

Growing Nuclear Physics Research at Sheffield Hallam University

Robin Smith

robin.smith@shu.ac.uk



@UnclearPhysics

**Sheffield
Hallam
University**

UConn
UNIVERSITY OF CONNECTICUT



Overview

- My background
- Physics at Sheffield Hallam University
- Areas of research and personnel
 - Structure
 - Astrophysics
 - Nuclear data
 - Fusion
- Grants and funding
- Outlook



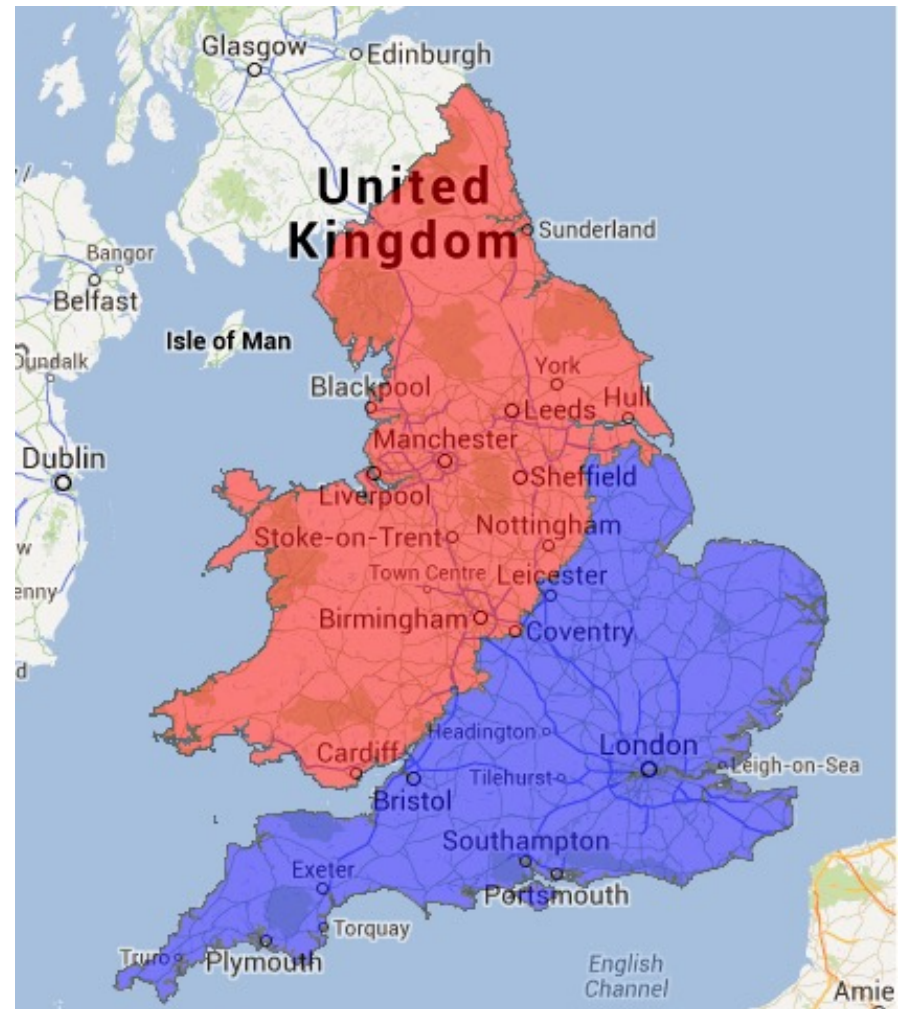
The North's Newest Nuclear Physics Group

- *“The North-South border is extremely well-defined; just ask any Northerner and he will gladly tell you that ‘the South’ is everywhere immediately south of where he happens to live.”*



