Australian Government

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Use and Benefits of Gamma Imaging for Radiation Protection

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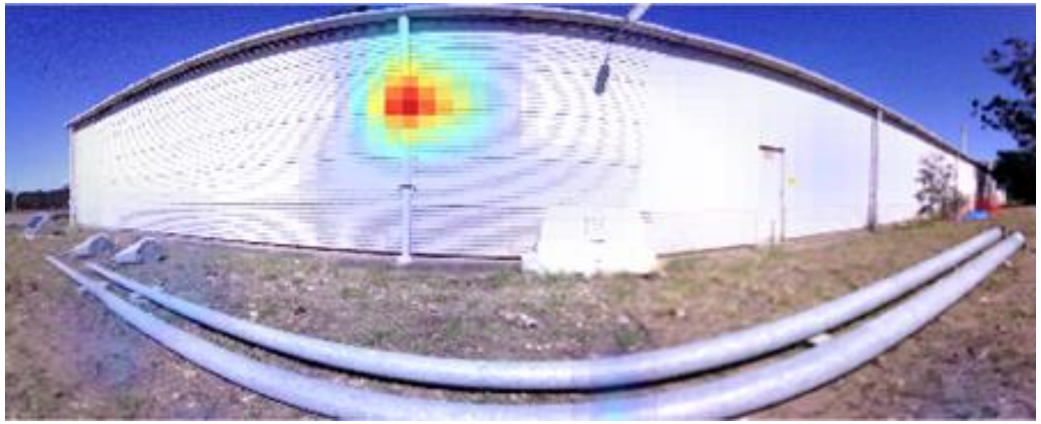
Science. Ingenuity. Sustainability.

Radiation Imaging

- Advanced radiation detection technique
- Offers new insight into complex radiation environments
- Maximise worker safety
- Optimise decision making



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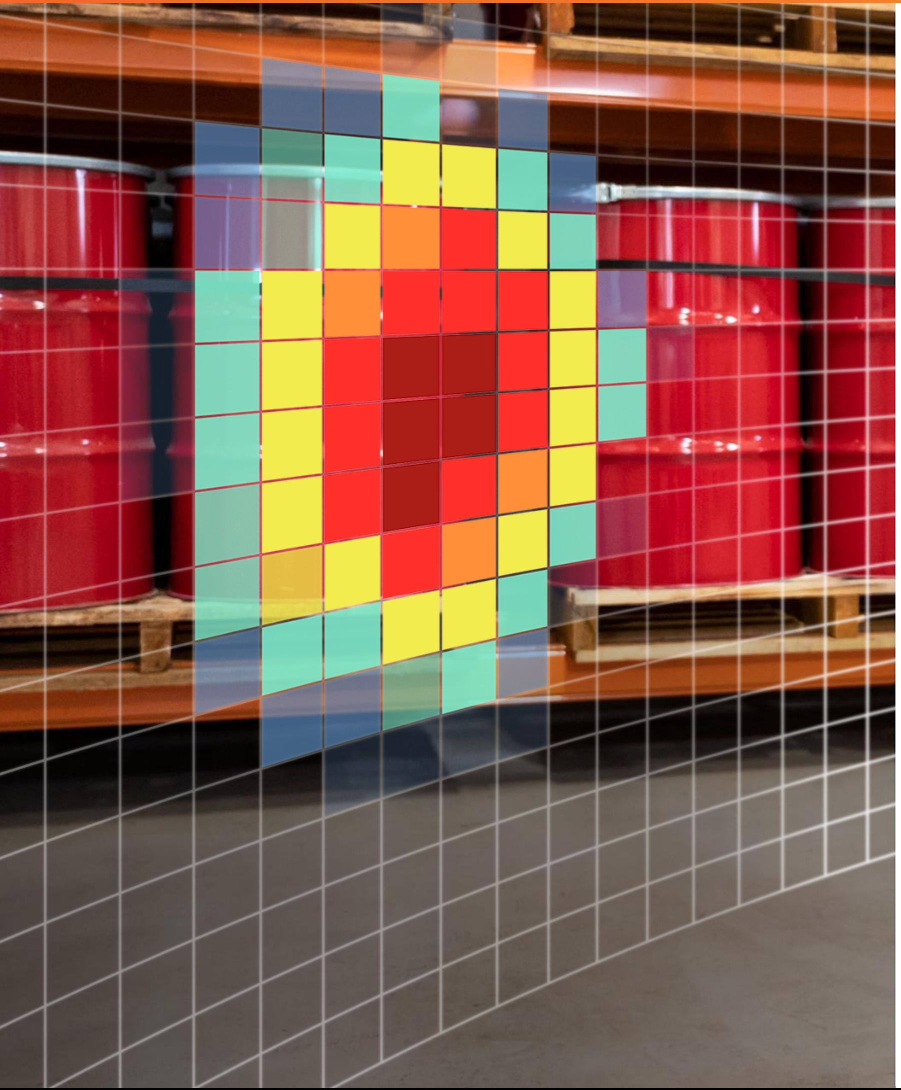

CORIS360®

Introducing the world's most advanced radiation imaging solution

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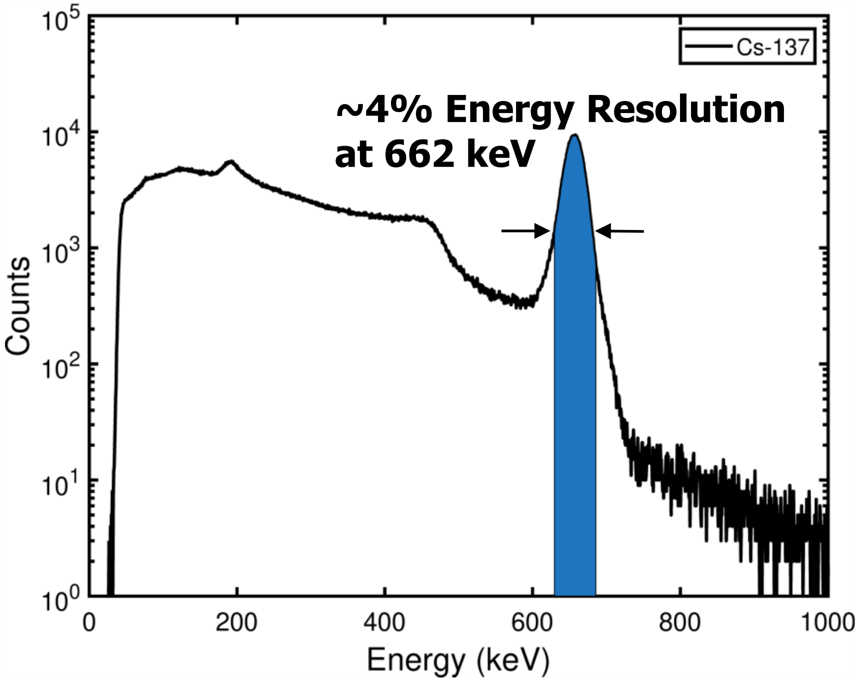
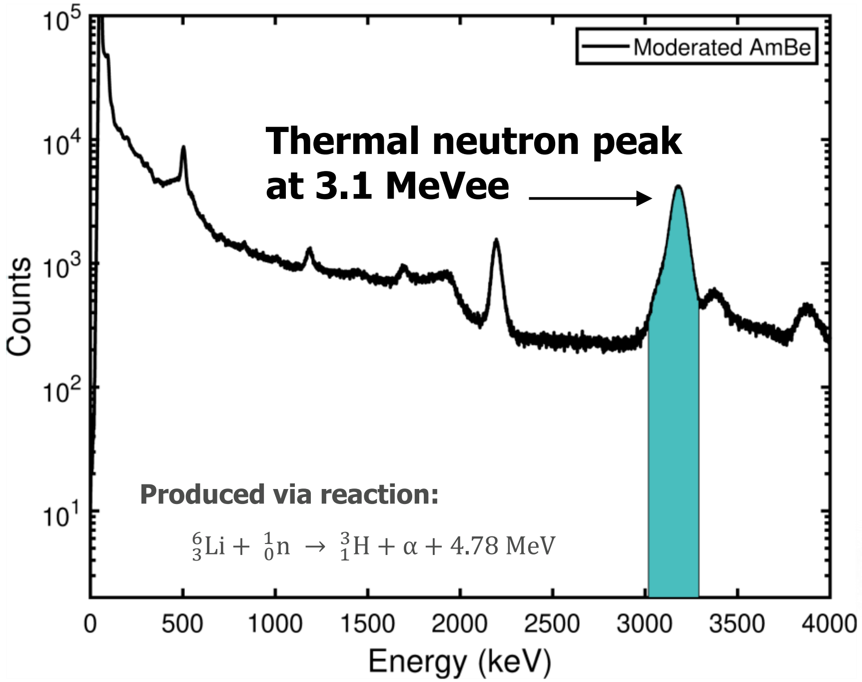
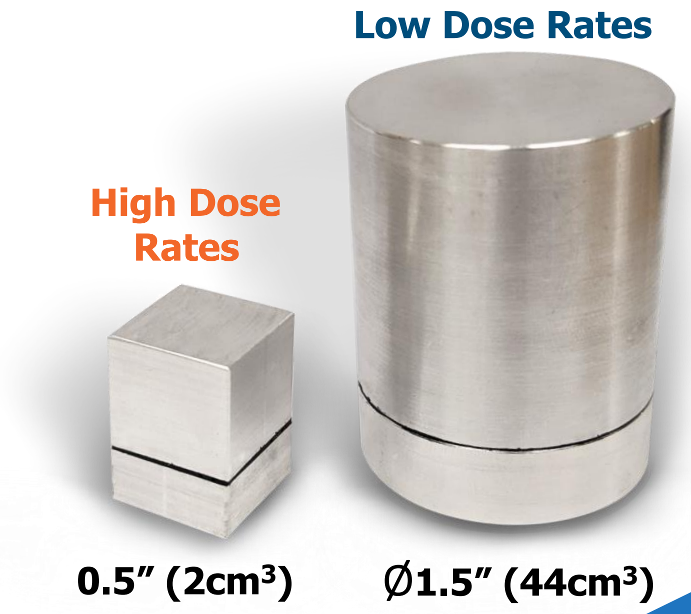
Detector Technology

