Keeping the standards:
The Role of the National Physical Laboratory in UK Radionuclide Measurement and Waste Assay

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PANEL SESSION II

UKNAM Lancaster, 4 Sept. 2017

NPL - The UK's national standards lab

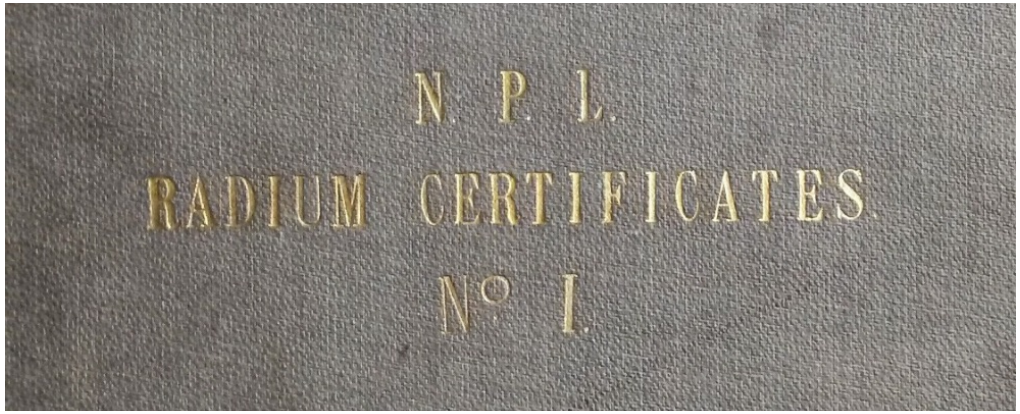
- Founded in **1900**
- A **National Measurement Institute**
- ~600 scientists plus 200 visiting researchers pa
- State-of-the-art laboratory facilities
- The core of the UK's **National Measurement System** to support business and society
- Academic partners Uni. Surrey & Strathclyde plus other formal agreements (B'ham, Edinburgh, Southampton, Cambridge...)

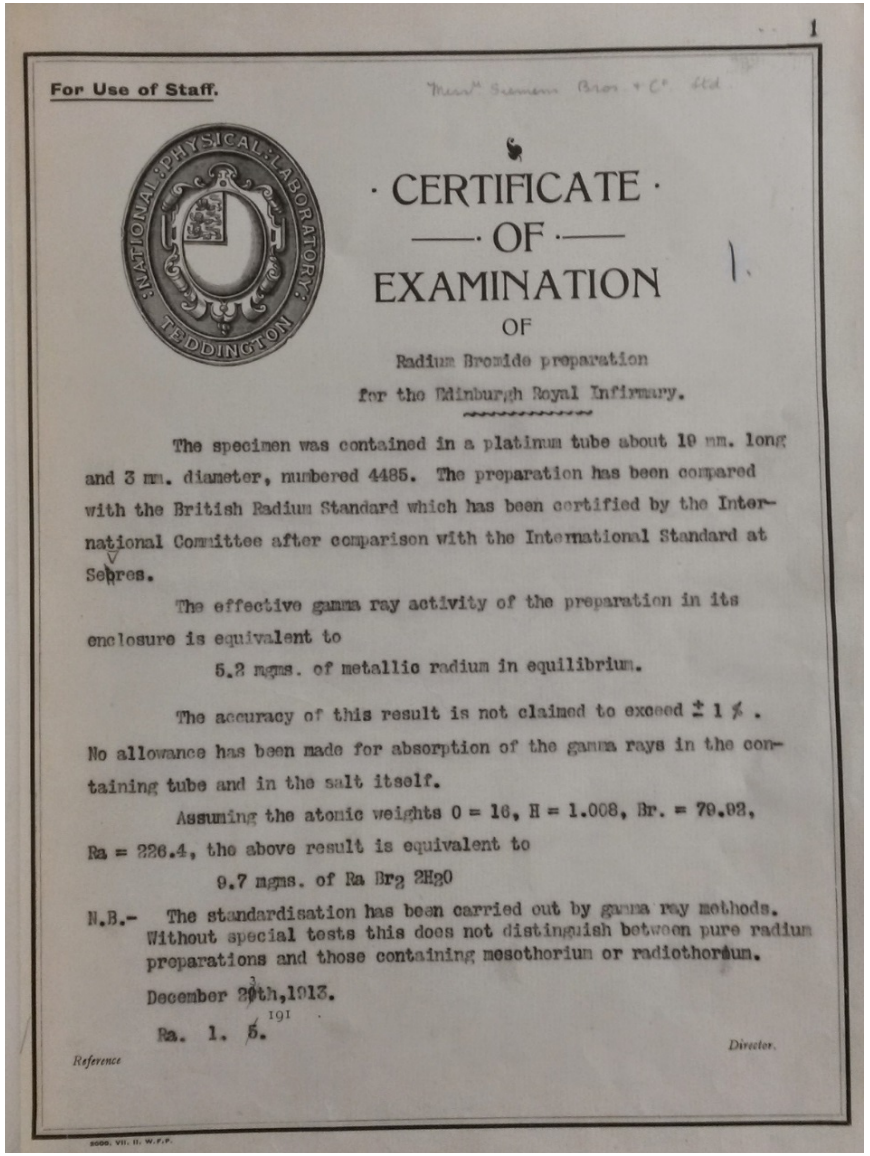
All measurements of radioactivity in the UK rely on the **primary standards held at NPL**. The NPL standards are linked to the international measurement system and provide a route to demonstrate that measurements are **accurate, consistent and independent**.