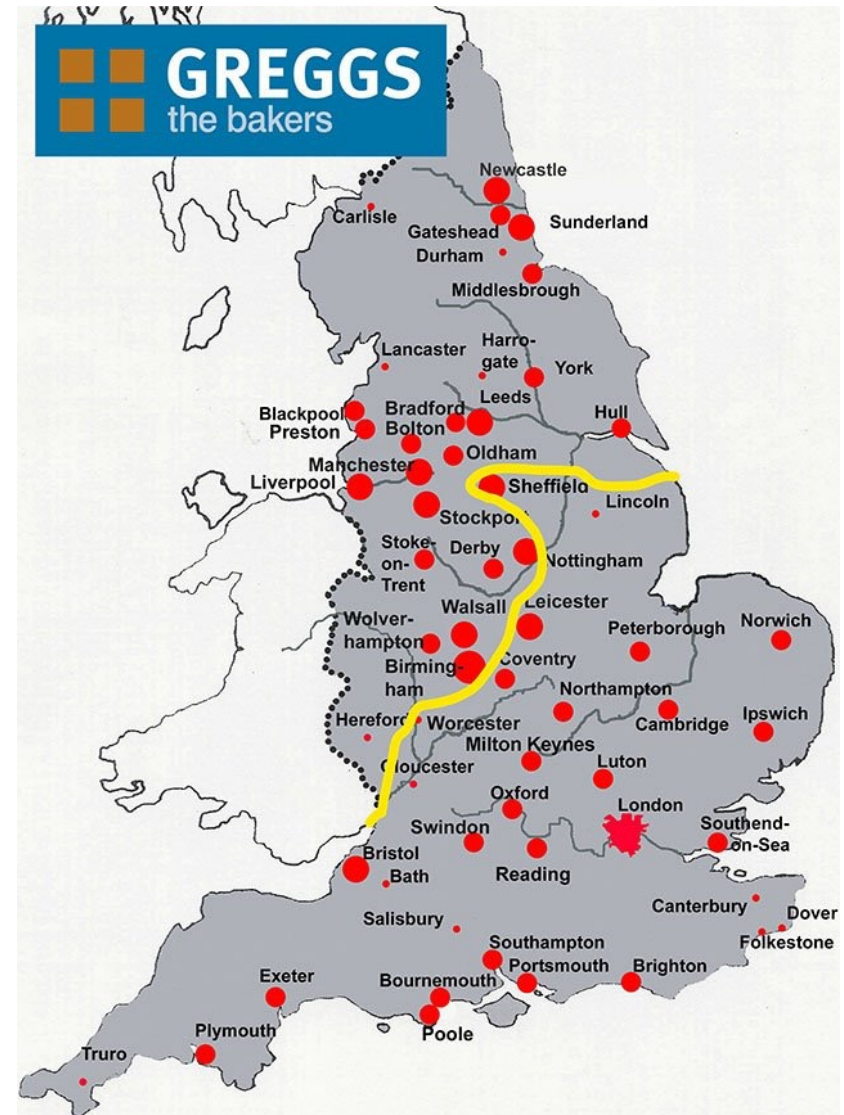
The North's Newest Nuclear Physics Group

- 2007 study by University of Sheffield
<https://www.sheffield.ac.uk/news/nr/908-1.175274>



The North's Newest Nuclear Physics Group

- 2017 study by “The Tab”
<https://thetab.com/uk/2017/08/02/weve-figured-exactly-north-plotting-every-single-greggs-store-map-44385>



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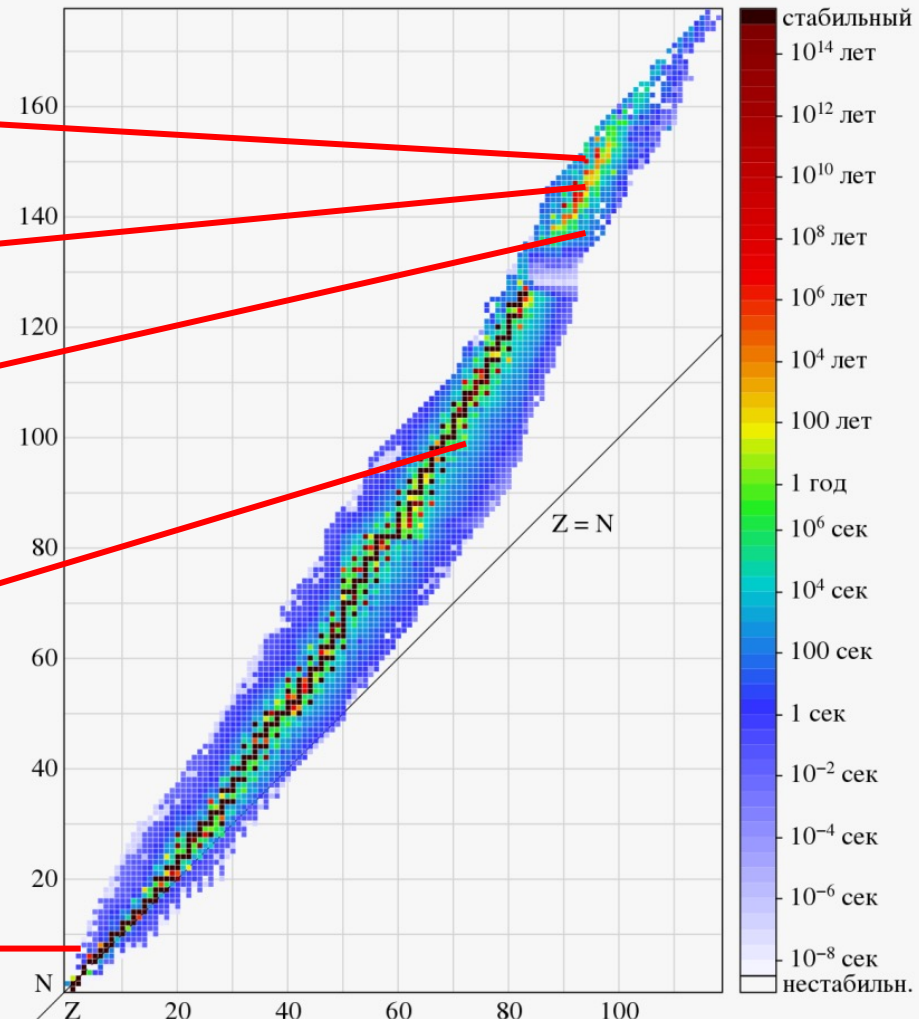
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- 2017 study by “The Tab”
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- *Issues with their methodology*