- Detection capability powered by CLLBC detectors (Radiation Monitoring Devices)





Two Detector Geometries



System Specifications Overview

Specification	Value
Detector Type	CLLBC Scintillator w/ SiPM Array (0.5”/Ø1.5”)
Energy Resolution	< 4% FWHM @ 662 keV
Energy range	40 keV - 3 MeV Gamma Thermal Neutron Detection
Imaging Region of Interest	Peaks and non-peaks
Gamma Field of View	360° x 90° (H x V)
Optical Field of View	360° x 90° (H x V)
Max. Angular Resolution	21° ± 1°
Dose Rate Range	0.5 µSv/h - 2 mSv/h (1.5" detector) 1 µSv/h - 40 mSv/h (0.5" detector)
Size & Weight	210 mm × 425 mm (D x H), 21.5 kg
Communication & Control	Ethernet connected to PC/Laptop
Rating	IP 54, 5-40 °C

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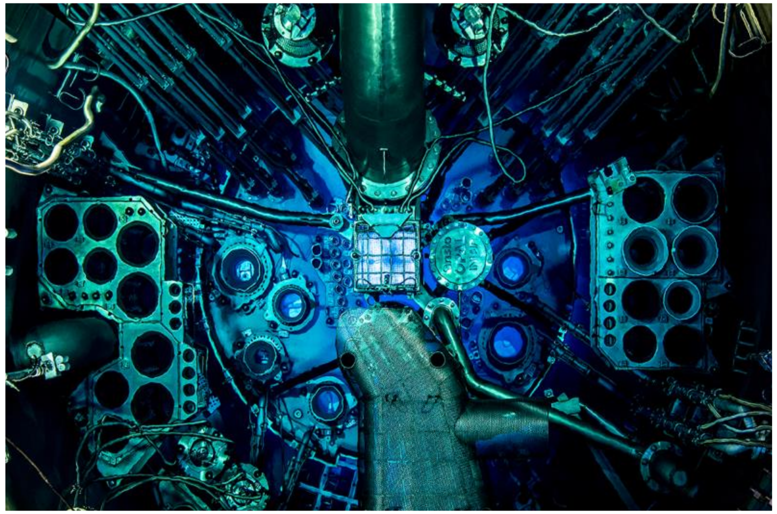
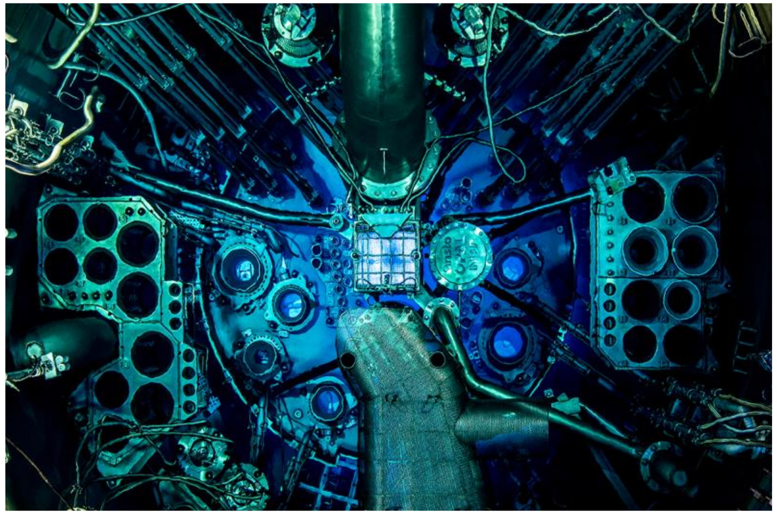
How does CORIS360® work?

Compressed Sensing



VS



Original camera file – **UNCOMPRESSED** | 26.9 MB

JPEG file – **COMPRESSED** | 690 KB

Data collection → Compressed sensing ← Compression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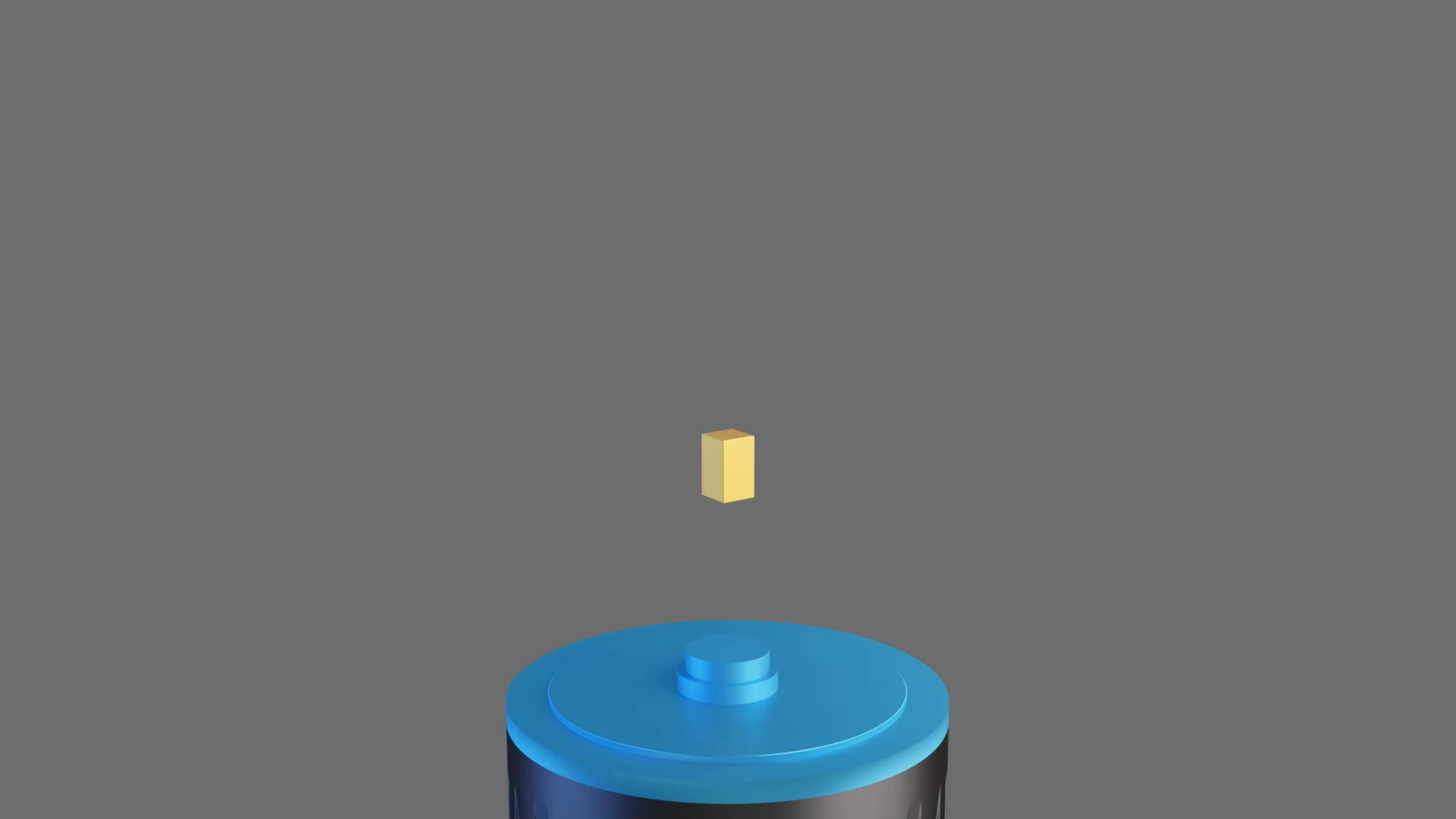
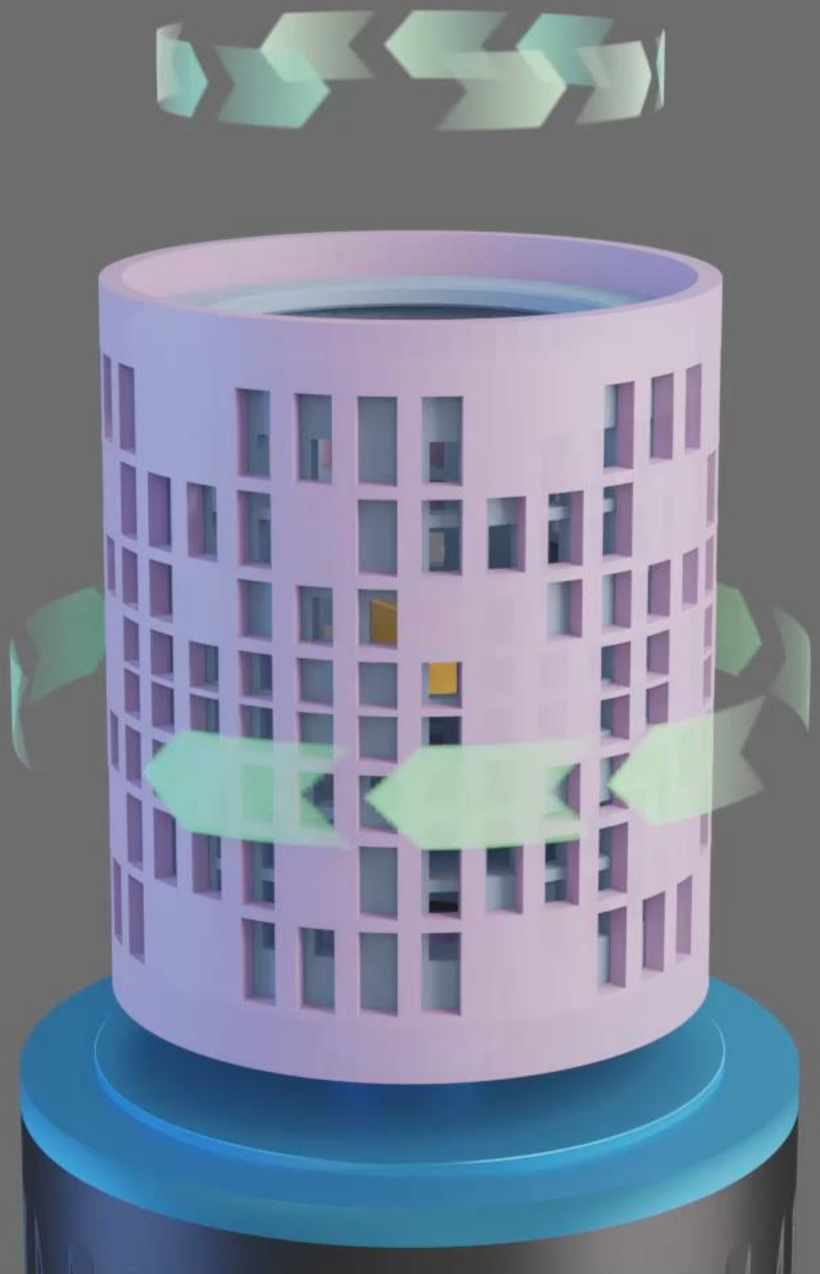


