

A national network of academics working on Nuclear Threat Reduction (NTR) research.

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Science and
Technology
Facilities Council



Nuclear Security
Science Network



Why form an academic network on nuclear threat reduction?

- The **UK Government** has a strong desire to see **enhanced academic work** in the UK to address national security priorities including **counter terrorism** and **non-proliferation**.
- Addressing nuclear security issues relies on **advanced science and engineering expertise** in which UK academia excels.
- Enhanced academic programmes would provide capabilities to solve **key science and technical issues of national and international importance**.
- An increased academic involvement would also provide **peer review and challenge** to existing national efforts within Government and at AWE, as well as a **source of recruitment** for national programmes.

The challenges regarding nuclear threat reduction.

- Ensuring the UK, as well as global partners, have **robust and reliable capabilities and expertise to address future nuclear security challenges is essential**, including from potential nuclear terrorism or non-compliance with current or future Treaty obligations.
- Key scientific challenges remain in areas of **nuclear arms control verification, nuclear detection and nuclear forensics**.
- Work on arms control verification also plays a central role in fulfilling the UK obligations to the nuclear Non-Proliferation Treaty and the **desire to work towards a nuclear weapon free world**.
- Science and engineering research activities also include **transmutation science, passive and active detection systems, data handling and isotope verification** plus many others...

What is nuclear forensics?

- Following a nuclear security incident, the UK Government and investigating authorities need to know **what the material in question is**, and an **assessment of its provenance**.
- The collection, analysis and assessment of nuclear materials following such an incident is commonly referred to as **nuclear forensics**.
- Nuclear forensics may include comparative analysis from multiple potential crime scenes, as well as an understanding of the use of nuclear materials in various processes.
- This requires a **wide range of analytical and material science capability**, and **knowledge, relevant to nuclear materials**.
- A key question is whether the material is consistent or inconsistent with UK holdings, past and present.

Capturing Academic NTR Activity

Nuclear Threat Reduction

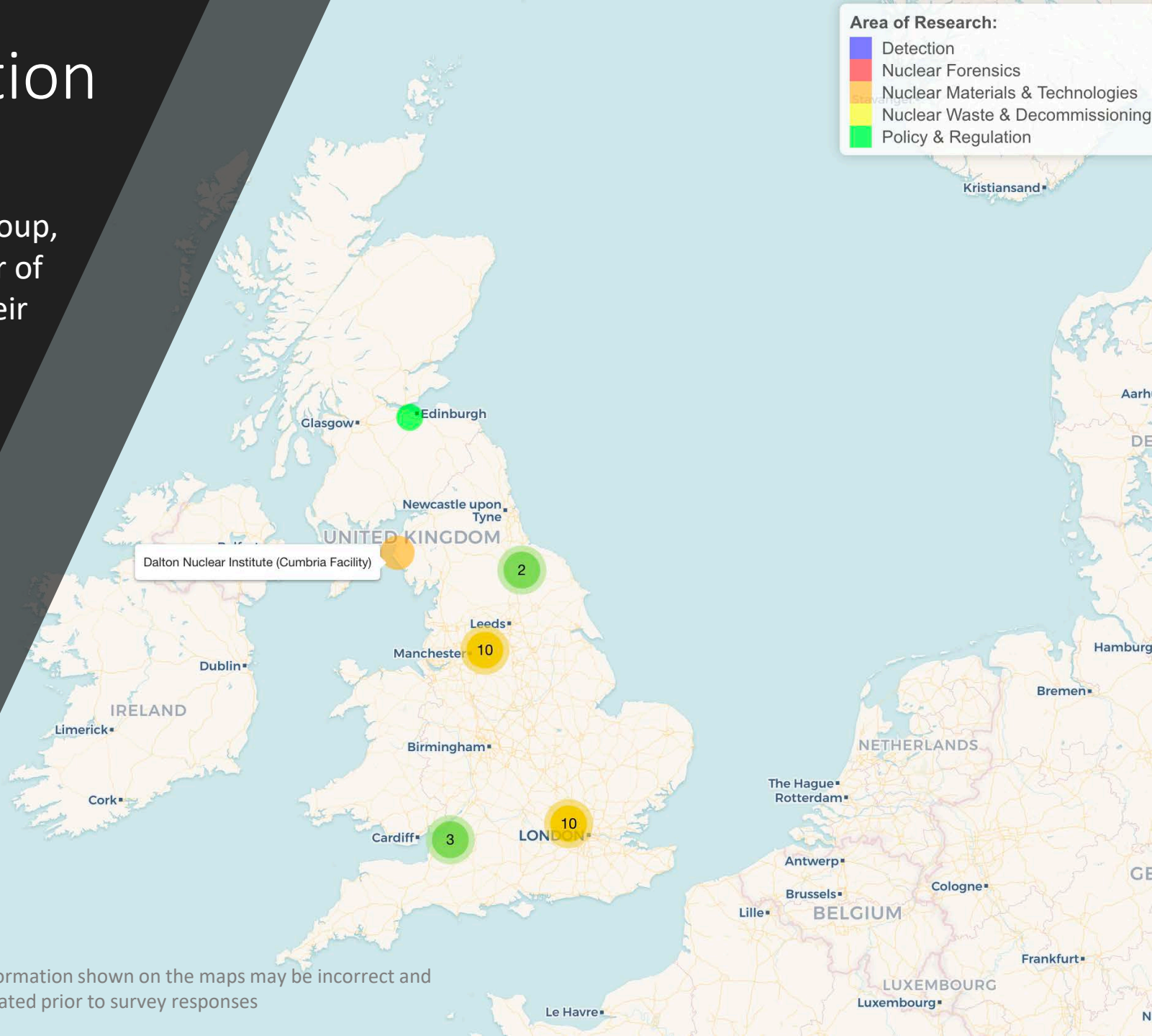
Research Map:

- Markers plotted at location of research group, with their size proportional to the number of researchers, and their colour based on their main area of NTR research
- Map is interactive, and so markers can display information when clicked
- Can be incorporated into a web app to allow for worldwide usage and sharing of the tool
- Great potential for further functionality, e.g. ability to show connections between research groups, and display informative demographics on the state of current UK NTR research

N.B: Information shown on the maps may be incorrect and was collated prior to survey responses

Area of Research:

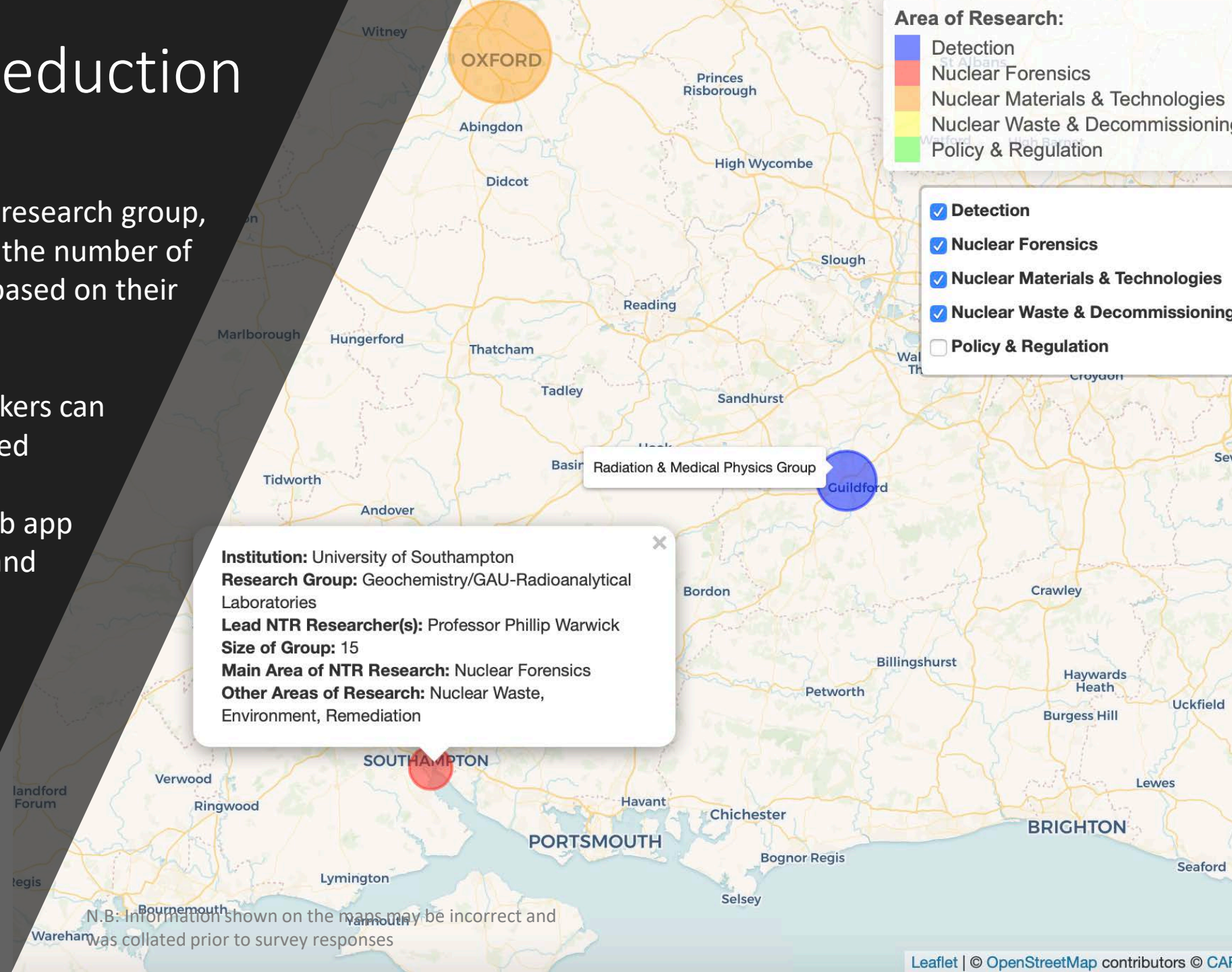
- Detection
- Nuclear Forensics
- Nuclear Materials & Technologies
- Nuclear Waste & Decommissioning
- Policy & Regulation