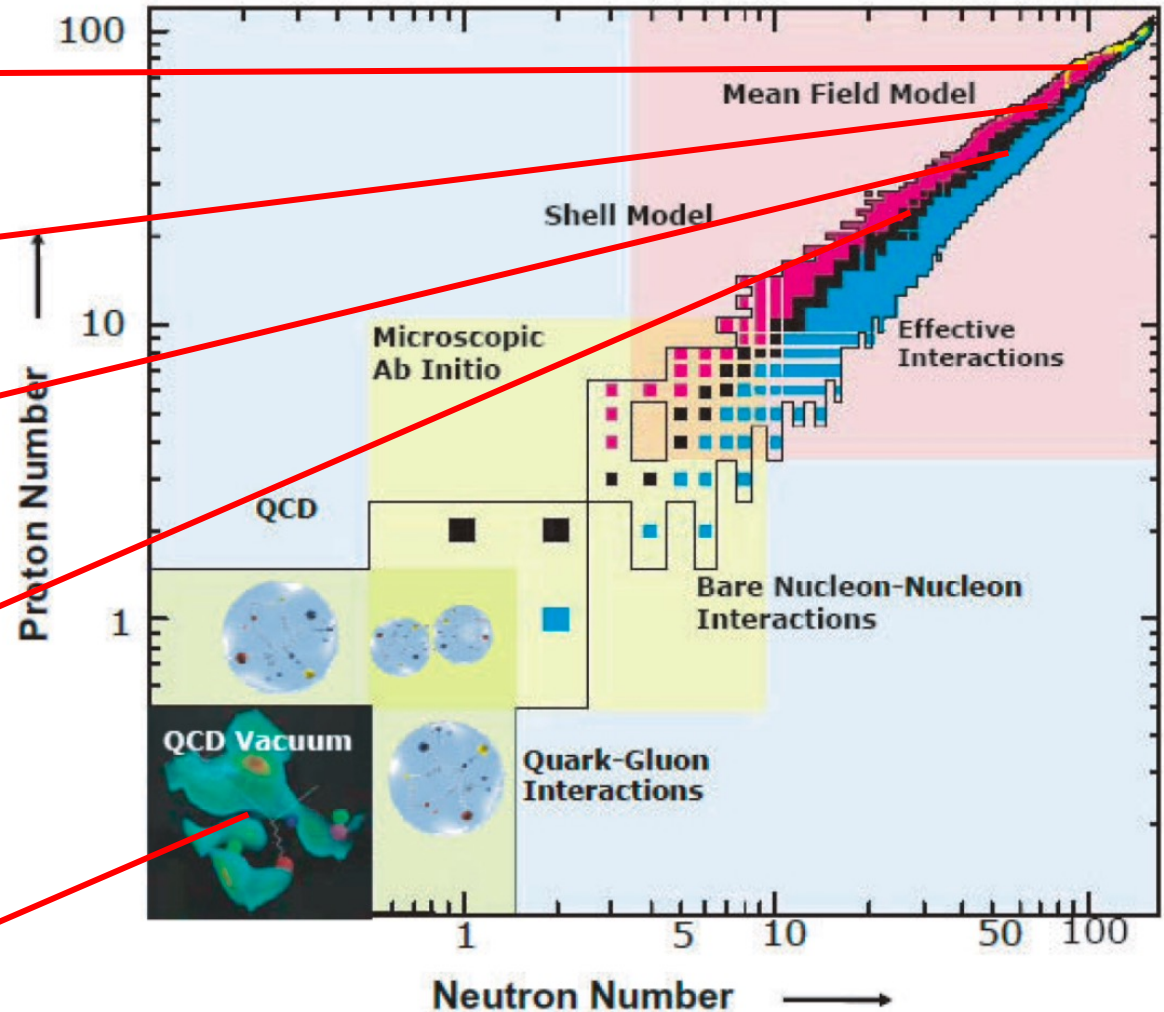
The North's Newest Nuclear Physics Group

- Manchester
- Liverpool
- York
- Daresbury
- Sheffield Hallam



The North's Newest Nuclear Physics Group

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The North's Newest Nuclear Physics Group

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- Sheffield Hallam



Robin Smith



Ocean Wong



Raed Dallal



Kris Haverson

My background

- MSci degree in Physics
2013
 - *Uni of Birmingham*
- PhD in nuclear physics
2017
 - *Uni of Birmingham*
- *Joined Sheffield Hallam
University as lecturer 2017*
- *Joined University of
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Research Prof. in 2019*



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- MSci degree in Physics 2013
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About Sheffield Hallam Uni

- SHU is 6th largest university in UK – student no's
- Mainly recruits locally from South Yorkshire region
- Strong track record of recruiting under-represented groups in STEM
- Aim: to become *world's leading applied university*