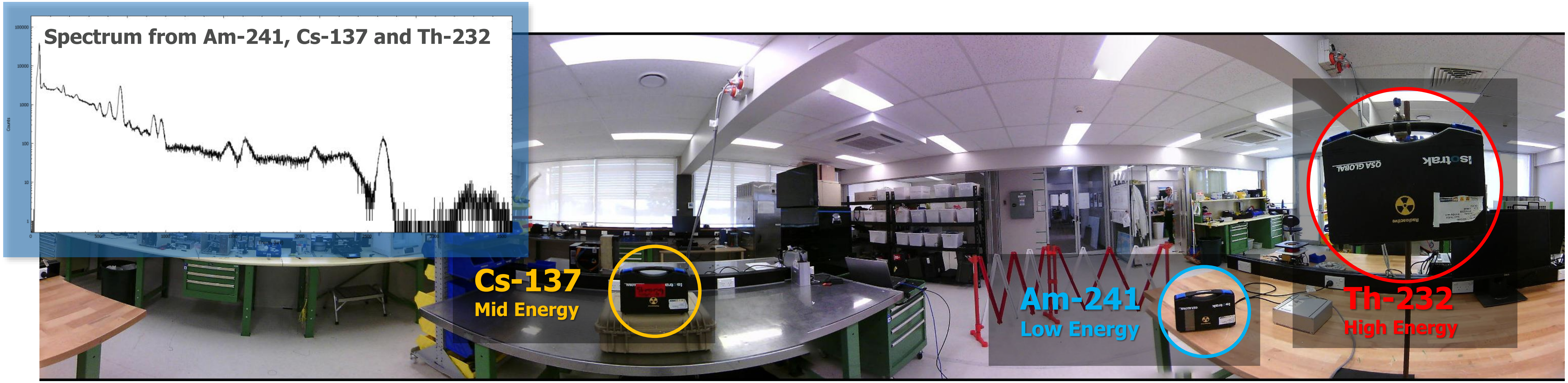



Cs-137
Cs-137

Case Studies

Laboratory Demonstration

- Measurement from 40 keV to 3 MeV over the full 360° FOV
- Example imaging 3 sources between 60 keV and 2.6 MeV



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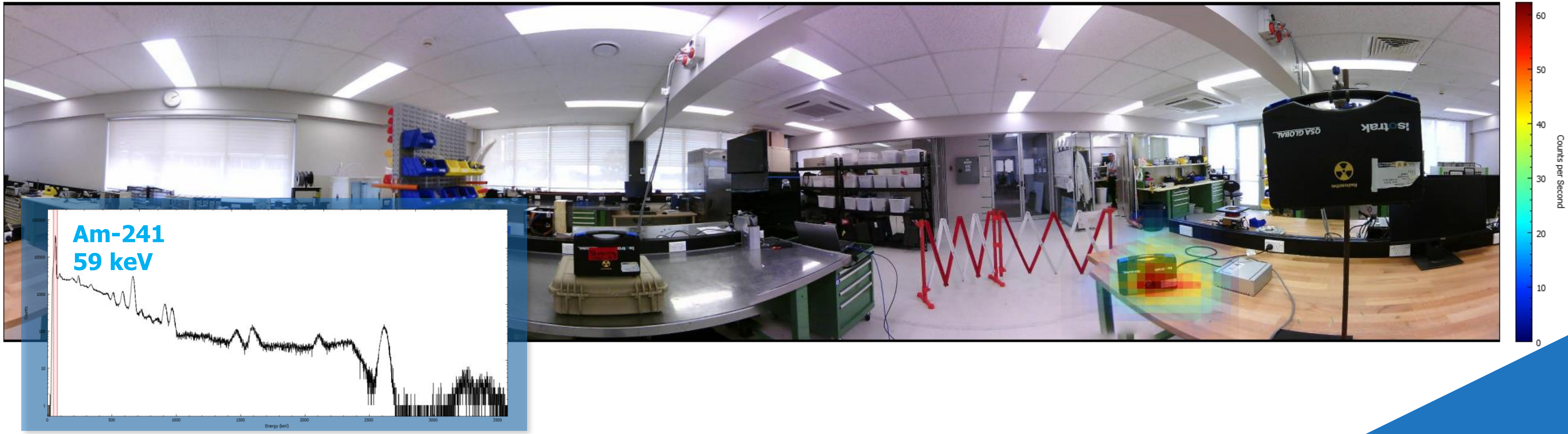

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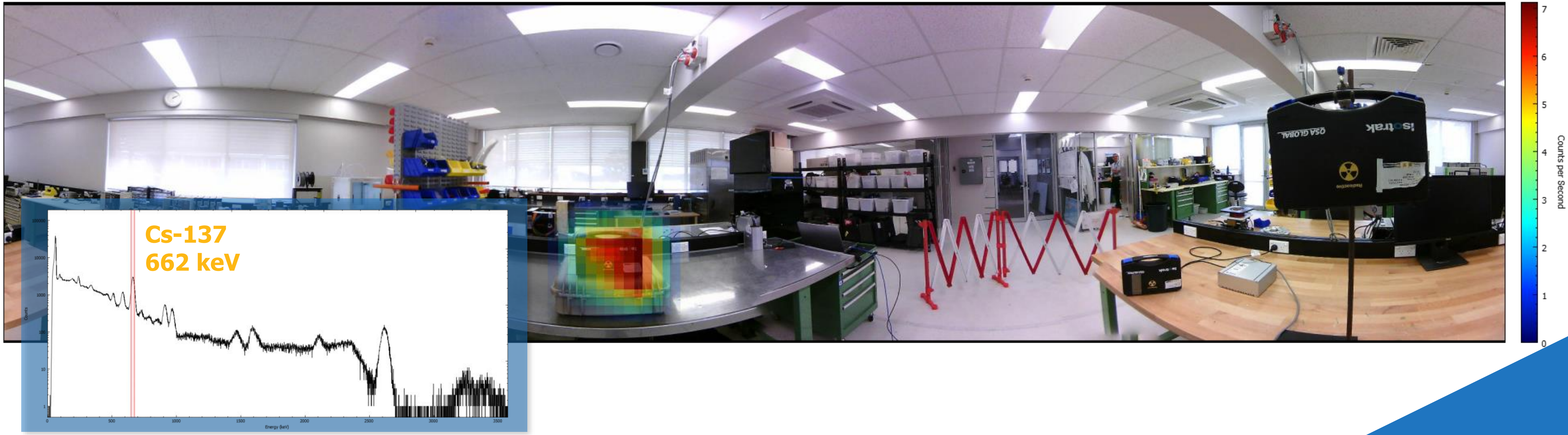