Nuclear Threat Reduction

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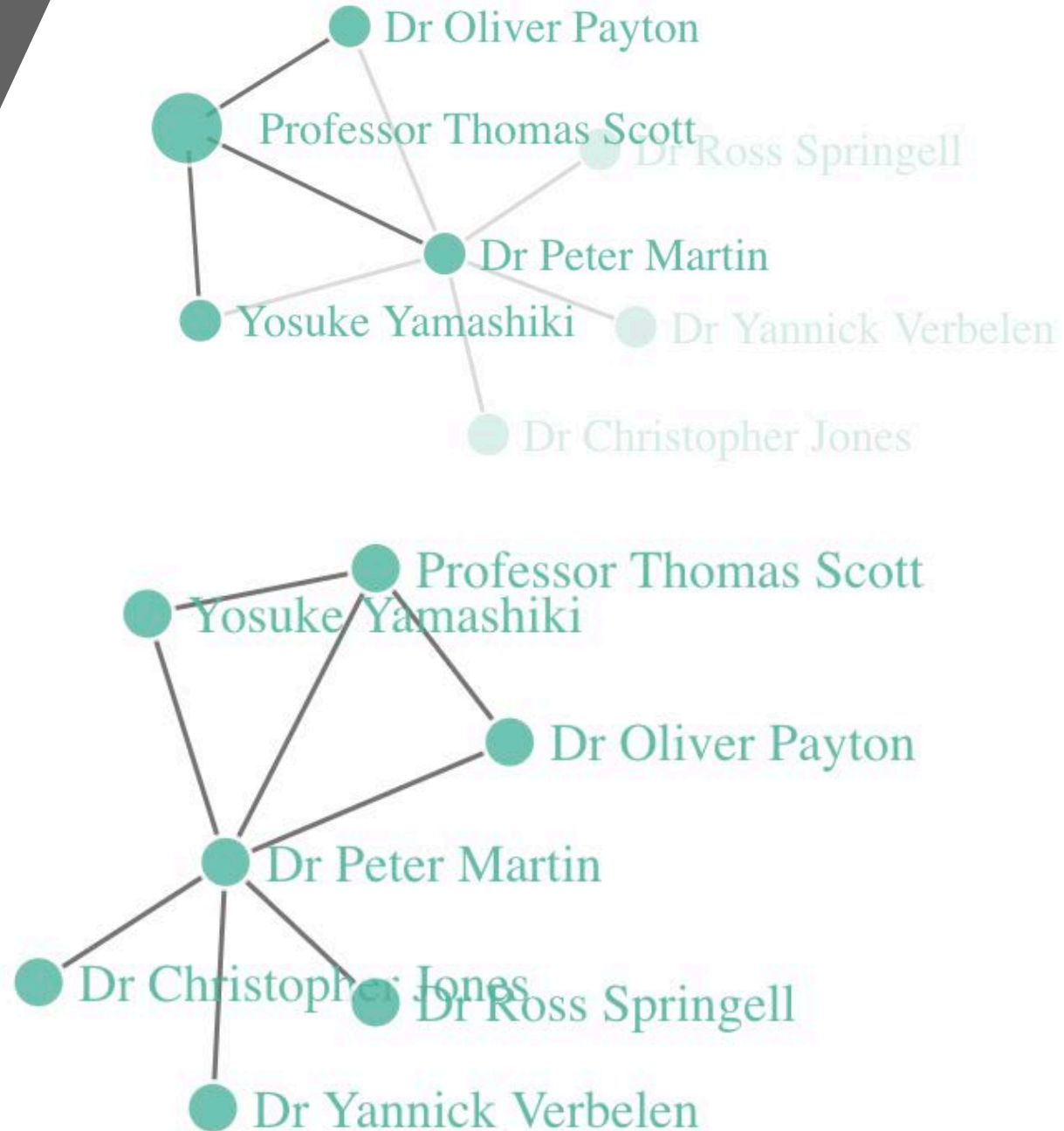