Lecturing at Sheffield Hallam University

- Reinstatement of BSc physics degree programme at SHU in 2016
- Role is a mixture of teaching and research
 - 80% teaching
 - 20% research

IOP Institute of Physics

Lecturing at Sheffield Hallam University

- Modules:

- Y1 Astronomy (10 credits)
- Y1 Atomic & Nuclear physics (20 credits)
- Y2 Electromagnetism (10 credits)
- Y2 Physics lab coordinator (10 credits)
- Y3 Physics projects coordinator (40 credits)
- Y3 Physics projects supervisor (5 per year)
- Tutorials/academic advising

Nuclear physics research

- Research areas:
 - Structure
 - Astrophysics
 - Nuclear data
 - Fusion

Nuclear structure research

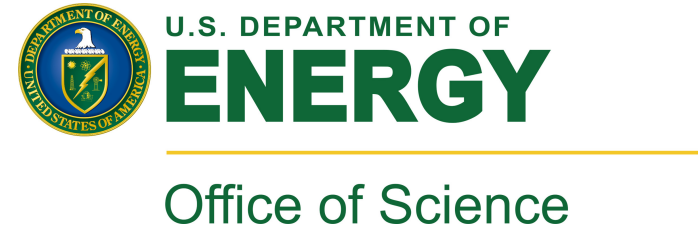
- Funding:

- STFC consolidated grant (joint application with Birmingham)
- US DOE division of nuclear physics (subaward via Uconn)



- UK personnel:

- Tzany Kokalova, Carl Wheldon, Robin Smith
- PhD student Kris Haverson



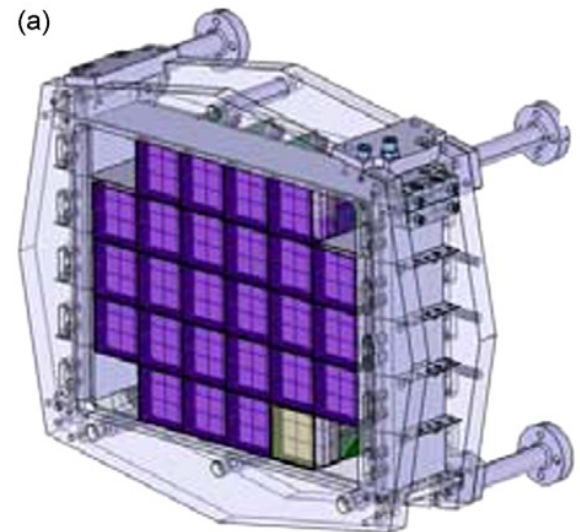
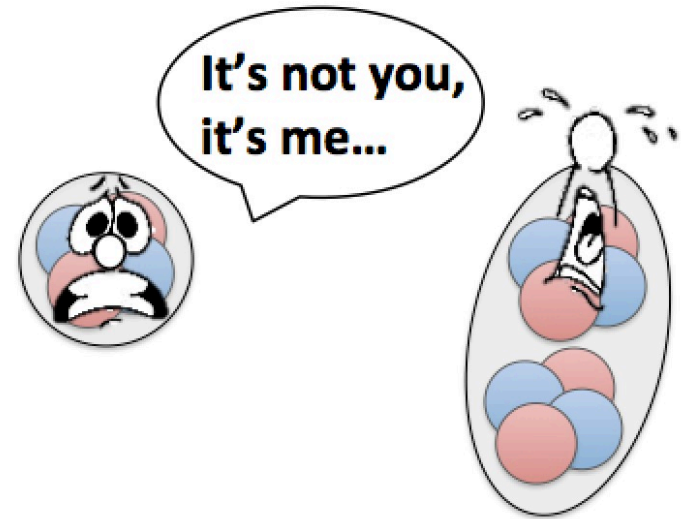
UNIVERSITY OF
BIRMINGHAM

