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The PLATINUM project

Laser-driven x-rays and neutrons for nuclear waste management

Dr Ceri Brenner
Group leader – Industry Partnerships and Innovation
STFC Central Laser Facility

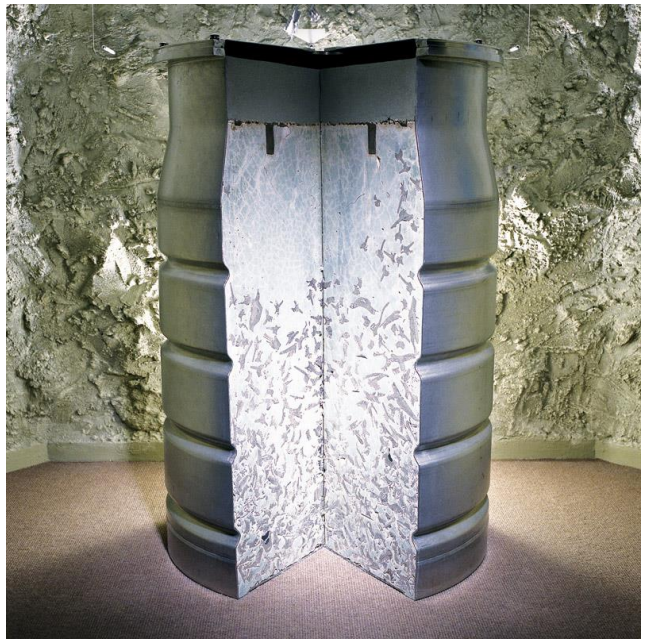
ceri.brenner@stfc.ac.uk

The Challenge

The principle concern regarding intermediate level waste (ILW) containers is the internal volumetric expansion due to the formation of corrosion products.

At present > 216,000 tonnes of non-military radioactive waste is stored across the UK

- 120,000 tonnes are ILW
- 54,000 containers exist in modern engineered stores.
- Non-destructive testing can permit an assay of the present status of the waste material and the formulation of predictive models which can be used to ascertain the evolution of the waste in storage.



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The Solution

X-ray and neutron beams

With MeV energy to penetrate grout and metal

Radiography/tomography

Active/passive interrogation for element identification

BUT……..

Slow and resolution is severely limited by existing x-ray and neutron sources

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The Solution (with innovation)

X-ray and neutron beams

With MeV energy to penetrate grout and metal

Radiography/tomography

Active interrogation for element identification

Laser-plasma accelerators

Petawatt lasers can generate pulsed beams with:

- High brightness
- High energy
- Ultra-short short pulse width
- X-ray and neutron beams from same system