The absolute primary standardisation of activity is a key mission of National Measurement Institutes such as NPL (UK), NIST (USA), PTB (Germany).

They provide unbroken traceability to the SI unit of the becquerel (Bq) = s^{-1} .

NPL has maintained the traceability of radioactive sources to the Bq in the UK for over 100 years





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For Use of Staff.

NATIONAL PHYSICAL LABORATORY TEDDINGTON

· CERTIFICATE ·
—· OF ·—
EXAMINATION
OF
Radium Bromide preparation
for the Edinburgh Royal Infirmary.

The specimen was contained in a platinum tube about 10 mm. long and 3 mm. diameter, numbered 4485. The preparation has been compared with the British Radium Standard which has been certified by the International Committee after comparison with the International Standard at Sèvres.

The effective gamma ray activity of the preparation in its enclosure is equivalent to

5.2 mgms. of metallic radium in equilibrium.

The accuracy of this result is not claimed to exceed ± 1 % .

No allowance has been made for absorption of the gamma rays in the containing tube and in the salt itself.

Assuming the atomic weights O = 16, H = 1.008, Br. = 79.92, Ra = 226.4, the above result is equivalent to

9.7 mgms. of $Ra\,Br_2\,2H_2O$

N.B.- The standardisation has been carried out by gamma ray methods. Without special tests this does not distinguish between pure radium preparations and those containing mesothorium or radiothorium.

December 29th, 1913.

Ra. 1. 5. 191

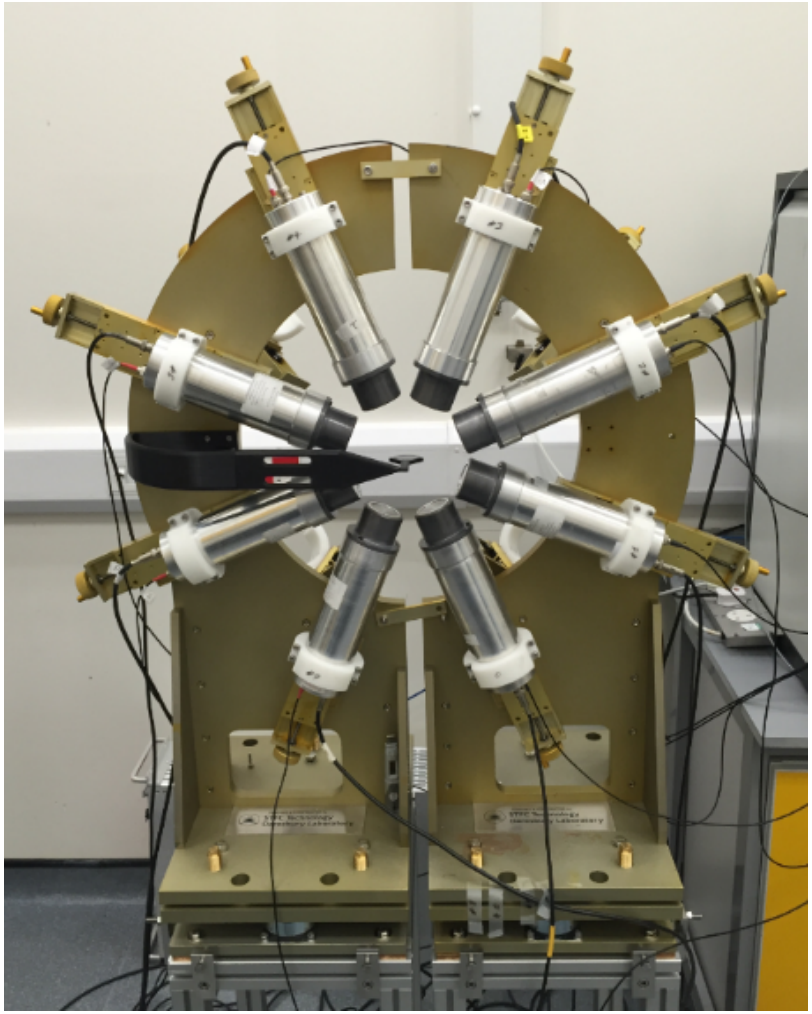
Director.