Sheffield
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University

UConn
UNIVERSITY OF CONNECTICUT

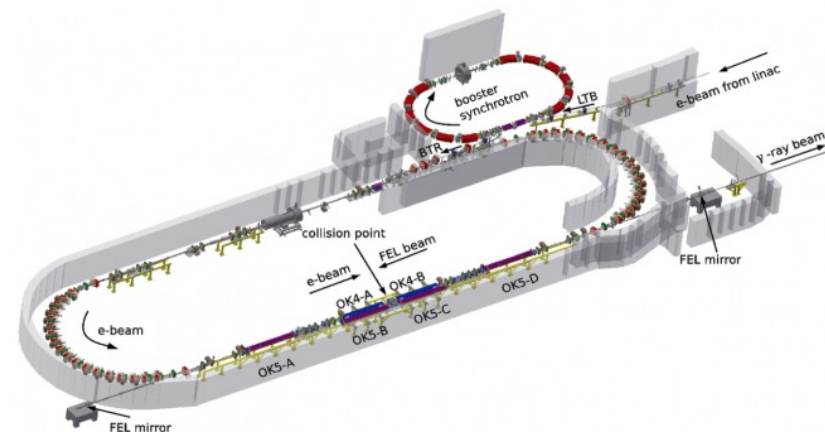
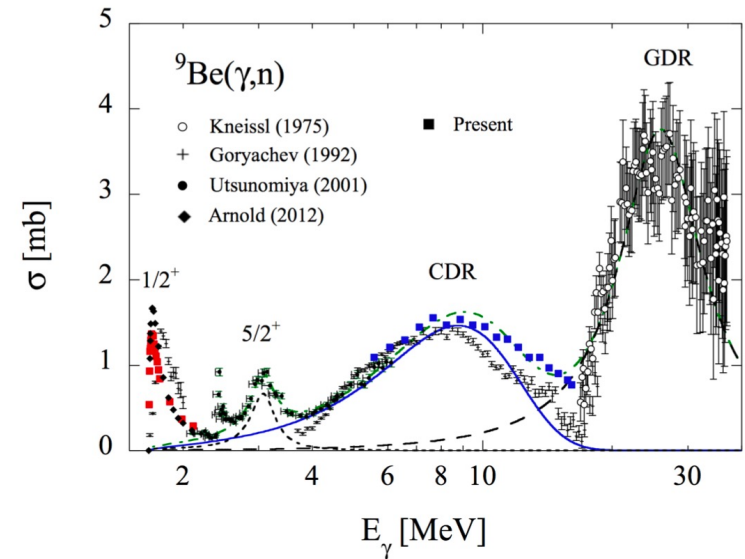
Nuclear structure research

- What? Precision probes of nuclear clustering
 - Decay of ^{12}C with particle beams
 - Photodissociation of ^{12}C and ^9Be
 - Gamma decay of clustered states
 - Spectroscopy of ^8Be at ISOLDE



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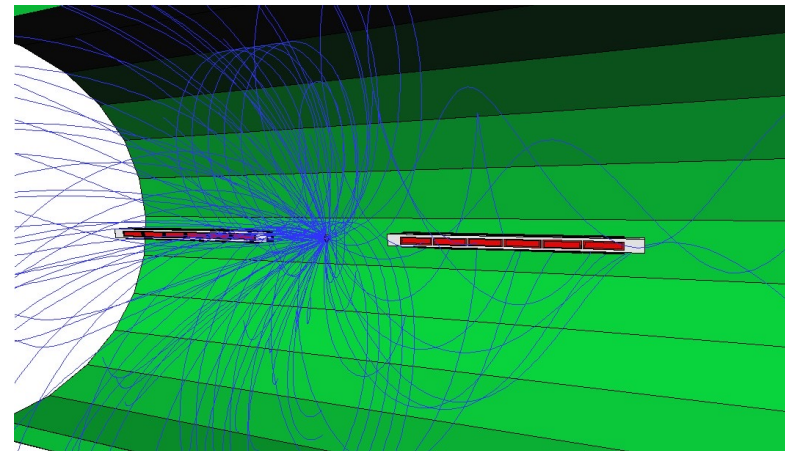
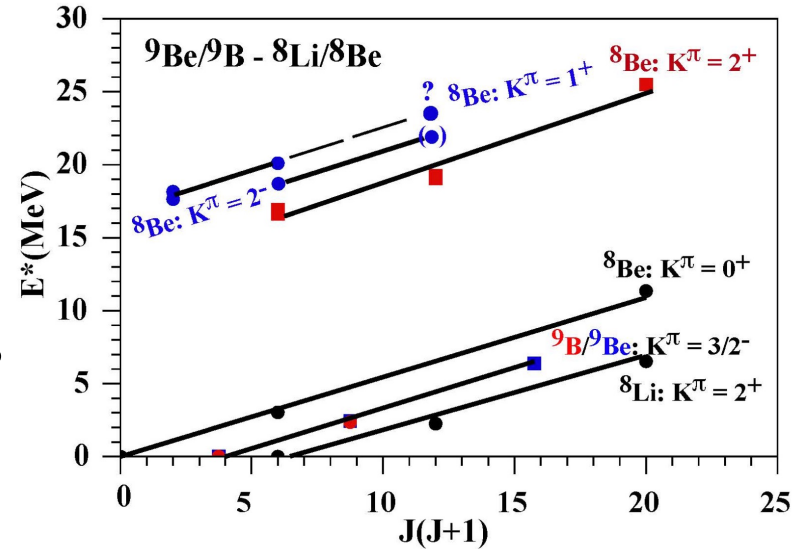
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Nuclear astrophysics research

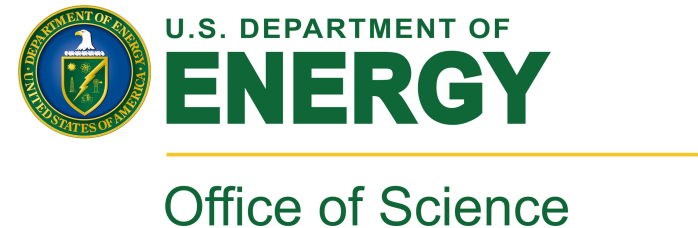
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- PhD students: S. R. Stern, D. K. Schweitzer, Kris Haverson



