Detecting the presence and location of **nuclear material** via a novel **gamma imaging** technology

Gamma ray imaging results of nuclear fuel pin measurements at the IPNDV Belgium Exercise

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INTRO

A novel gamma-ray imager, designed around the theory of compressed sensing, was evaluated at the IPNDV Belgium Exercise in September 2019. The imager is potentially suitable for nuclear disarmament verification activities as it can identify and localise gamma emitting radiation over a large field of view (360° x 90°) and across a wide energy range (40 keV to 3 MeV).

METHODS

1. Measurements were taken of MOX fuel configurations with varying: quantities of nuclear material, plutonium grades and shielding materials
2. The ANSTO developed gamma imaging technology collected the gamma ray spectrum, gamma image and optical images. The system detector could also detect the presence of neutrons
3. Gamma signatures were identified and localised, with gamma images overlaid onto the generated optical panorama

Figure 1: ANSTO's gamma ray imaging system

RESULTS

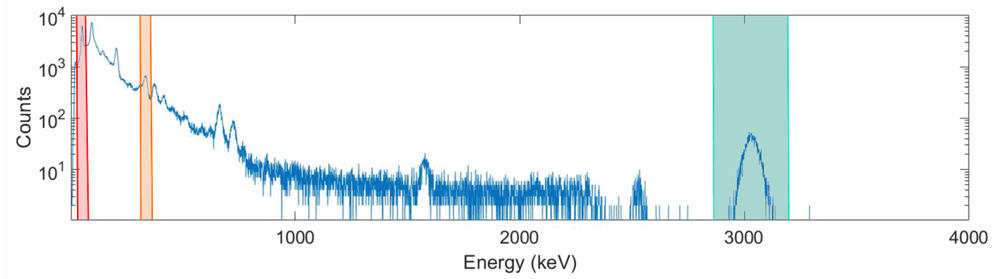

Figure 2: Gamma spectrum from the CLLBC scintillator detector. The red region indicates emissions from ^{241}Am, the orange region indicates emissions from ^{239}Pu and the green region shows the neutron response of the scintillator.

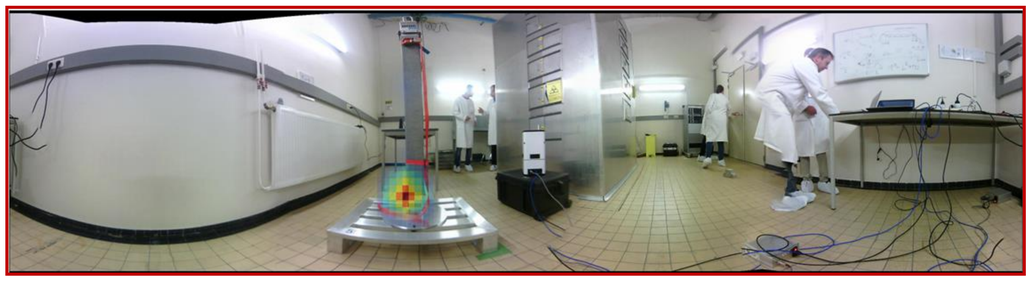

Figure 3: Gamma image of the ^{241}Am (red) region of the gamma spectrum

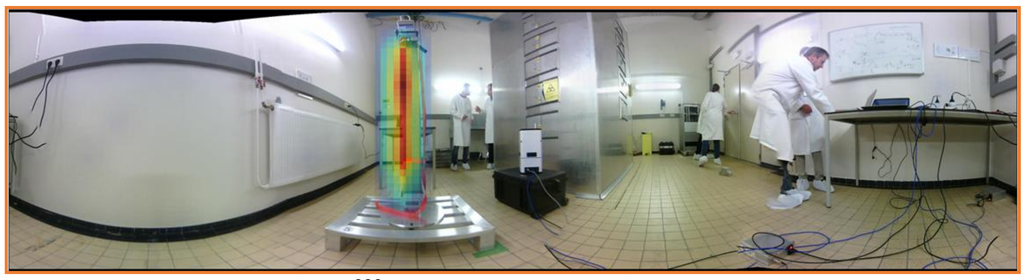

Figure 4: Gamma image of the ^{239}Pu (orange) region of the gamma spectrum

DISCUSSION

- The imager identified and localised the nuclear material gamma emissions and also detected the presence of neutrons
- In a single acquisition, the presence and absence of nuclear material was confirmed for a significant fraction of the facility room
- Imaging different energy regions of the gamma spectrum has demonstrated what effects shielding can have on the nuclear fuel

3D Localisation

Two imaging systems, positioned at 90°, can confine the source localisation in 3D space.

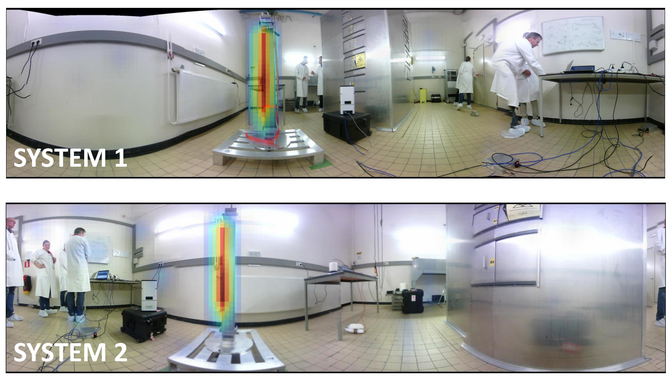

Figure 5: The arrangement of two imaging systems and their generated images.

Information barrier

Encrypted image information is held within measured count modulation. Sensitive spectral & image information can be hidden.

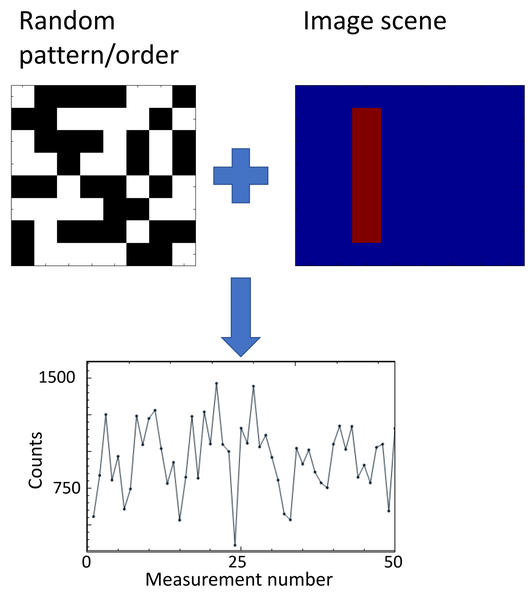

Figure 6: Random sampling of the image scene generates a modulation in the detected photon counts.

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