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Laboratory Demonstration

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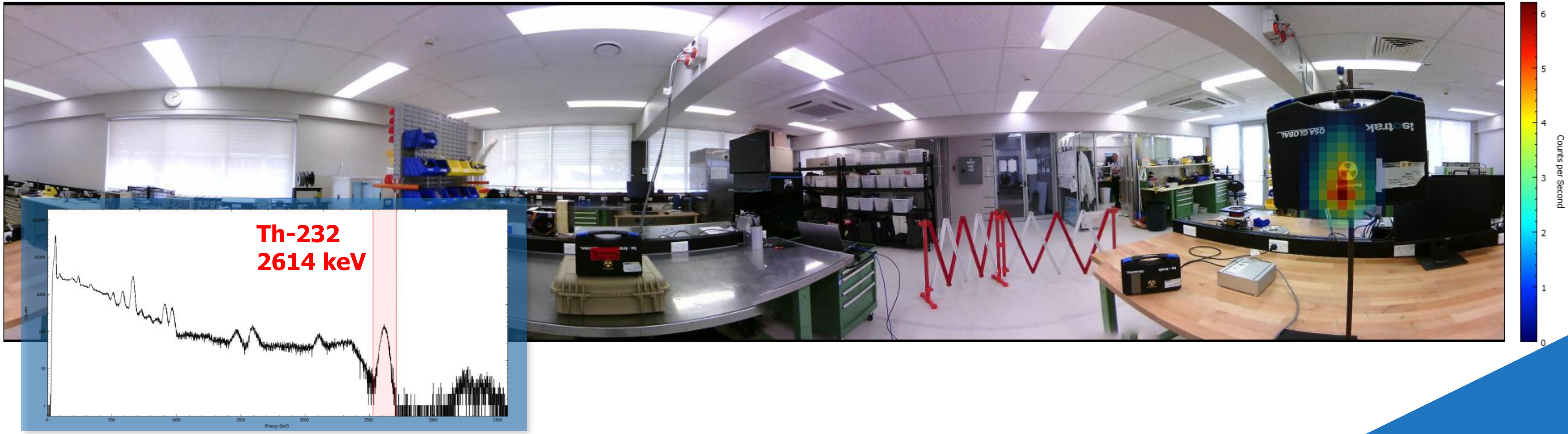
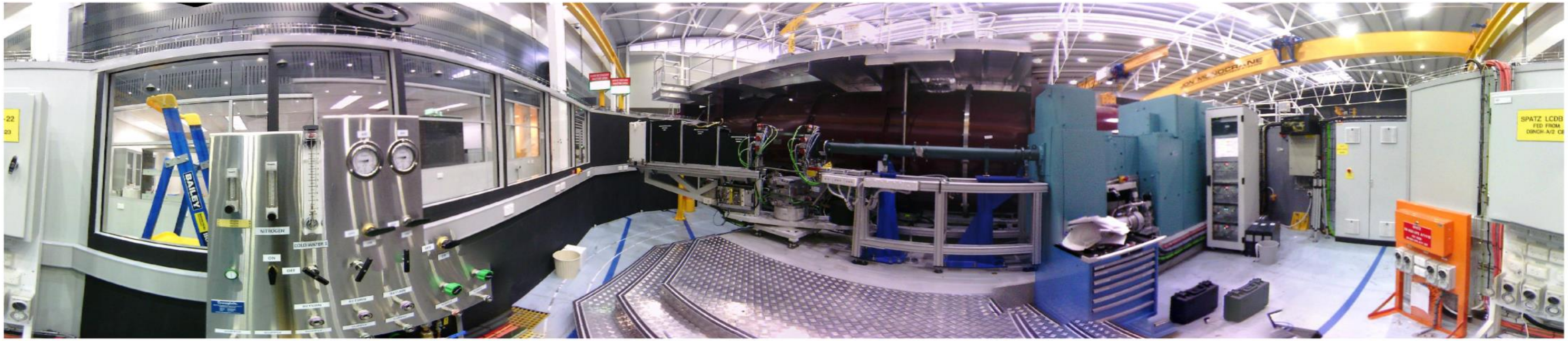
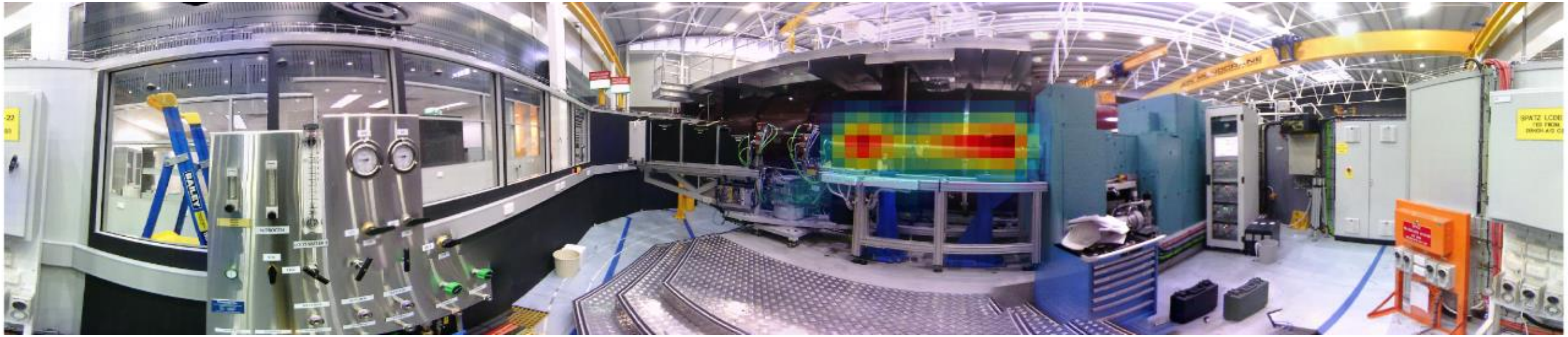


SPATZ Neutron Beam Line



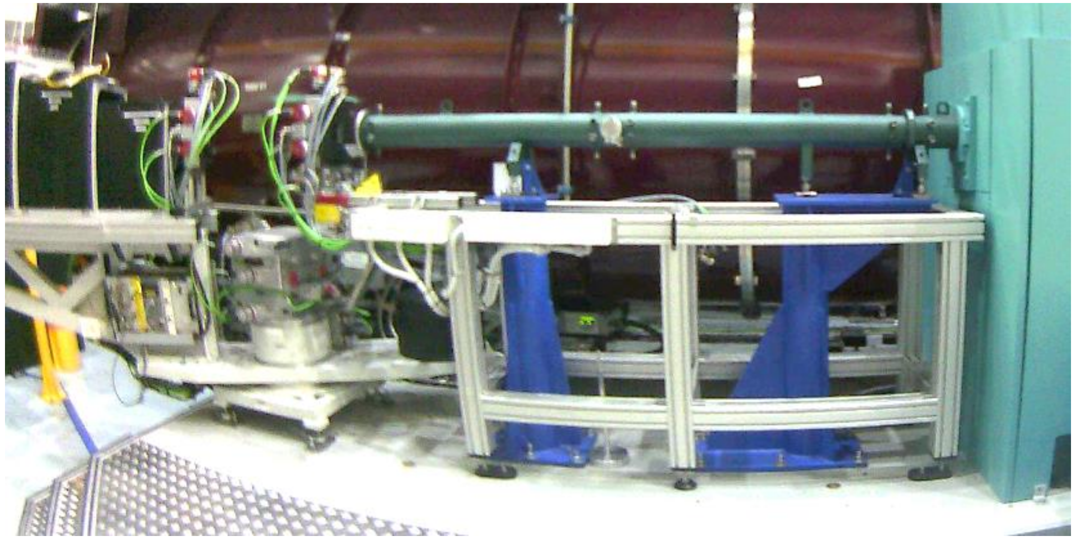
- Commissioning of new beam line
- Dose surveys showed higher than expected dose rates
- CORIS360® was used to identify and localise the source of the elevated radiation