Reference

Role of National Physical Laboratory (NPL) in 'Nuclear'

- Reference materials for measurement and calibration.
- Provide traceability for ALL UK radiation measurements.
- Fast-neutron facility for ABSOLUTE neutron cross-sections.
- Collaborations in nuclear data measurements (via the STFC-UKNDN) at for e.g., ^{238}U(n,f) fission waste residues.
- Measurements of long-lived radioisotopes via e.g., ICP-MS. (Needed for public 'confidence' in waste assay for e.g., ^{237}Np).
- Provide graduate-level training in radionuclide metrology.
- Expertise in radionuclide measurement; data analysis; radiochemistry; env. radioactivity monitory; links to nuclear security (e.g., via CTBTO).

SUCCESSFUL CASE STUDY



Robert Shearman, NPL-based, **NDA-NNL** funded U. Surrey PhD student, working on
'*Development of a Novel Gamma-ray Detection System For Fission Fragment Management and Evaluation*'.
Designed and commissioned the **NA**tional **N**uclear Array (NANA).

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Radiation Physics and Chemistry

journal homepage: www.elsevier.com/locate/radphyschem

Commissioning of the UK NAtional Nuclear Array

R. Shearman[a,b,*], S.M. Collins[a], G. Lorusso[a,b], M. Rudigier[b], S.M. Judge[a,b], S.J. Bell[a], Zs. Podolyak[b], P.H. Regan[a,b]