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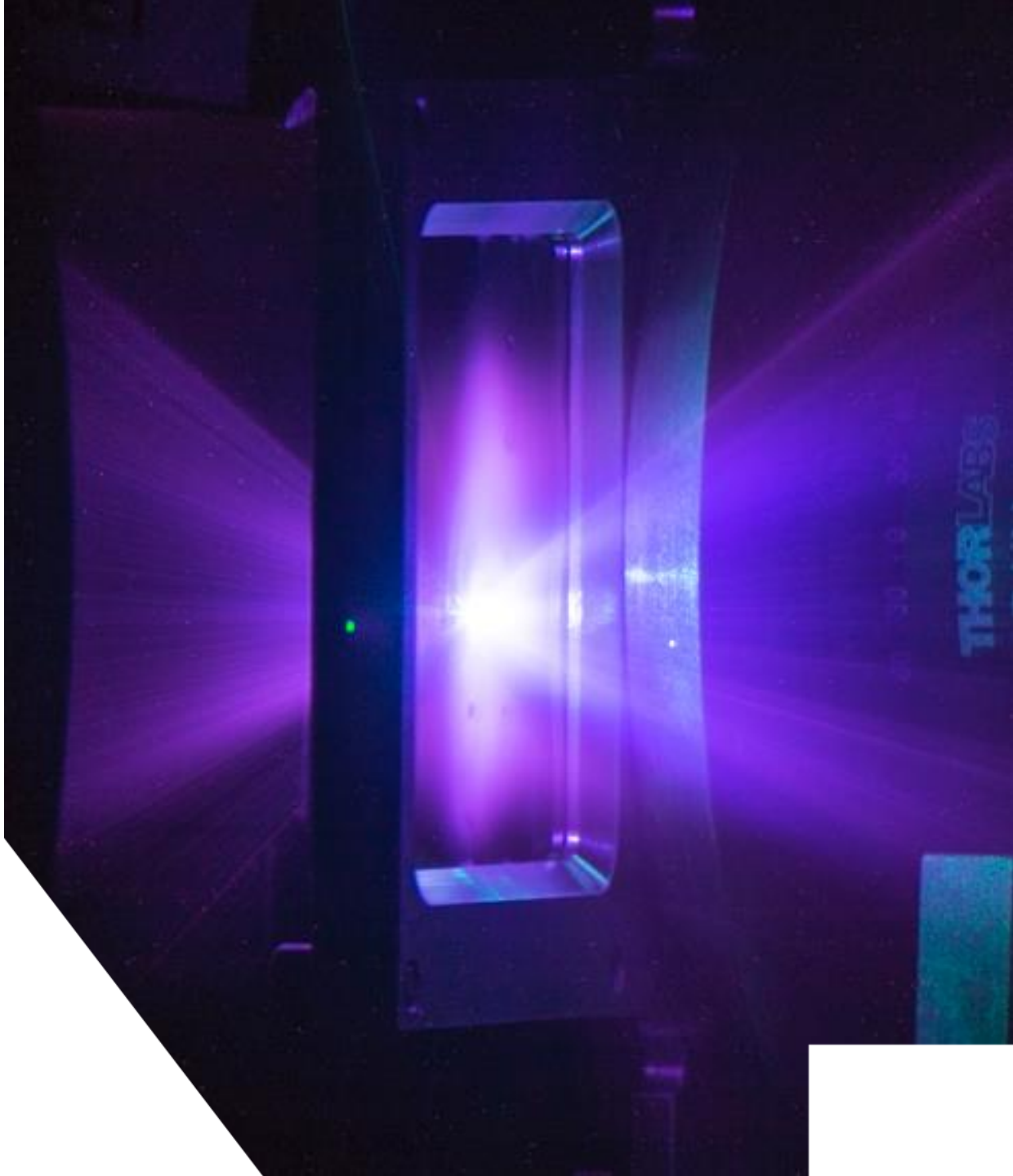

The Solution (with innovation)

CLF's world leading 10 Hz 100 J laser DiPOLE100

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The Partnership

P L A T I N U M

Pulsed Laser Accelerators for The Inspection of NUclear Materials

Sellafield Ltd

central laser facility

University of BRISTOL

QUEEN'S UNIVERSITY BELFAST

The PLATINUM project will assess the impact of laser-driven high-energy bremsstrahlung radiation for imaging and laser-driven thermal energy neutrons for isotopic quantification.

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Testing the concept

The Innovations Partnership Scheme award enabled:

A full experiment campaign using the CLF's existing system, Vulcan, to demonstrate the x-ray imaging capability

A post-doc at Bristol to prepare the test samples, deliberately induce corrosion growth on encased natural uranium and carry out post-evaluation