SPATZ Neutron Beam Line



- Commissioning of new beam line
- Dose surveys showed higher than expected dose rates
- CORIS360® was used to identify and localise the source of the elevated radiation
- The imager determined that prompt gammas from Boron was the main source of the elevated radiation levels

SPATZ Neutron Beam Line

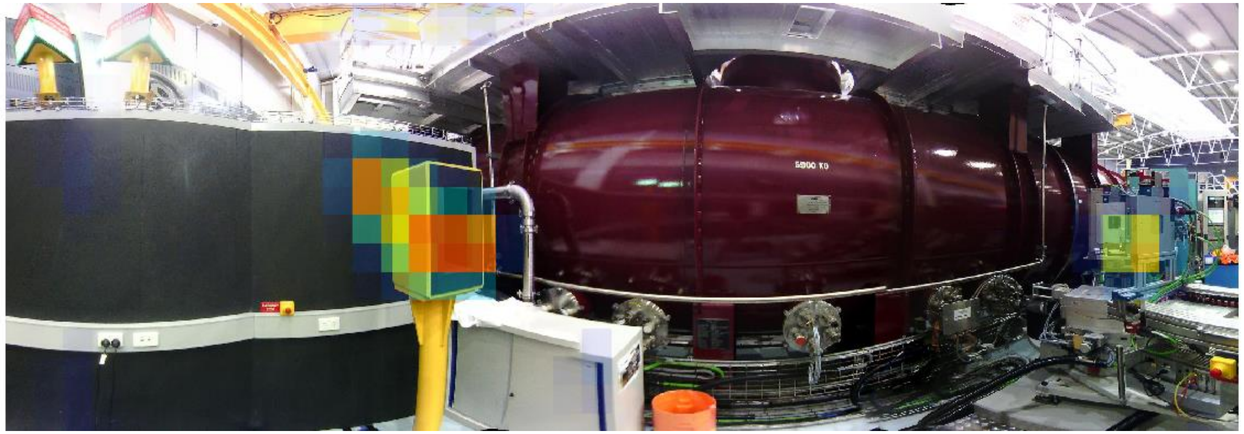


Before: No beam line shielding

After: Beam line shielded

- After the source of the radiation was identified, shielding was implemented to reduce the prompt gammas from Boron

SPATZ Neutron Beam Line



- Boron prompt gammas now shielding from the beam line
- Further Boron prompt gammas were localised coming from the beam stop
- A closer image of the beam stop confirmed the finding
- Boron prompt gammas also observed at beam exit

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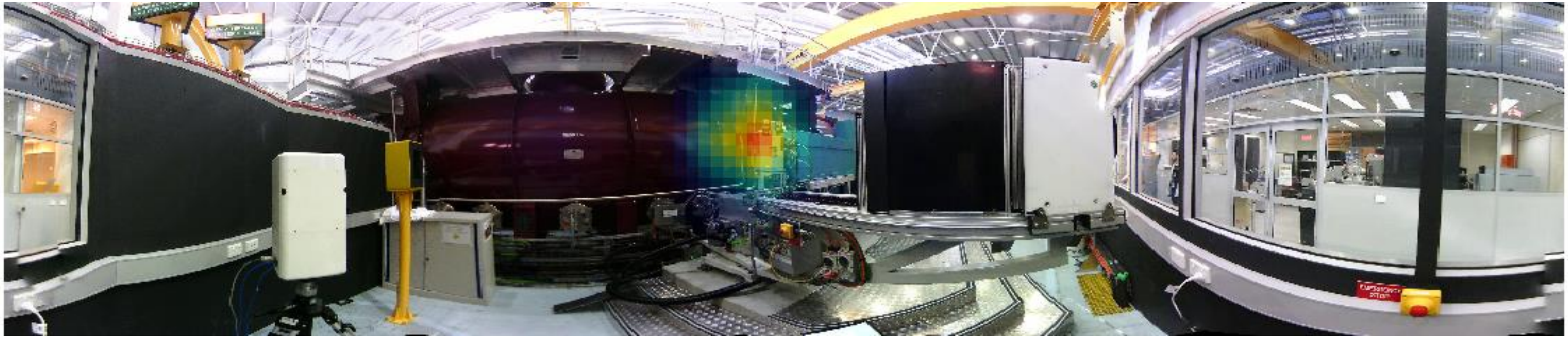
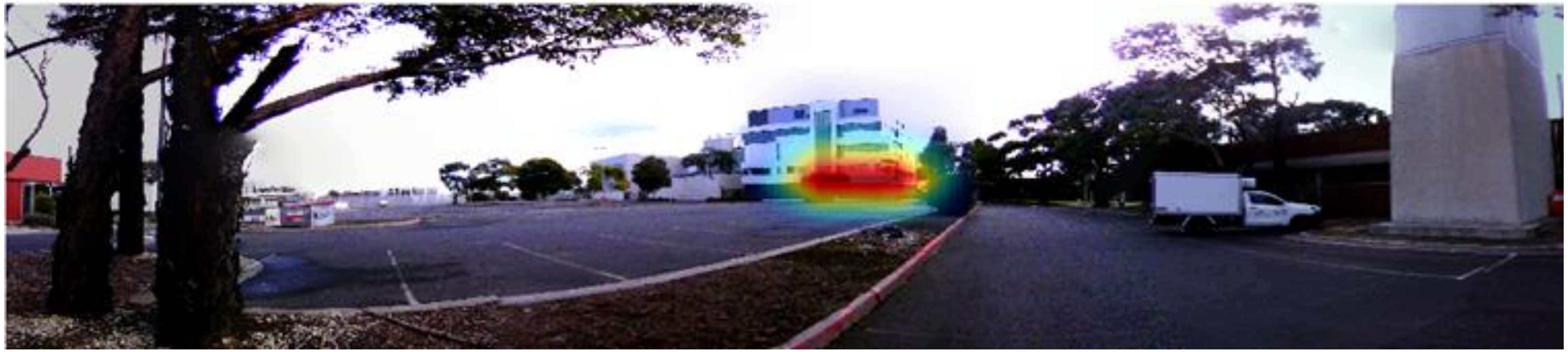
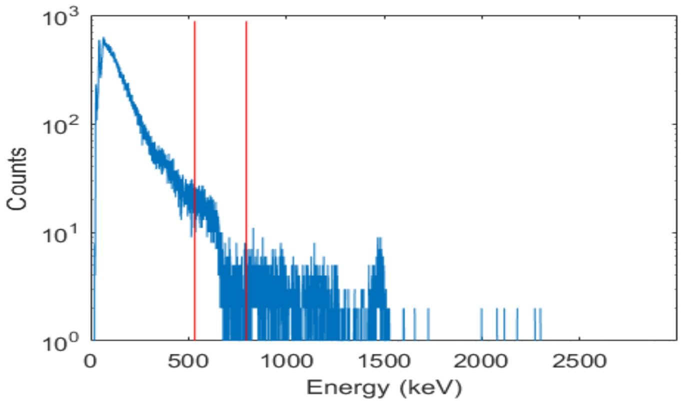
SPATZ Neutron Beam Line



- An additional beam chopper was utilised to reduce the neutron flux
- Boron prompt gammas were now only localised to the beam line exit
- Dose rates were now within the required operational limits

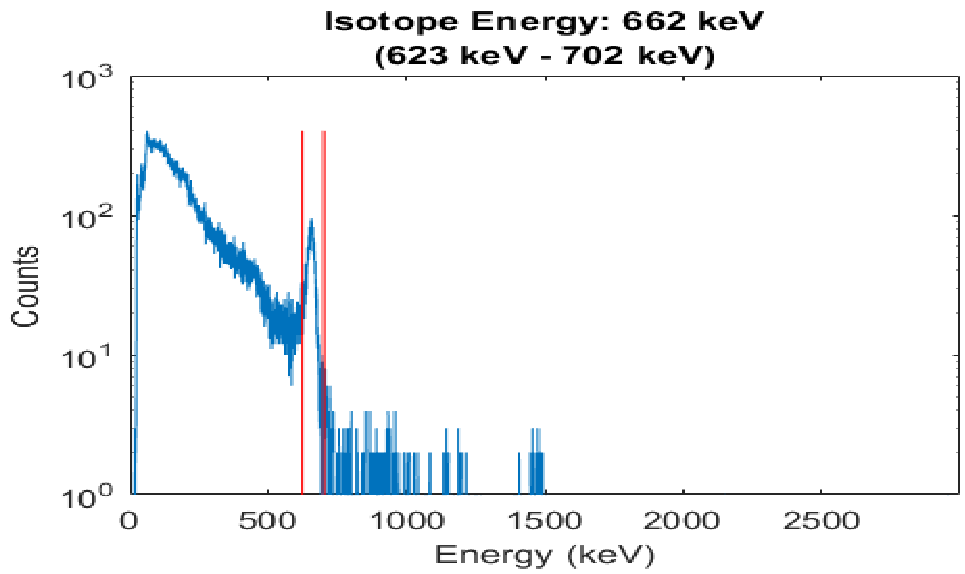
Urban Search Scenario





- Blind trial
- ~65 m standoff
- Images can be generated from any part of the spectrum including peak and non-peak regions
- Image produced from spectral ROI (region between red lines)
- 15 mins to localise source