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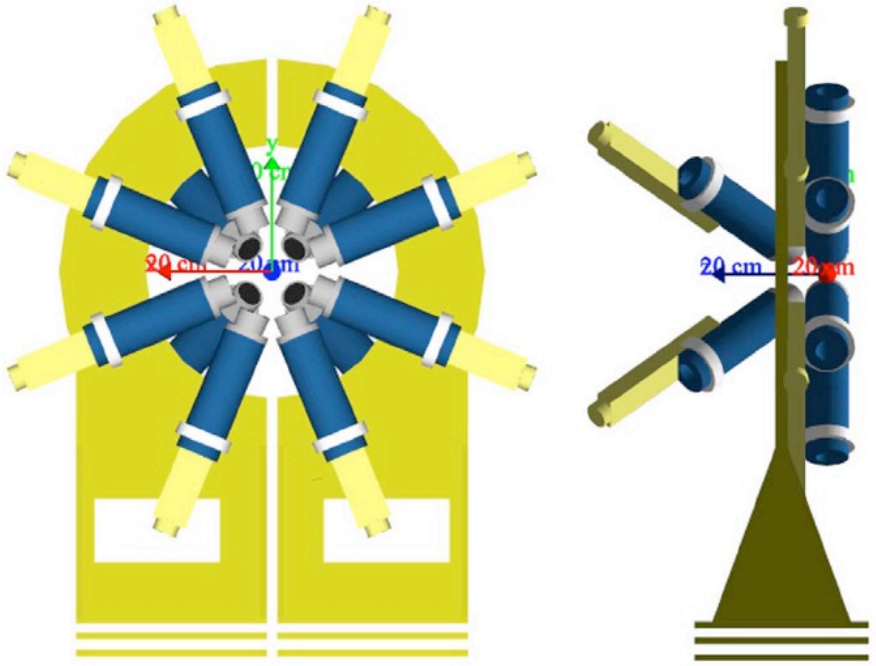
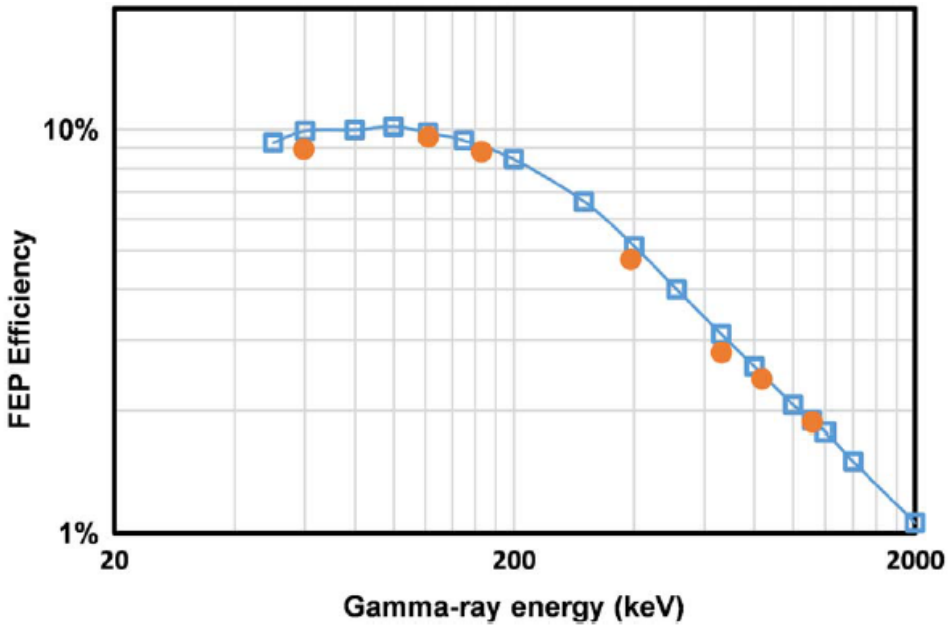




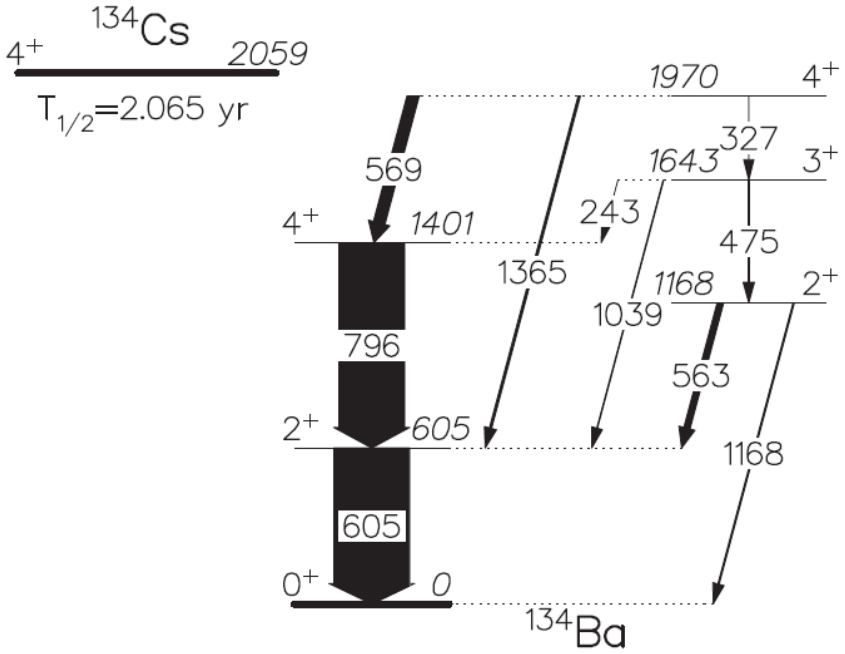
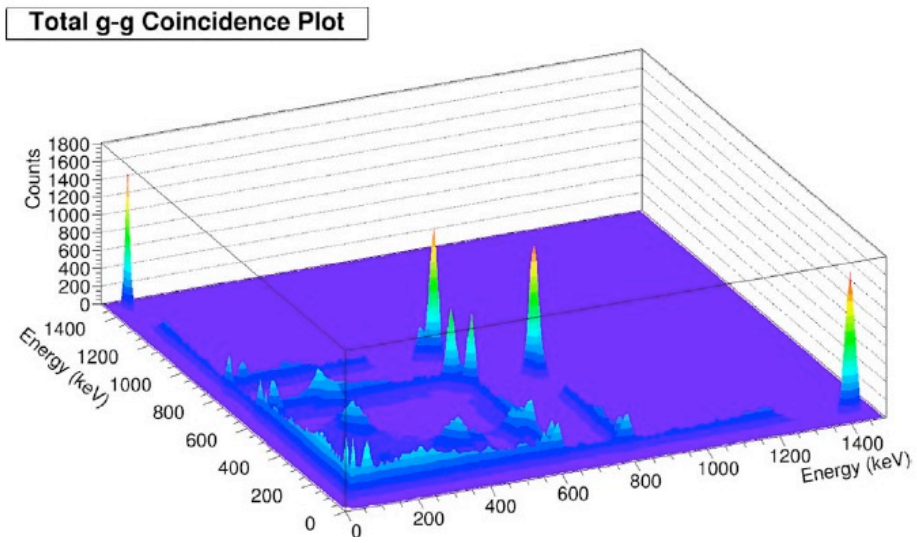