Resource for key diagnostic equipment

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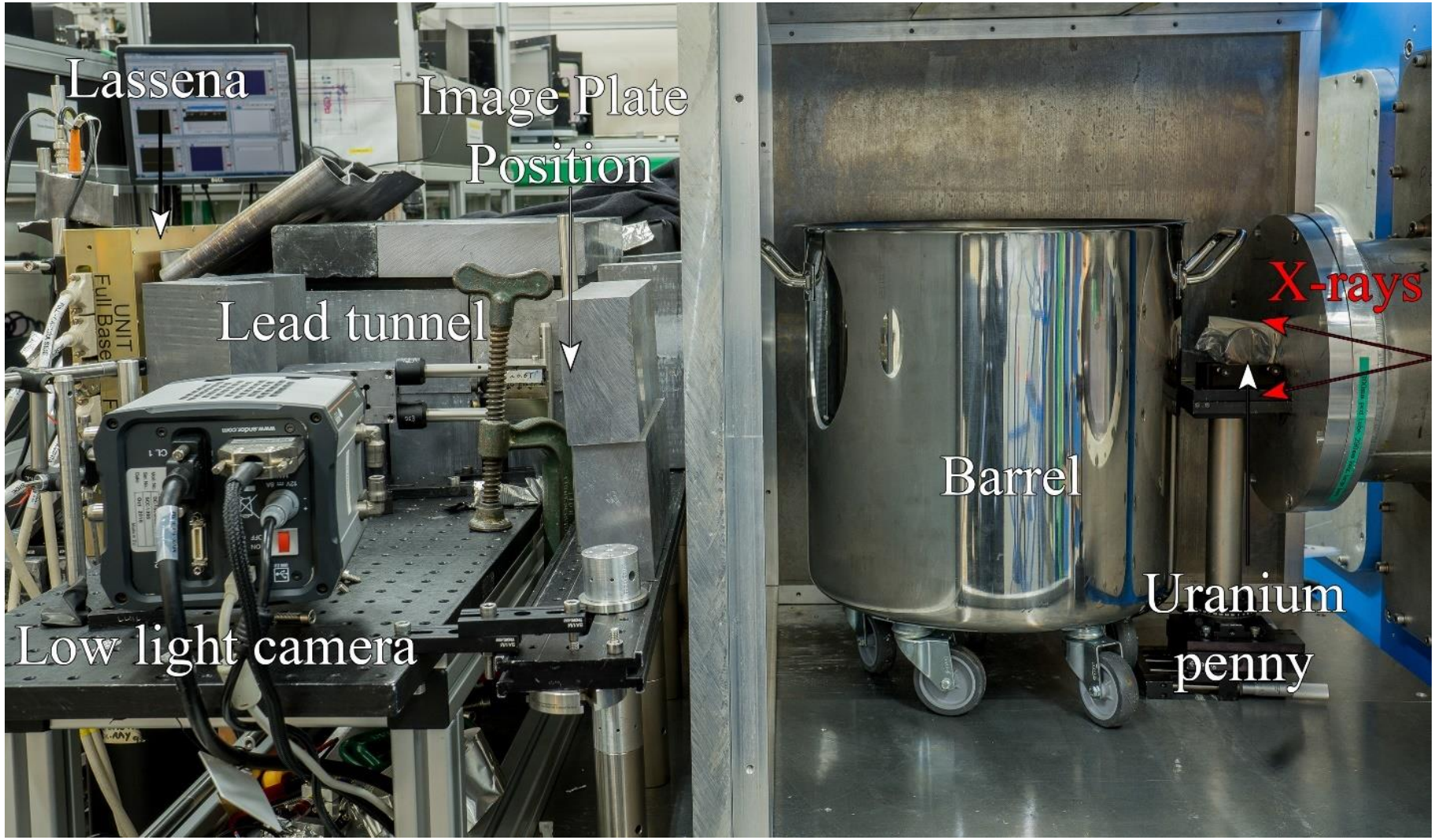
Testing the concept



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Awareness of competing technology

Data sets of ~ 200 GB per 3D scan

30 – 90 seconds per projection with 1500 projections requires ~ 72 hours over several days

50 – 75 μm resolution achievable with lens coupled scintillators, optics and CCD

6 MV M22 Microtron achieving resolution ~100 microns resolution with an X-ray source size of ~800 microns.

Estimated to scan a full waste drum (500l) in 2 hours.