Nuclear Threat Reduction

Researcher Connections:

Interactive web diagram can display connections between researchers

Further potential for development e.g. incorporation into web app and ability to informative demographics about a researcher when clicked (research group and institution, connection degree, research outputs etc)

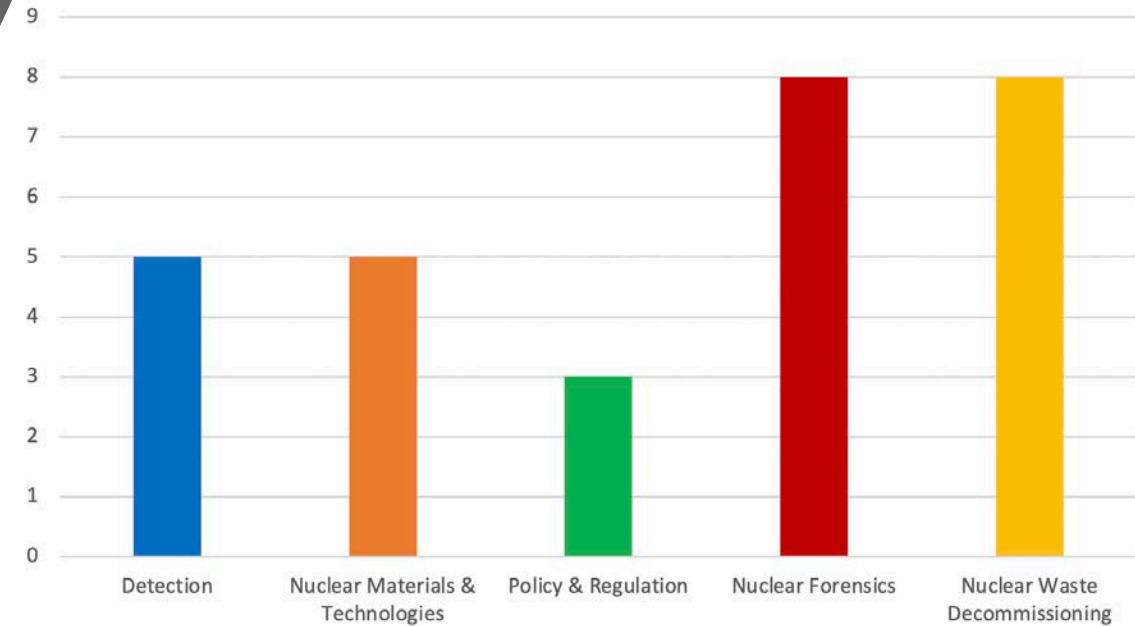


Nuclear Threat Reduction

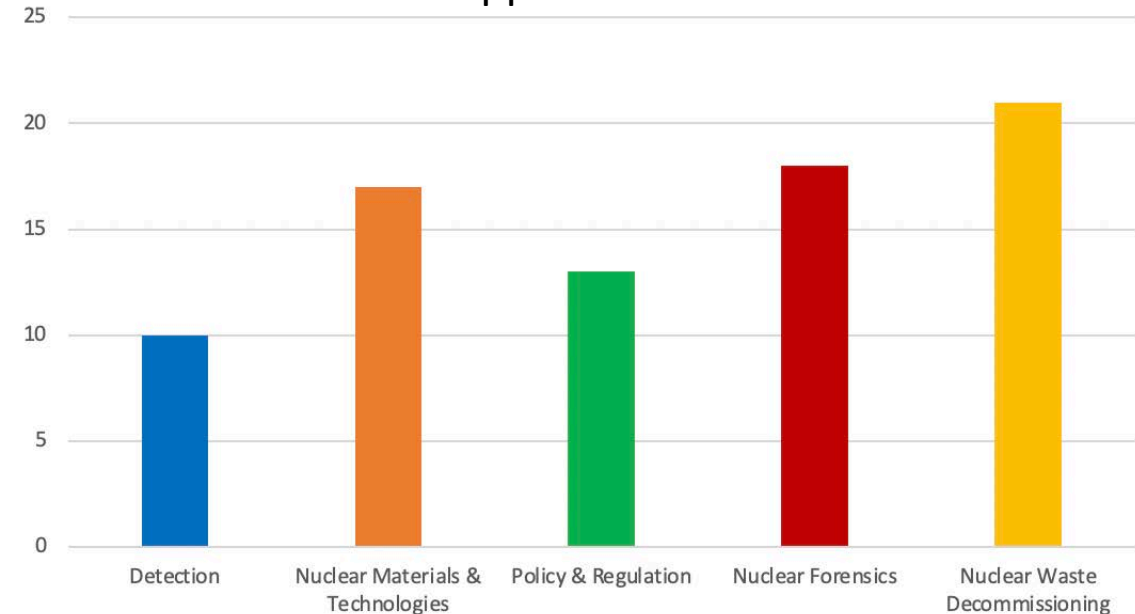
Demographics:

- We asked the community where their NTR research interests lay:
 - Radiation Detection
 - Nuclear Materials and Technologies
 - Policy and Regulation
 - Nuclear Forensics
 - Nuclear Waste Decommissioning
-
- N.B: All demographics from here on are based on only 9 and 37 respondents (so far) to each survey respectively

NTR Academics



Nuclear-Applicable Academics

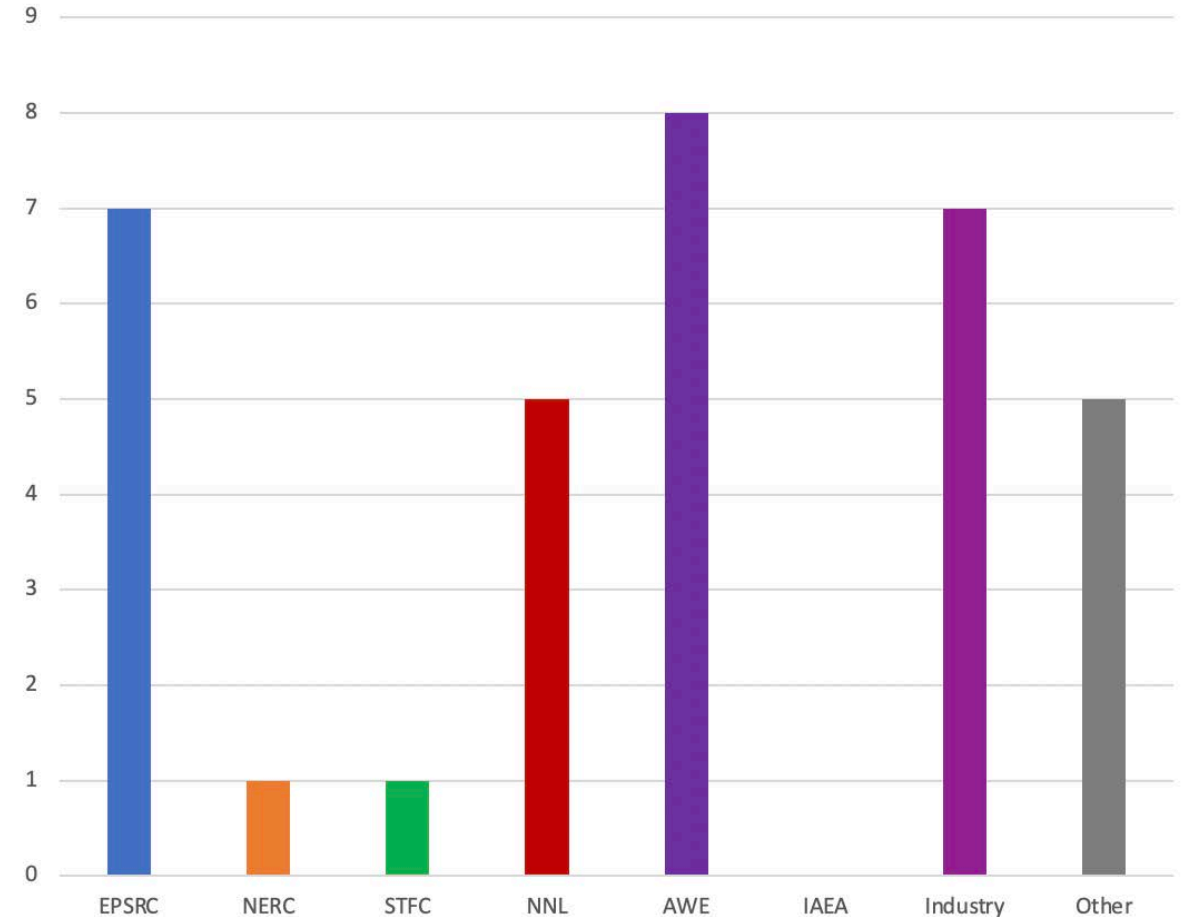


Nuclear Threat Reduction

Demographics:

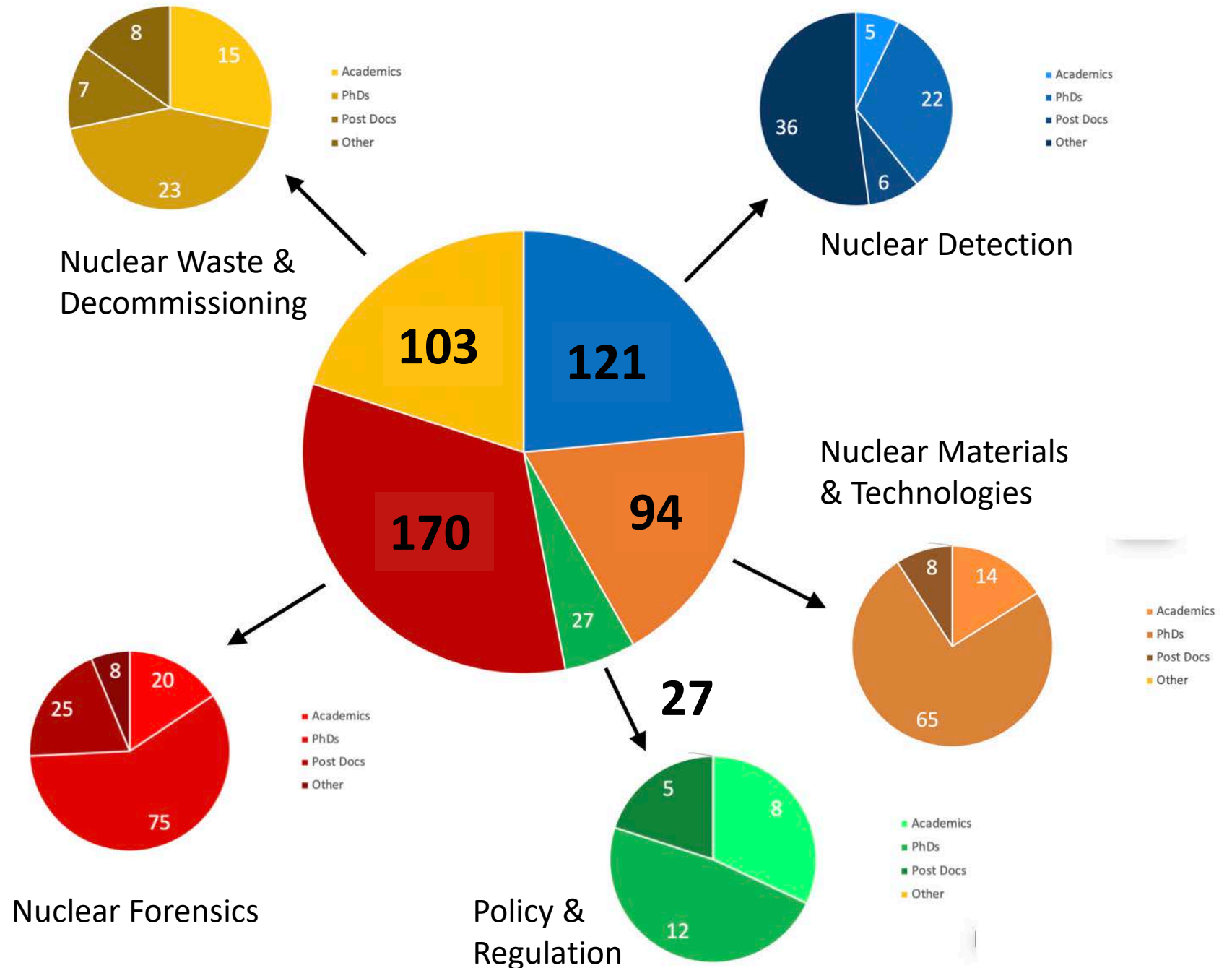
- Of research considered to 'fit' under NTR
It shows that a spread of funding supports this activity
- Interestingly, there was no funding from the IAEA nor mention of involvement with EU activities.