UNIVERSITY OF
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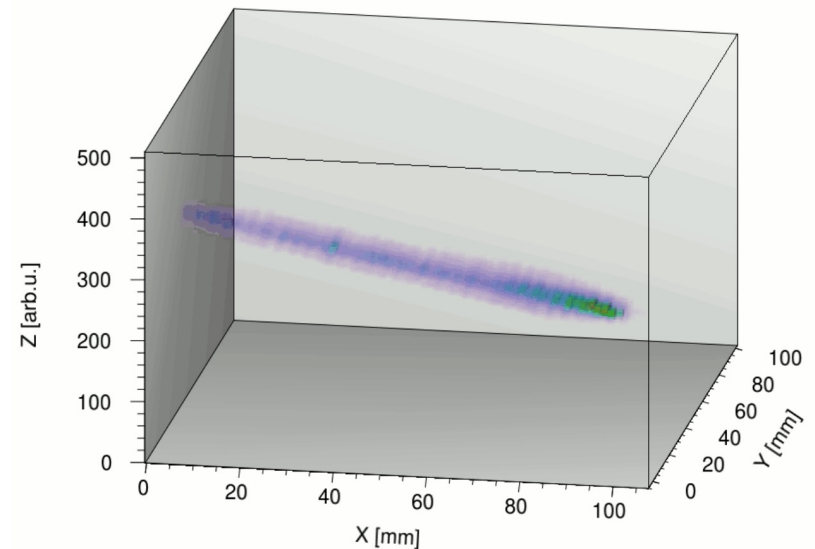
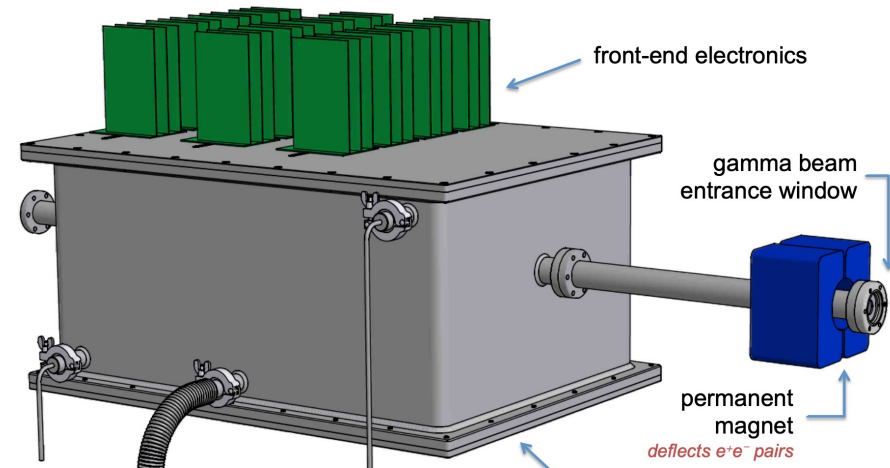
Sheffield
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TUNL
TRIANGLE UNIVERSITIES NUCLEAR LABORATORY

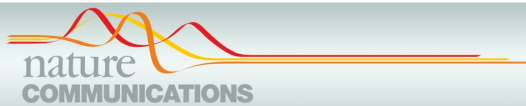
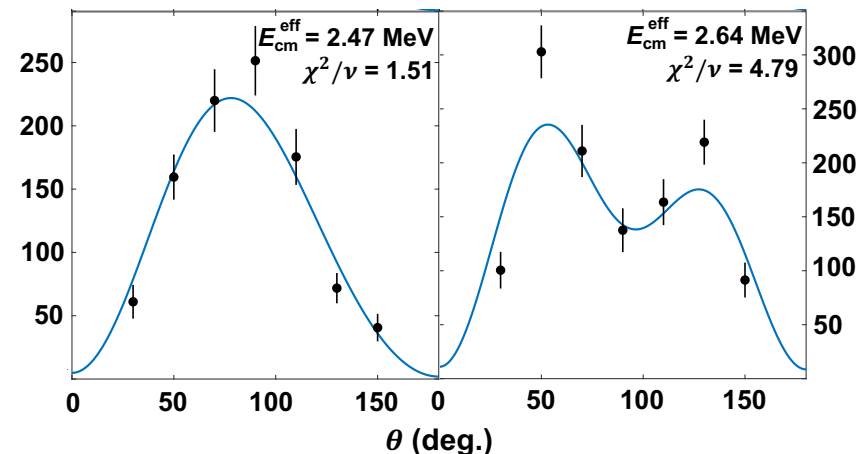
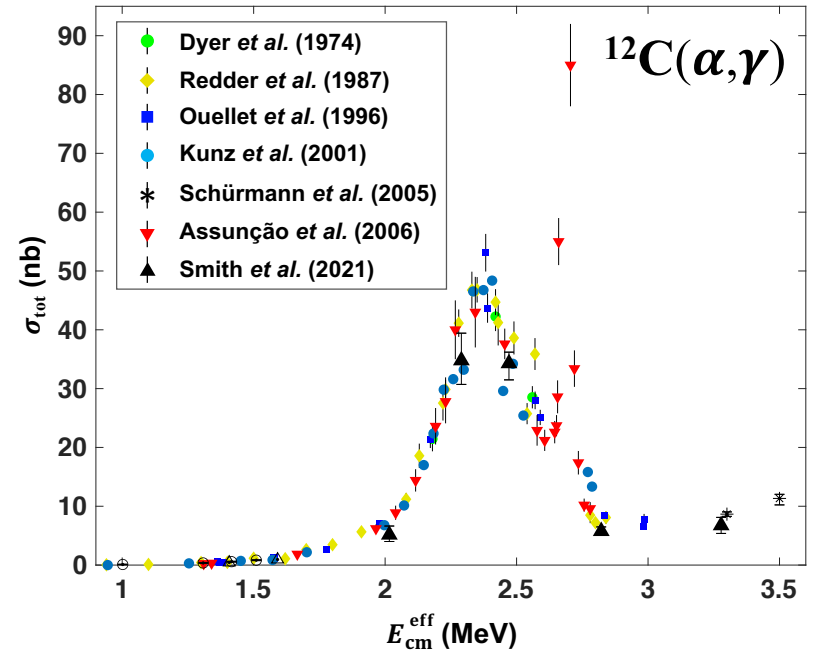
Nuclear astrophysics research