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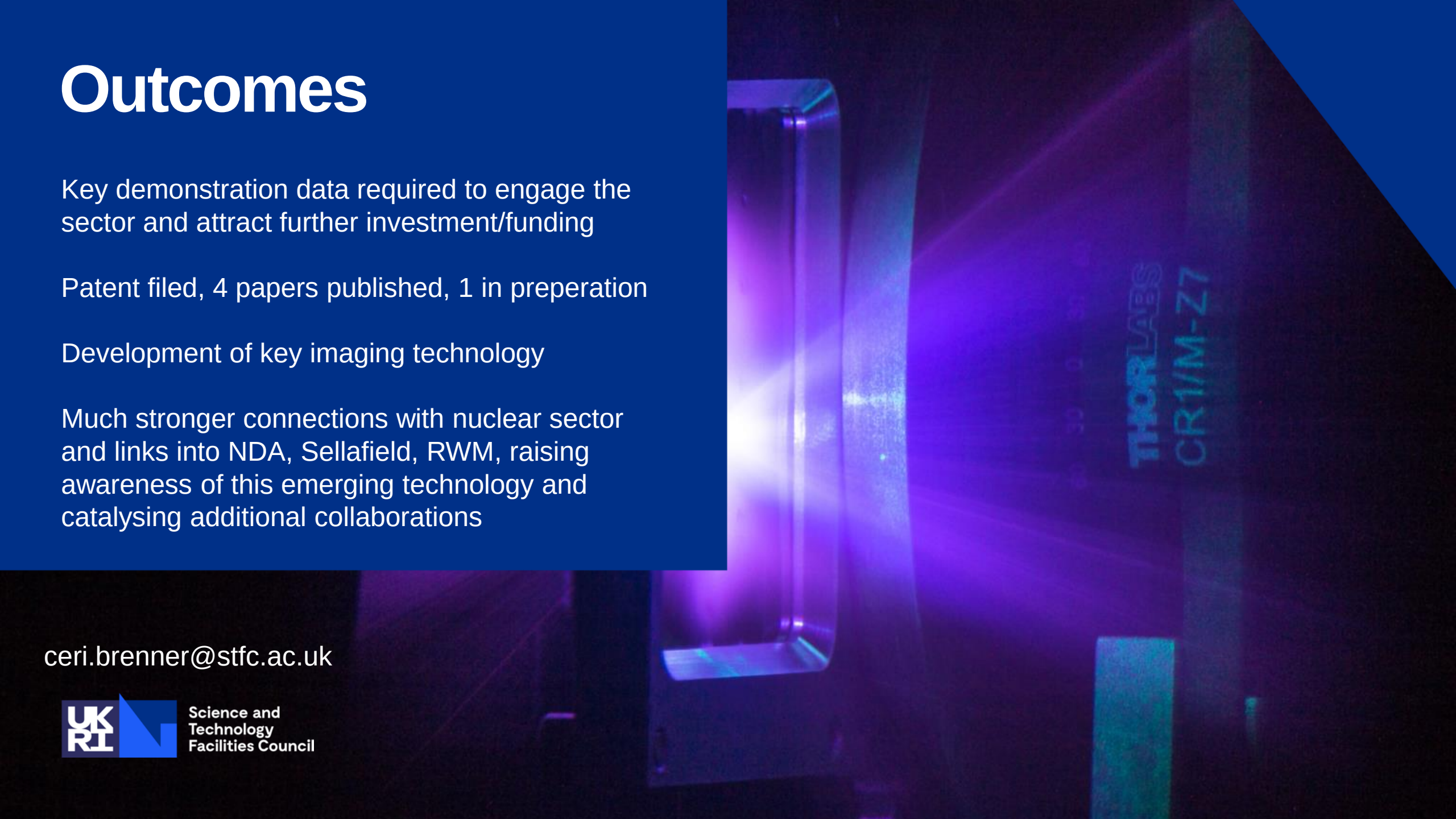
Outcomes

Key demonstration data required to engage the sector and attract further investment/funding

Patent filed, 4 papers published, 1 in preperation

Development of key imaging technology

Much stronger connections with nuclear sector and links into NDA, Sellafield, RWM, raising awareness of this emerging technology and catalysing additional collaborations



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Thank you

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