NTR Academics Funding Providers



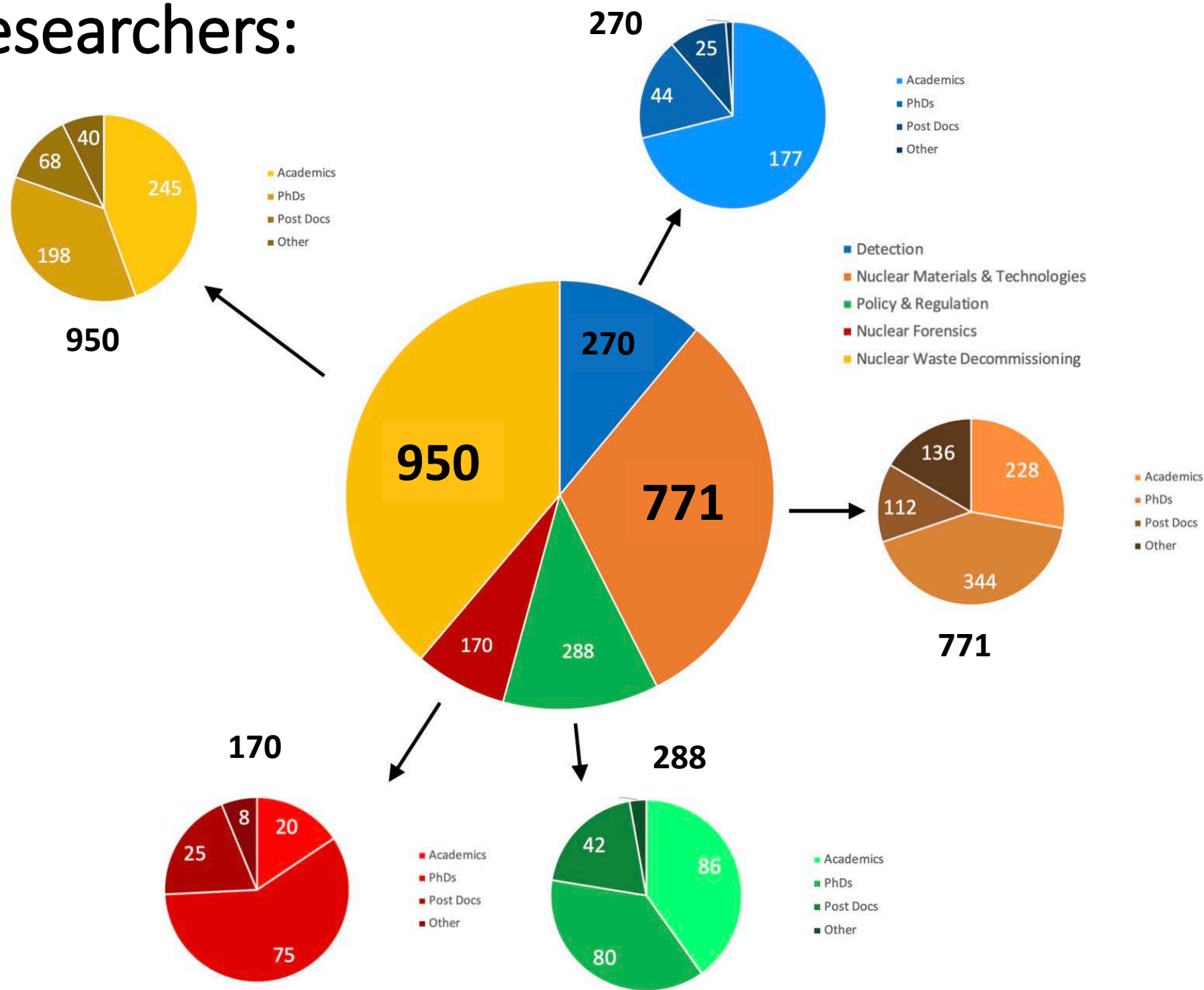
NTR Researchers:

- Out of those who said one or more of the following NTR themes formed part of their research group, the total combined researchers for these themes is given in no. people, with a breakdown of no. Academics, PhDs, Post Docs and Other given
- 'Other' includes general scientists and software engineers
- NB - Total number in breakdown may not equal the total number for the theme as not all respondents gave a breakdown



NTR Applicable Researchers:

- The questionnaire also captured the potential for additional academics, researchers and students from the wider research groups and institutions to become involved.
- 'Other' includes MSc/MSci students, general researchers, experimental officers and industry associates
- Highlights that there is significant potential to grow the community



We have mapped
the existing UK
community and
established there
is capability for
further growth

What next?

- We would like to ensure we've been as comprehensive as possible. There is still time to input to the landscaping exercise:
- https://forms.office.com/Pages/ResponsePage.aspx?id=MH_ksn3NTkgl2rGM8aQVGyVHxr6P5wlHnQ9XXFAWR7ZUQU1aOTYySIZZME44R0FTT0w0U0k4QTBtUi4u
- We will produce an NTR landscaping report for the Royal Society and BEIS (within 3 months).
- This will form part of the case and evidence base for funding an NTR network via UKRI

Support for NTR research through the NNUF

- Numerous NNUF facilities are applicable for supporting the
- Research of a future NTR
- Academic network.



Not limited to....

