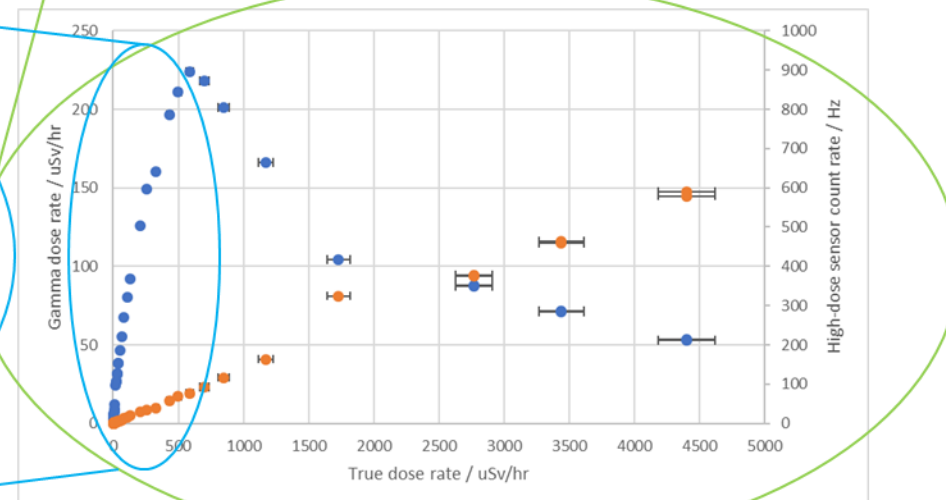
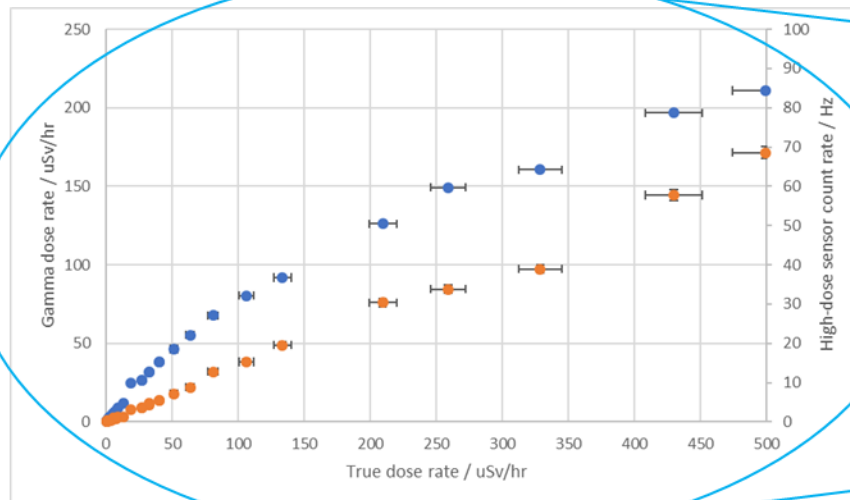
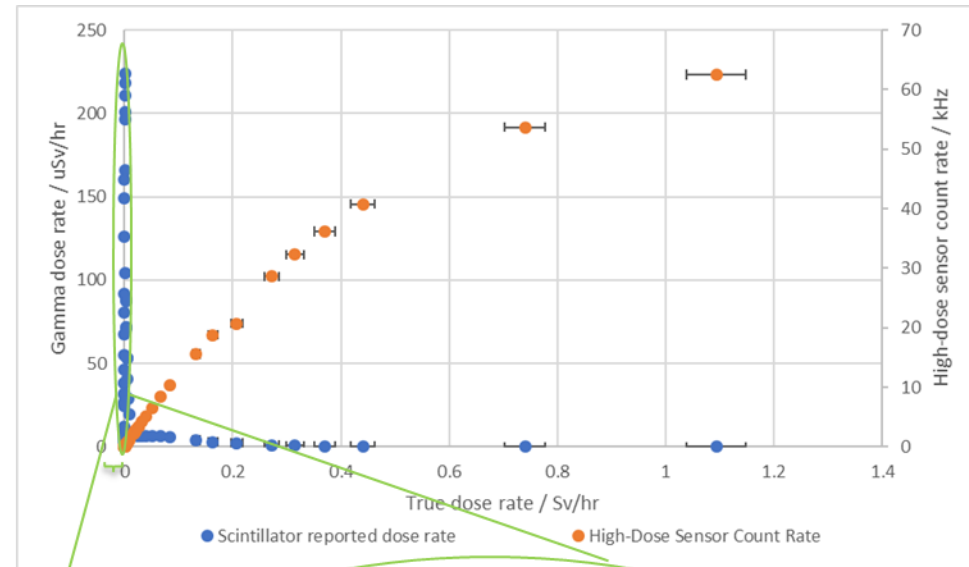




# Preliminary measurements – Dose range and accuracy

Plotted are the responses for Cs-137 (blue: scintillator dose reading, orange: high-dose sensor count rate)

The scintillator dose rate was accurate at low dose rates for both Cs-137 and Co-60, staying within 10% up to 50  $\mu\text{Sv/hr}$



# Thank you for listening!



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