Fig. 9. Level scheme showing the states populated in the β^- decay of the nuclear fission waste residue ^{134}Cs.



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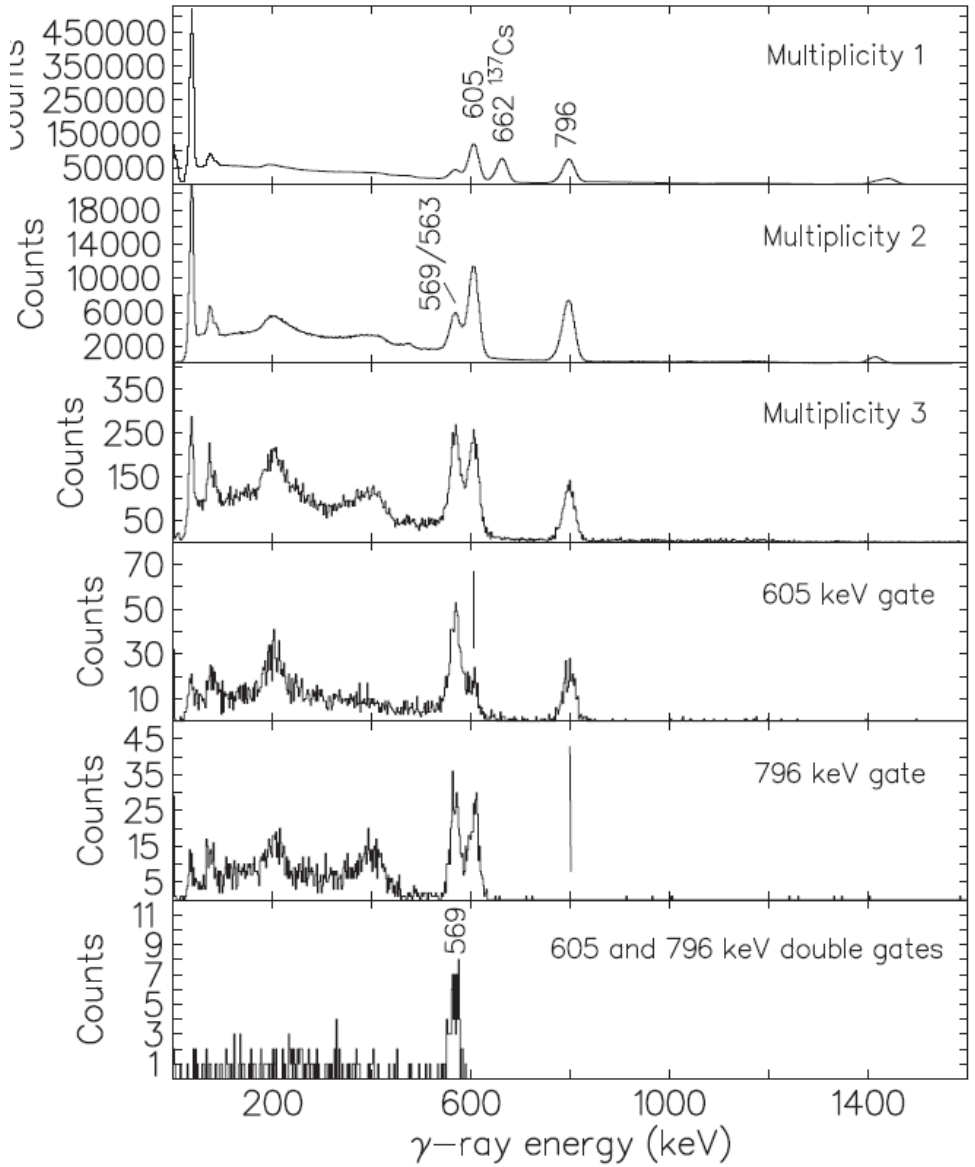