- NNL Central Laboratory, Cumbria
- Materials Research Facility, CCFE
- Southampton EXACT Facility
- Manchester NNUF Facility
- UTGARD Facility, Lancaster
- Hot Robotics Facility, Bristol, Cumbria, Culham



NNUF EXACT

Next Generation Accelerated Characterisation Technologies

- Aqueous flow rig designed to permit active testing of in-line and on-line sensors
- Kromek GR1A+ CZT gamma detectors
- Hidex AMG 3" NaI automated gamma spectrometer
- Hidex 300SL TDCR liquid scintillation counter
- Autosorb 6iSA SBET analyser



NNUF – EXACT facility

To **provide a state-of-the art, flexible facility** to support world-leading research on accelerated nuclear characterisation and remediation technologies;

To lead in the **development of automated and rapid measurement techniques** for *in-situ*, on-site and off-site radionuclide measurement, including those that can be integrated into robotic systems;

Radioanalytical
(GAU-Radioanalytical)

HPGe gamma
LEGe
Alpha spec
LSC, GFPC
ICP-MS/MS

Mass spectrometry
(Geochem Group)

ICPMS
HR-ICPMS
MC-ICPMS
TIMS
AF4-mass spec

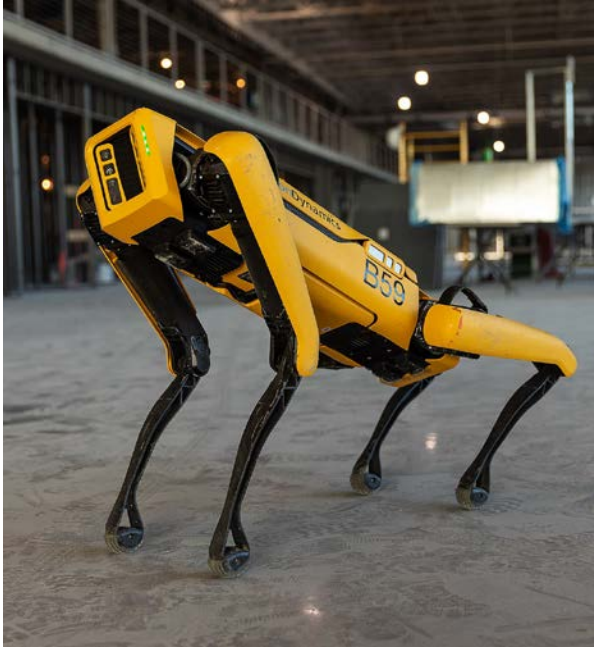
Organics
(Organic Geochem)

GC-MS
HPLC
Stable isotope

Physical
(Bristol Interface Centre)

X-ray tomography
FIBS / SEM
SEM/EDX

NNUF HOT ROBOTICS



Access to cutting edge equipment and facilities

RACE forms the primary NNUF-HR hub where a large array of robots and mock-ups are housed. Additional functionality is provided through 'hot' test capabilities and portable solutions. Collaboration with academia and industry is facilitated by RACE's proximity to Harwell, AWE and a multitude of academic institutions.

FACILITY

Barrel Store



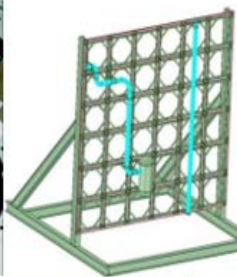
Glovebox



Magnox Graphite Core



Pipe Wall



Mock-ups



Demo
End
Uses

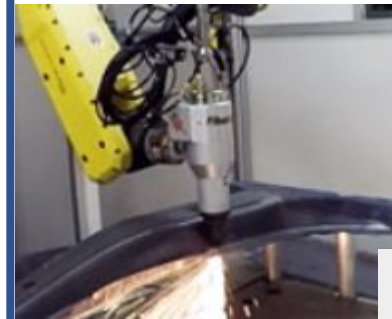
Hire
kit

UAV
UGV
Testing

Operator
Training

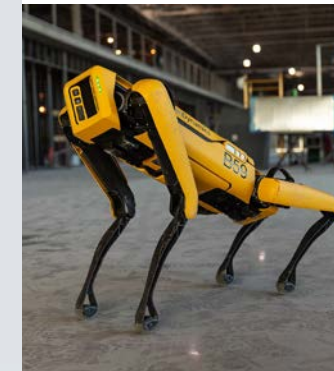
EQUIPMENT

4Kw Laser



Detectors

SPOT



Wheeled & Tracked UGVs



Force-Torque robots

Summary

- Landscaping of the UK NTR research community is nearly complete
- Still time to have input!
- Future plans are to form a UKRI-funded network
- Aim for the UK to be a major leader in NTR research

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