Urban Search Scenario



- Moved to a ~30 m standoff
- <2 mins to localise ^{137}Cs source

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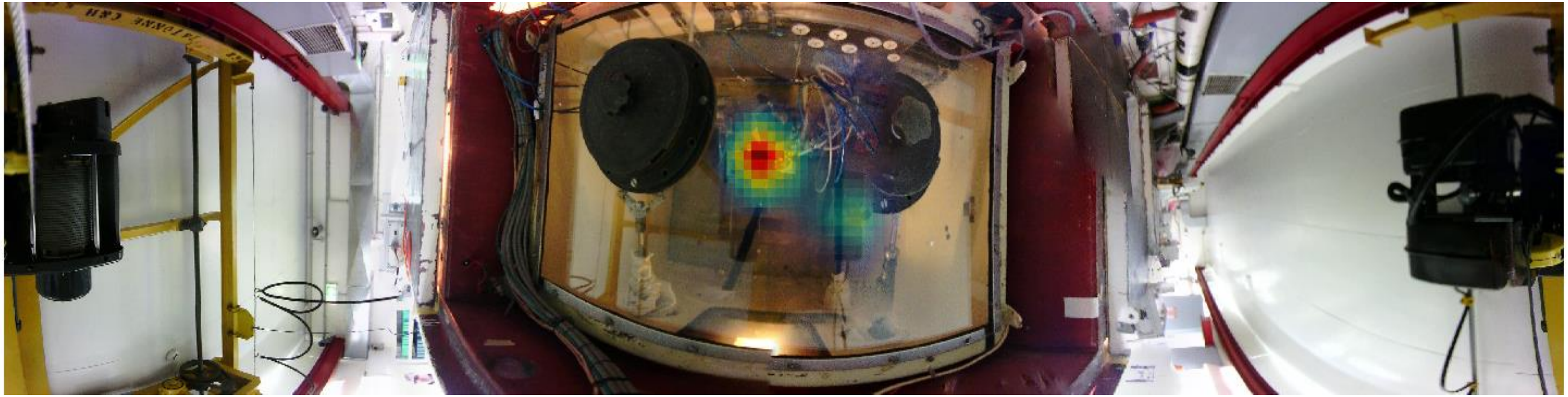
Hot Cell Imaging



- Cleaning of ^{131}I hot cell required
- Goal was to reduce worker dose by identifying the hottest areas in the hot cell and focusing on these areas first when cleaning
- Imaging over 364 keV peak identified two main hot spots

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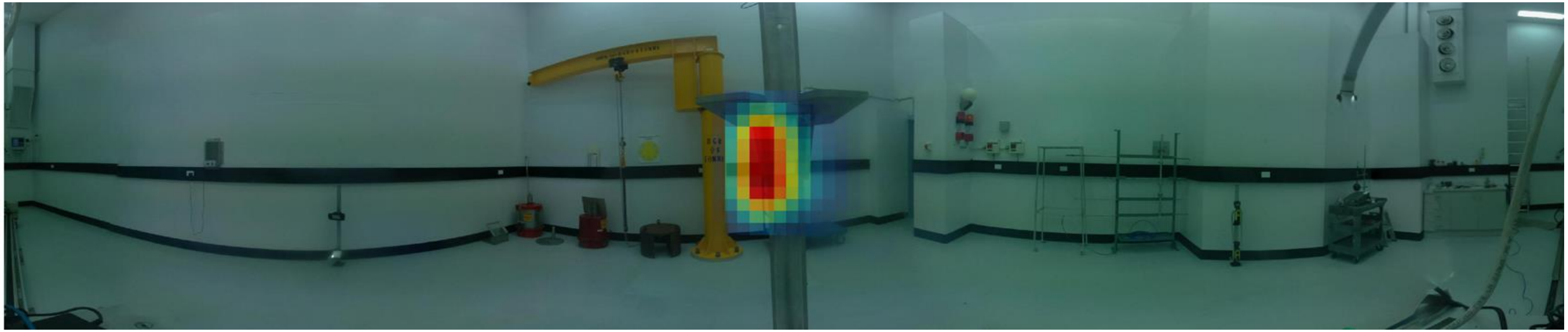
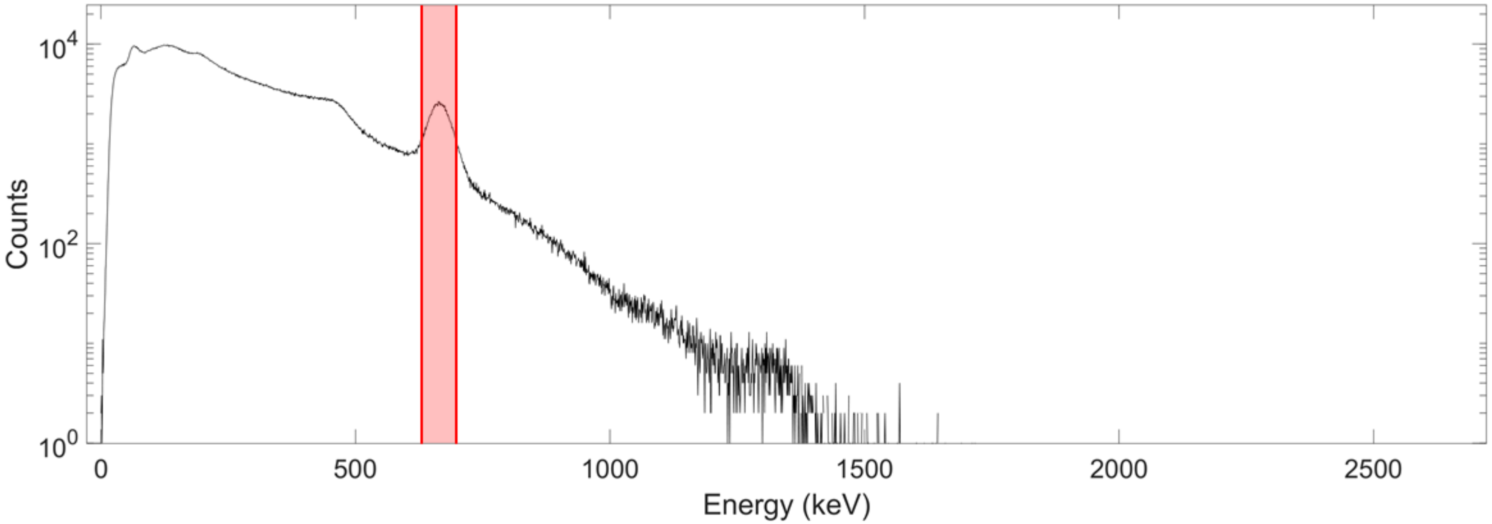
High Dose Rate Imaging – 10 mSv/h





- Imaging ^{137}Cs in 10 mSv/h dose rate environment
- Results show imaging 662 keV peak using 0.5" CLLBC detector
- Able to image in dose rates from 1 μSv/h – 40 mSv/h with 0.5" detector