NUCLEAR (DECAY) DATA:

- Nuclear data and standards UNDERPIN:

  – medical radiopharmaceutical dose evaluations;
  – nuclear security (e.g., CTBT verification)
  – nuclear waste assay (Np, Pu, Am, Cs, Sr etc.);
  – environmental assay (U, Th, Ra NORMs);
  – nuclear forensics (U, Pu isotope ratios);
  – Gen IV reactor operation modelling;

  …..and nuclear structure / astrophysics research.

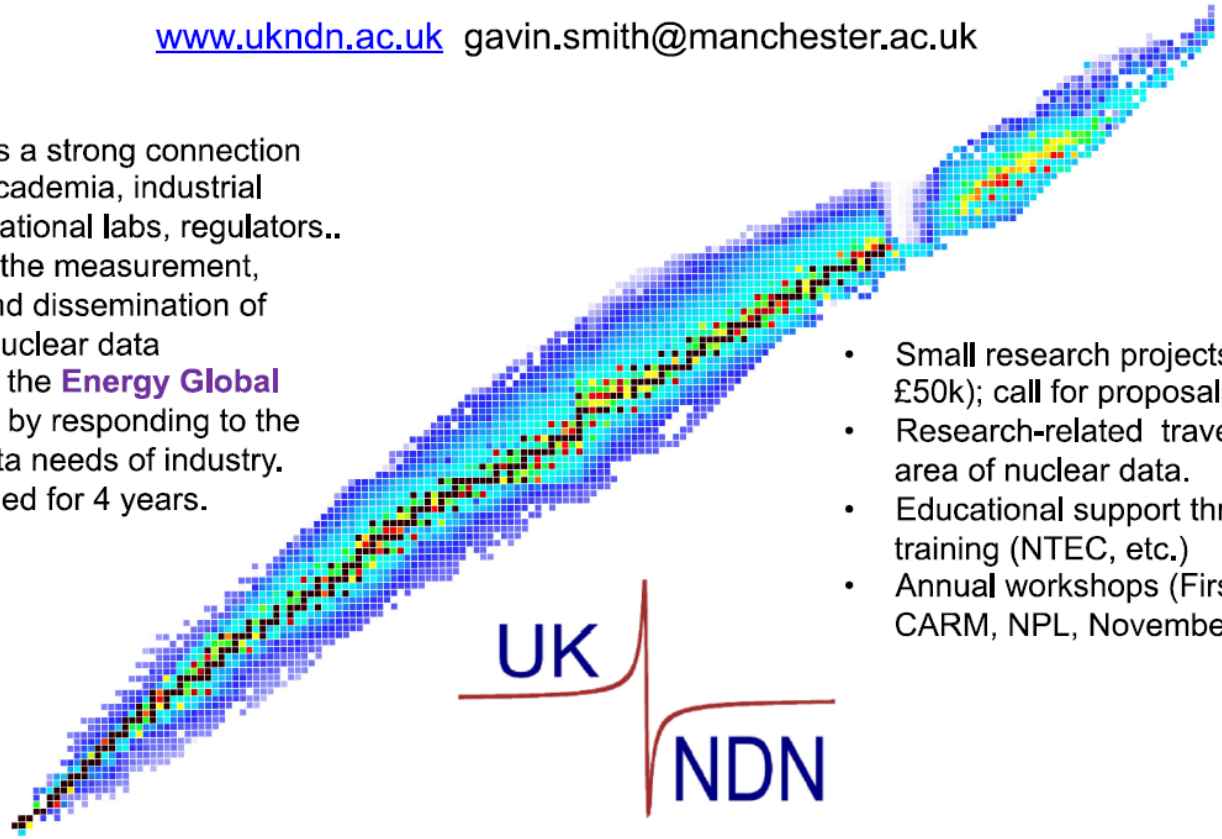
MANCHESTER 1824

The University of Manchester

UK Nuclear Data Network+ (UKNDN)
Manchester, Surrey & York, and NNL & NPL

www.ukndn.ac.uk gavin.smith@manchester.ac.uk

- Establishes a strong connection between academia, industrial partners, national labs, regulators..
- Facilitates the measurement, analysis and dissemination of industrial nuclear data
- Addresses the **Energy Global Challenge** by responding to the nuclear data needs of industry.
- STFC funded for 4 years.



- Small research projects (£10k or £50k); call for proposals twice PA.
- Research-related travel in the area of nuclear data.
- Educational support through CPD training (NTEC, etc.)
- Annual workshops (First one at CARM, NPL, November 2016)