- What? Novel approaches to measuring key reactions in astrophysics
 - Photodissociation of ^{16}O to infer $^{12}\text{C}(\alpha,\gamma)$ cross section
 - Measurement of $^{13}\text{C}(\alpha,n)$ in inverse kinematics



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ARTICLE

<https://doi.org/10.1038/s41467-021-26179-x>

OPEN

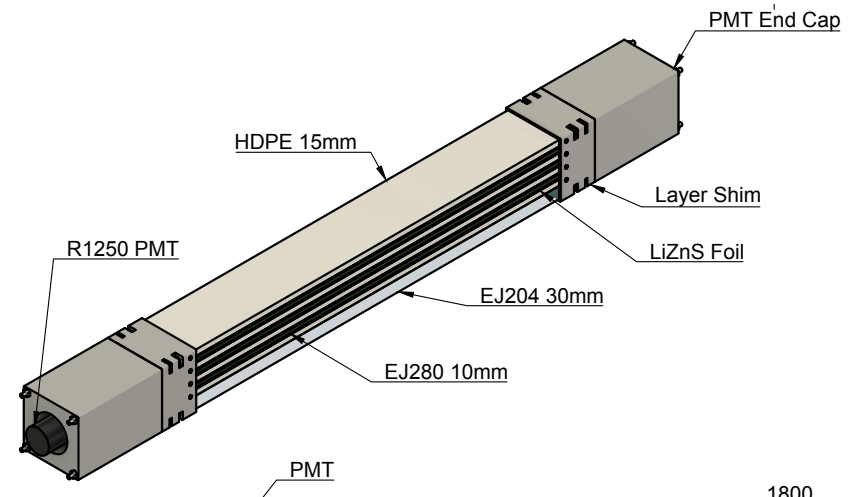
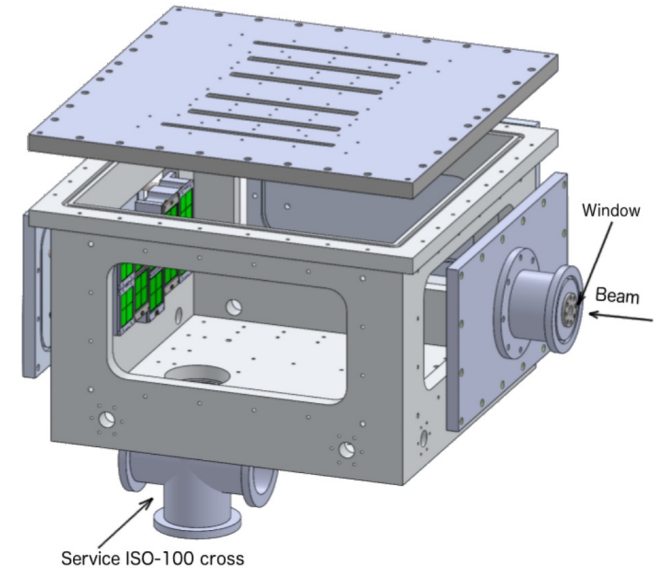


Precision measurements on oxygen formation in stellar helium burning with gamma-ray beams and a Time Projection Chamber

R. Smith^{1,2✉}, M. Gai², S. R. Stern², D. K. Schweitzer² & M. W. Ahmed^{3,4}

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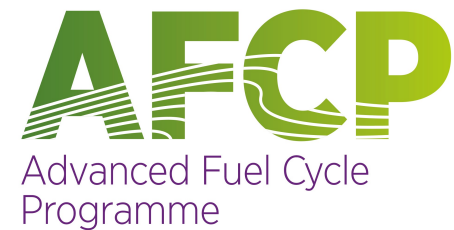
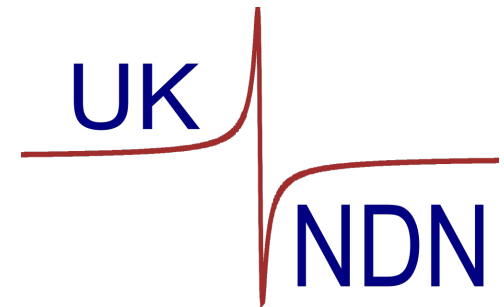
Nuclear data research