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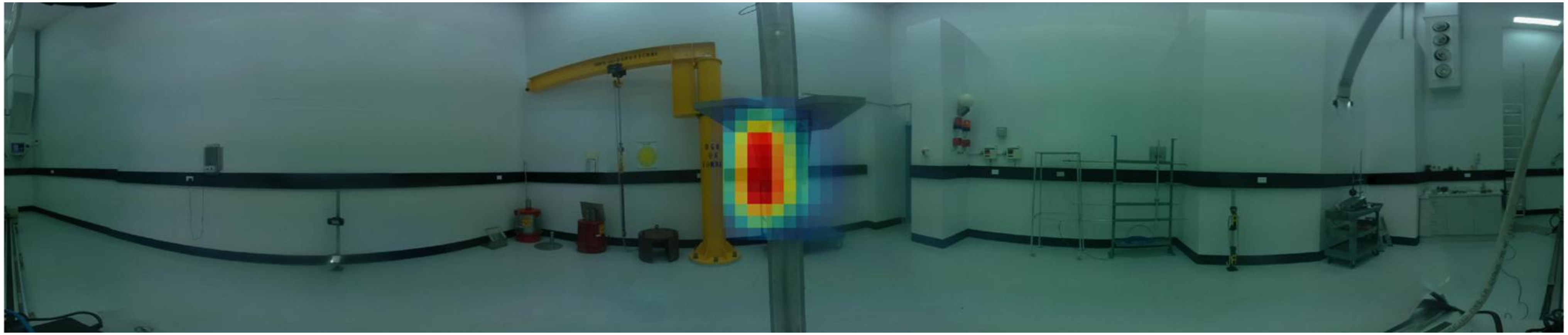
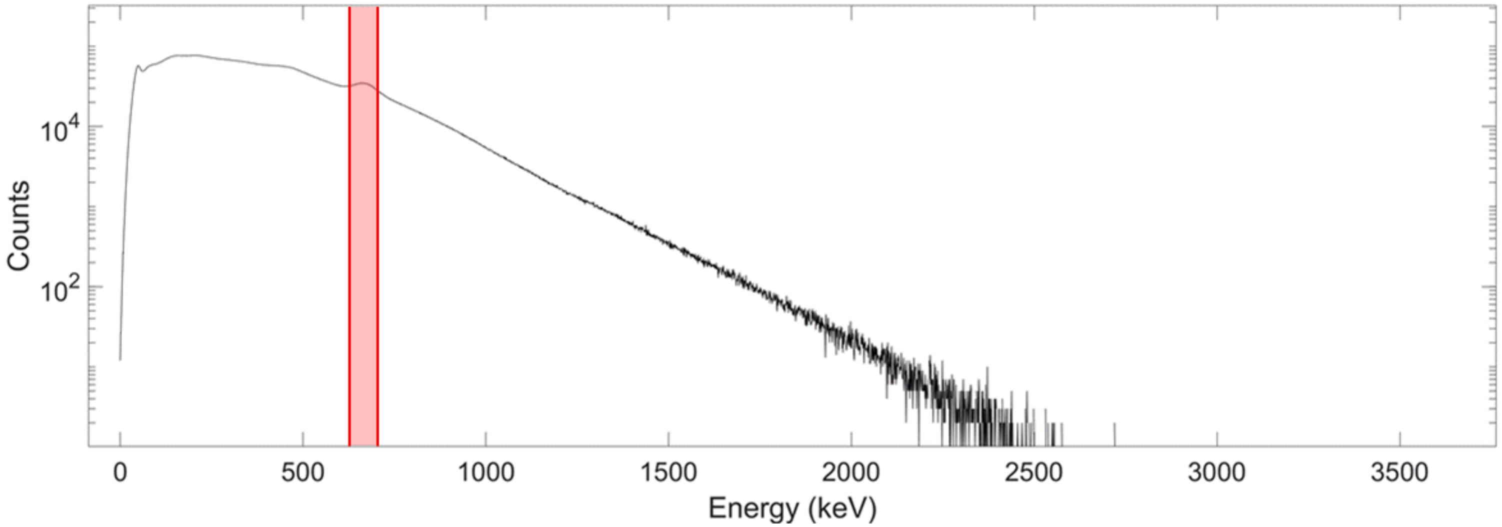
High Dose Rate Imaging – 40 mSv/h





- Imaging ^{137}Cs in 40 mSv/h dose rate environment
- Results show imaging 662 keV peak using 0.5" CLLBC detector
- Able to image in dose rates from 1 μSv/h – 40 mSv/h with 0.5" detector

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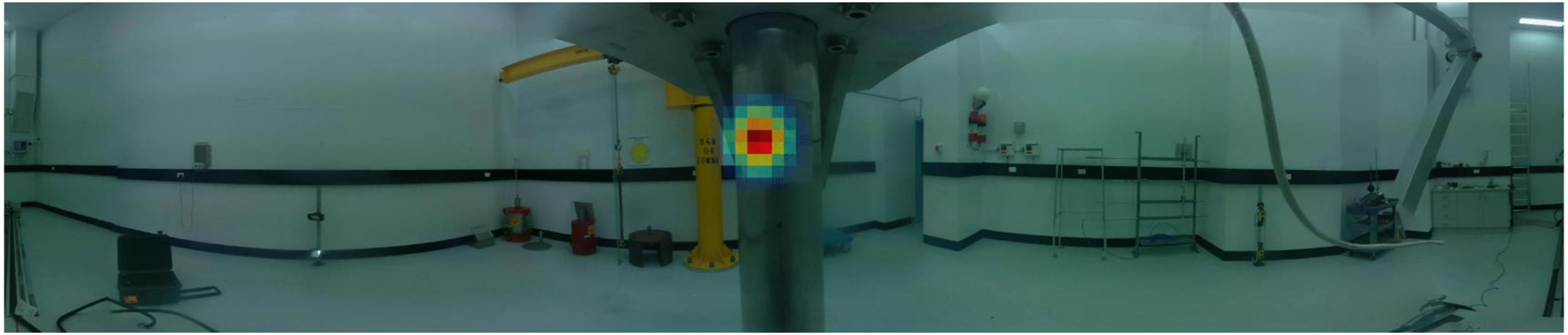
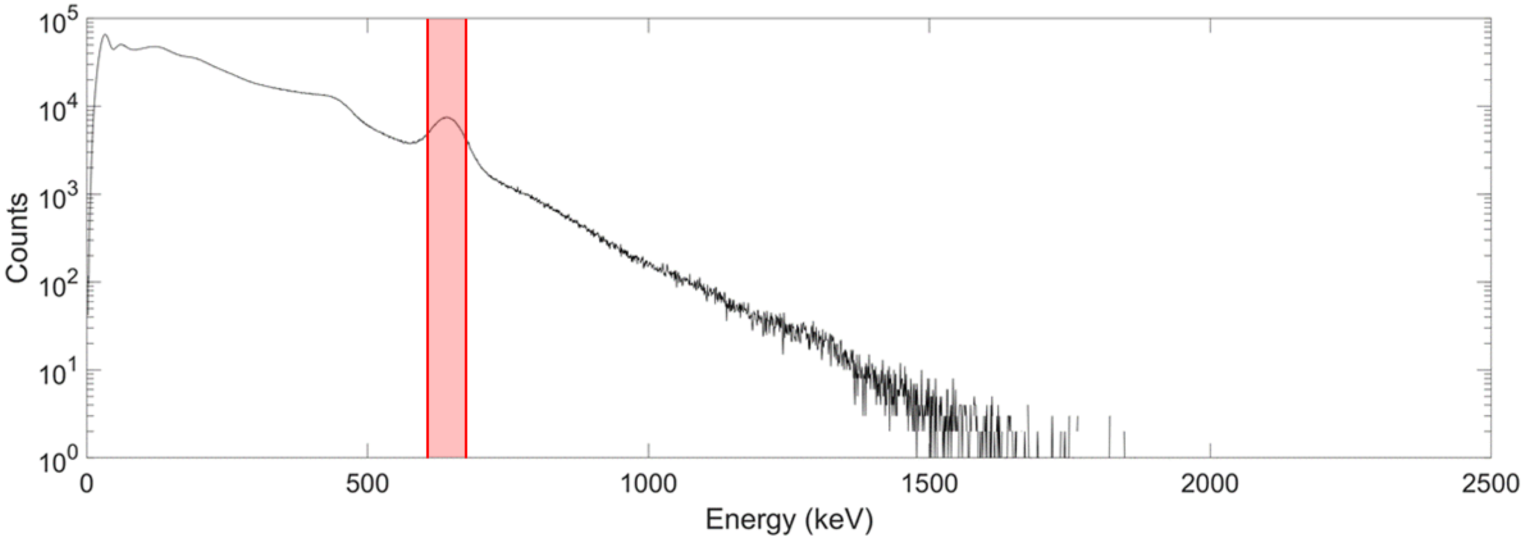
Current Research and Development

High Dose Rate Imaging – 186 mSv/h





- Imaging ^{137}Cs in 186 mSv/h dose rate environment
- Results show imaging 662 keV peak using cubic 6 mm CLLBC detector
- Able to image > 186 mSv/h

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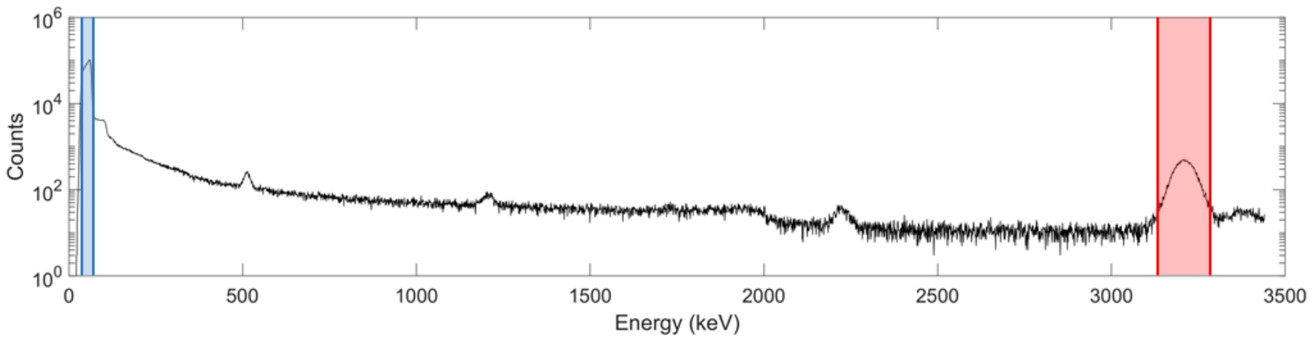
Neutron Imaging