UK NDN

NPL National Physical Laboratory

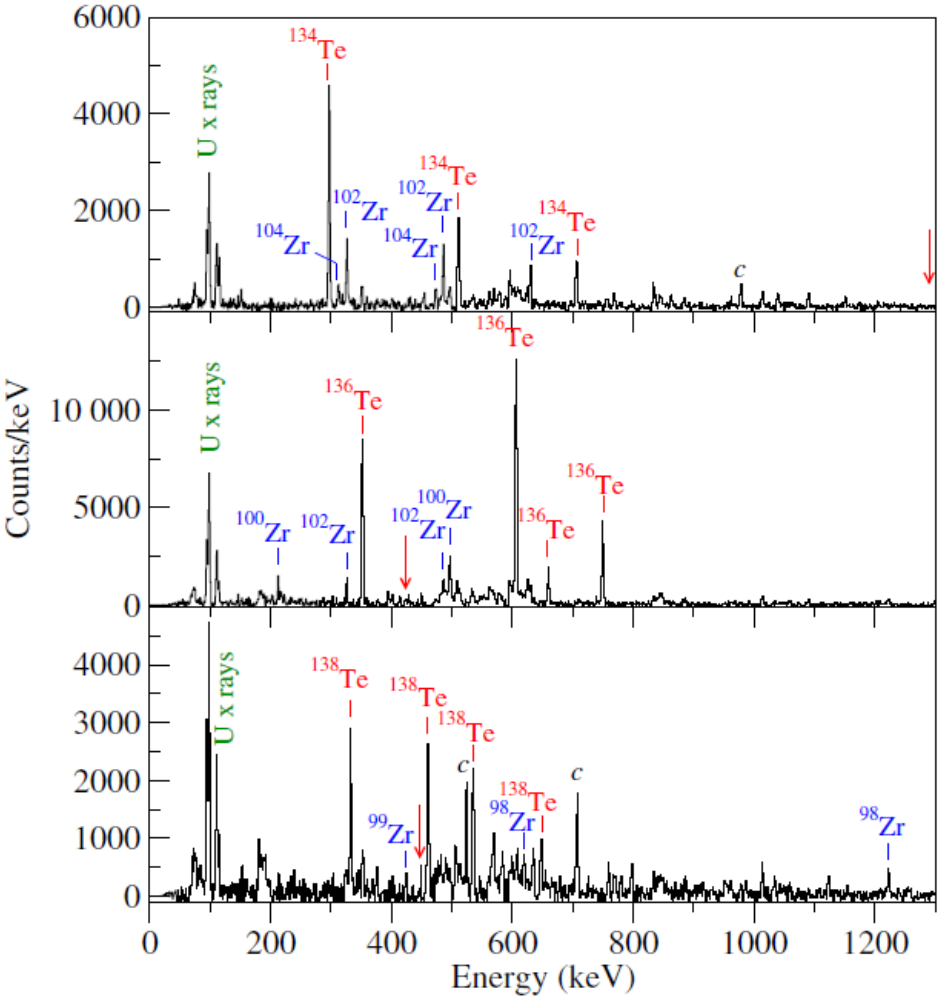
NATIONAL NUCLEAR LABORATORY

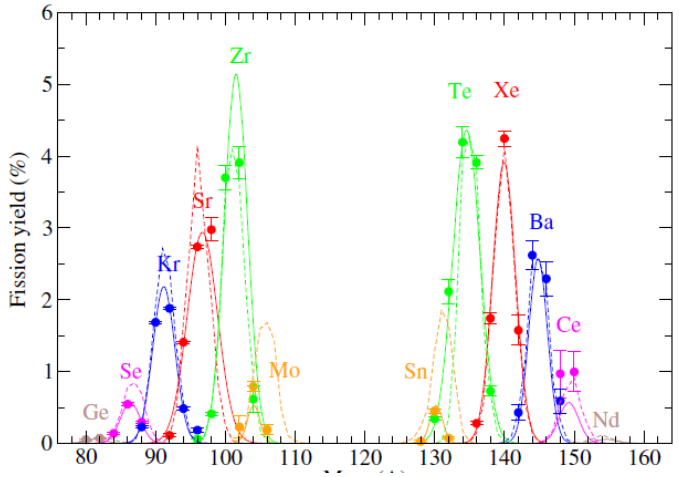
UNIVERSITY OF SURREY

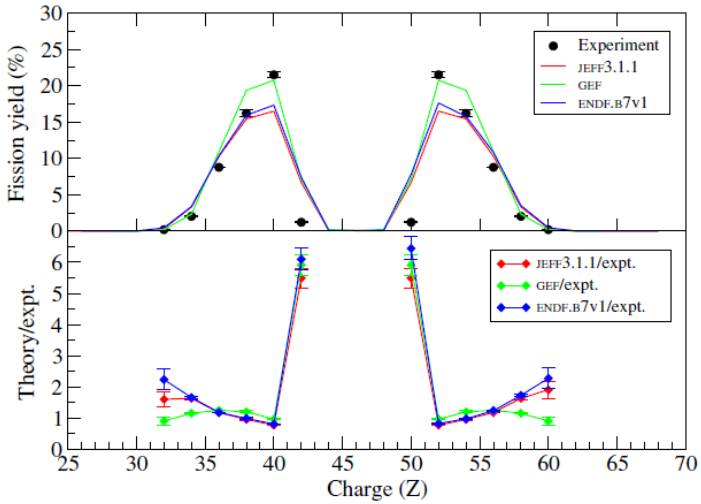
UNIVERSITY of York

Anomalies in the Charge Yields of Fission Fragments from the $^{238}U(n,f)$ Reaction

J. N. Wilson,[1] M. Lebois,[1] L. Qi,[1] P. Amador-Celdran,[2] D. Bleuel,[3] J. A. Briz,[4] R. Carroll,[5] W. Catford,[5] H. De Witte,[6] D. T. Doherty,[7] R. Eloirdi,[2] G. Georgiev,[8] A. Gottardo,[1] A. Goasduff,[8] K. Hadyńska-Klęk,[9] K. Hauschild,[8] H. Hess,[10] V. Ingeberg,[11] T. Konstantinopoulos,[8] J. Ljungvall,[8] A. Lopez-Martens,[8] G. Lorusso,[12] R. Lozeva,[8] R. Lutter,[13] P. Marini,[14] I. Matea,[1] T. Materna,[7] L. Mathieu,[15] A. Oberstedt,[16] S. Oberstedt,[17] S. Panebianco,[7] Zs. Podolyák,[5] A. Porta,[4] P. H. Regan,[5,12] P. Reiter,[10] K. Rezynkina,[6] S. J. Rose,[11] E. Sahin,[11] M. Seidlitz,[10] O. Serot,[18] R. Shearman,[5,12] B. Siebeck,[10] S. Siem,[11] A. G. Smith,[19] G. M. Tveten,[11] D. Verney,[1] N. Warr,[10] F. Zeiser,[11] and M. Zielinska[7]







Some of the NPL team and expertise

- Pete Theobald (Group Leader)
- John Keightley (primary & absolute decay standards)
- Sean Collins & Andy Pearce (g-ray spec; absolute data)
- Rob Shearman* & Giuseppe Lorusso (NANA)
- Kelly Ferreira (Ionization chambers for standards)
- David Thomas (neutron facility, Science Area Leader)
- Peter Ivanov (radiochemical separations; actinide chem.)
- Cyrus Larijani* (radiochem / alpha spec / nuclear strategy)
- Andy Robinson + Andrew Fenwick (medical & theranostics)
- Prof. David Read (Radiochem / assay – also Joint U. Surrey)