Imaging 60 keV ^{241}Am gamma rays (blue)

Imaging thermalised neutrons (red)

- Using a dual cadmium/tungsten alloy mask, able to image gamma-rays and thermal neutrons
- ~17 min acquisition and no PSD used
- Neutron source was a 350 GBq AmBe source moderated by 13 cm of HDPE

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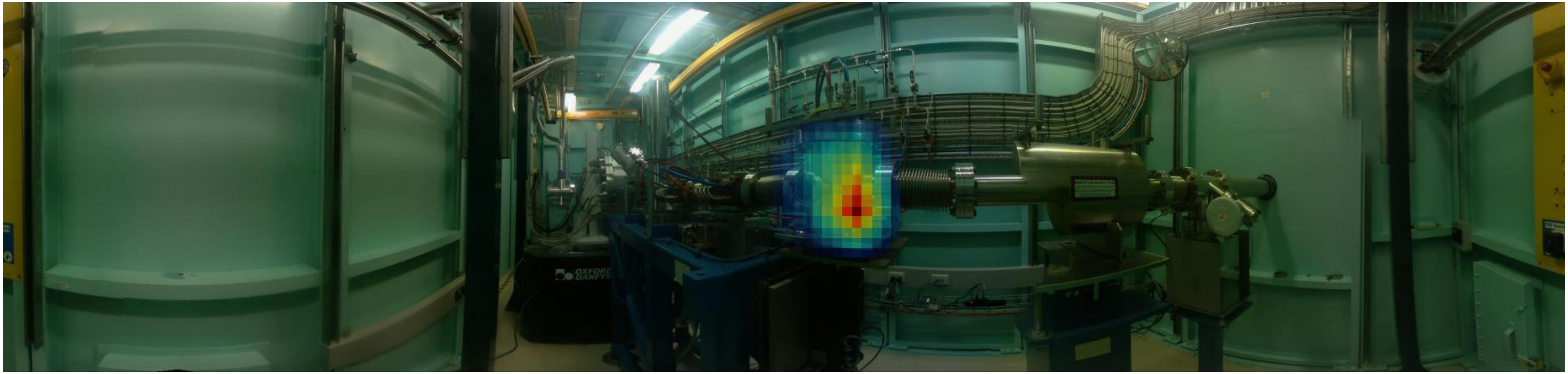
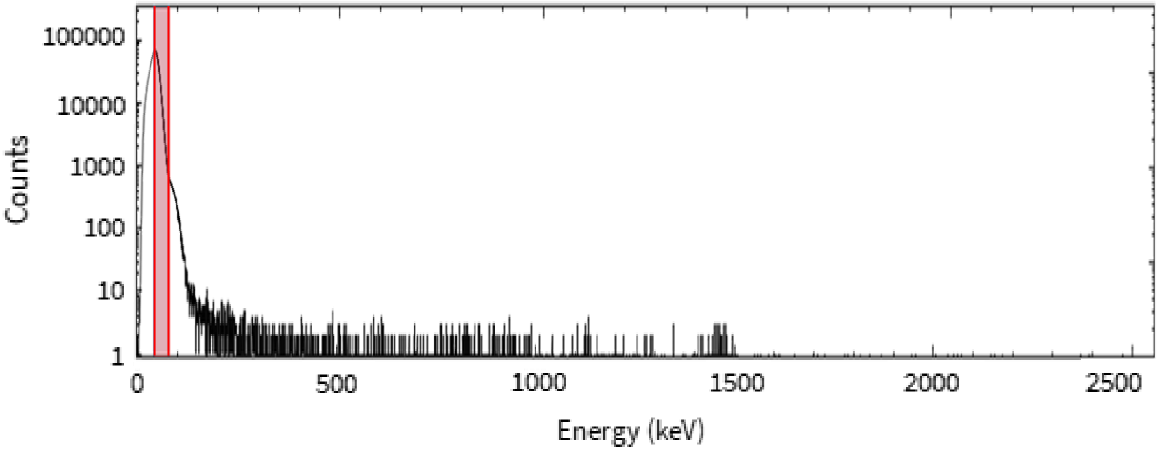
Synchrotron – Low Energy X-ray Imaging





- Imaging within X-ray Absorption Spectroscopy enclosure
- Imaging at energy < 40 keV shows hotspot localised to leak in beamline

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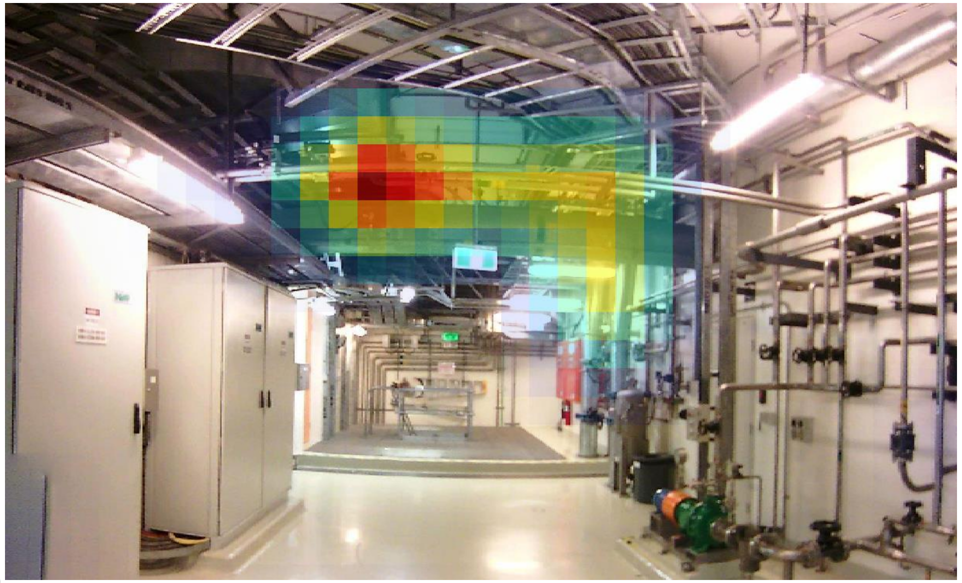
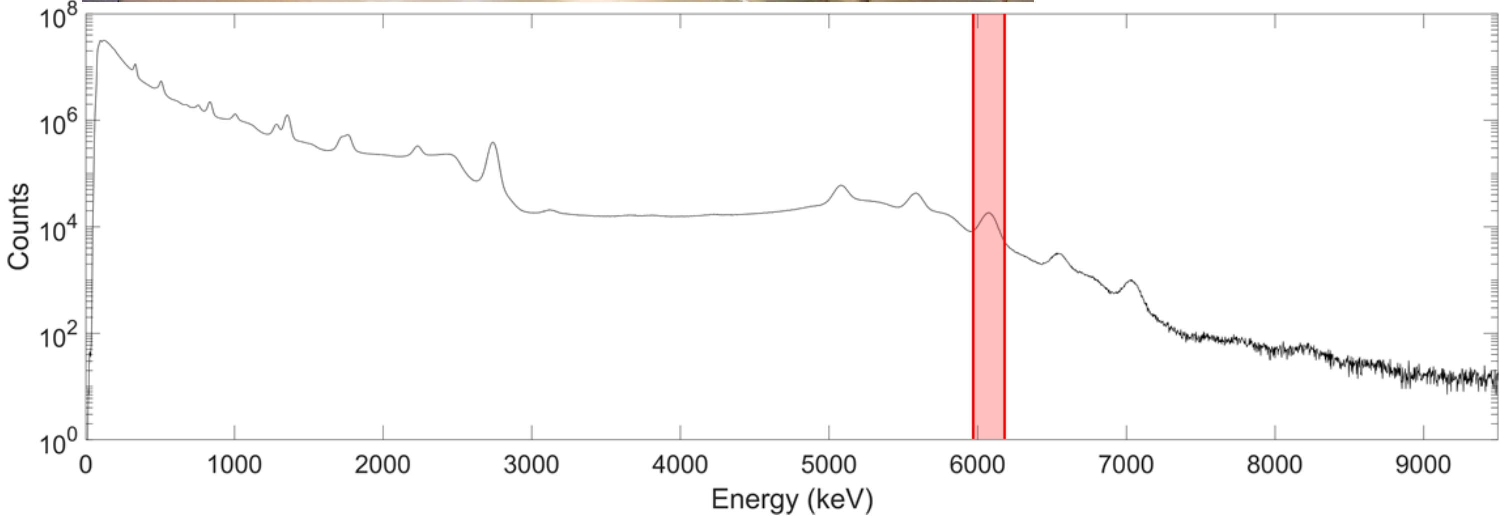
High Energy Imaging – Reactor Plant Room





- Imaging performed in plant room under OPAL reactor
- Results show imaging ~6.1 MeV prompt gammas
- Tungsten masks and 1.5" CLLBC detector were used
- Device is able to image from <40 keV to >3 MeV

THANK YOU

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