- Funding:

- UKNDN STFC Network+
- National Nuclear Laboratory

- UK personnel:

- Tzany Kokalova, Carl Wheldon, Lee Thompson, Patrick Stowell, Dominic Barker, Robin Smith
- PhD students: Raed Dallal

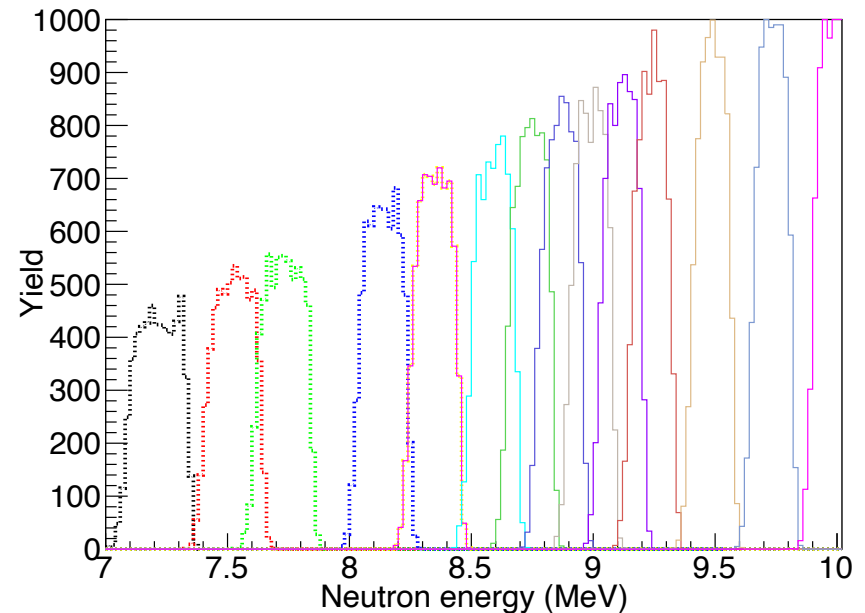
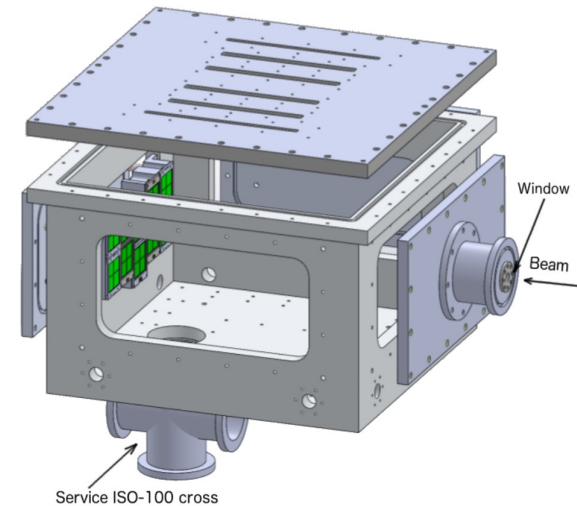


Nuclear data research

- What? Novel approaches to measuring high priority reactions

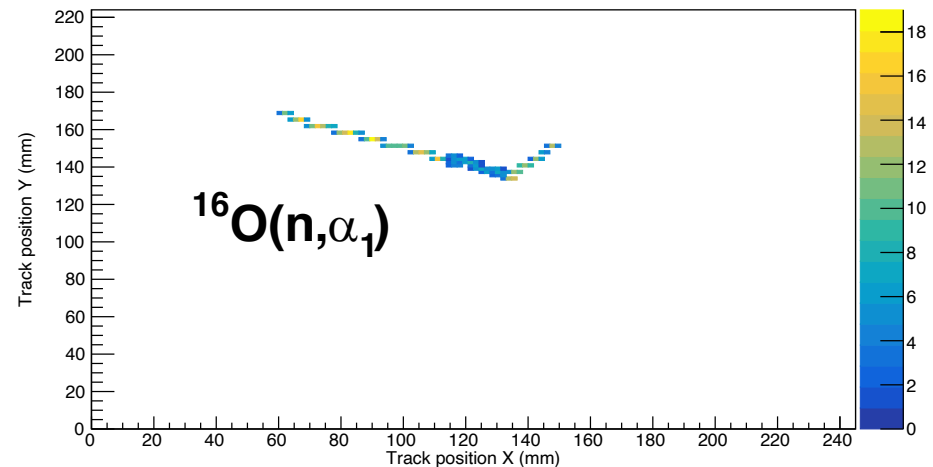
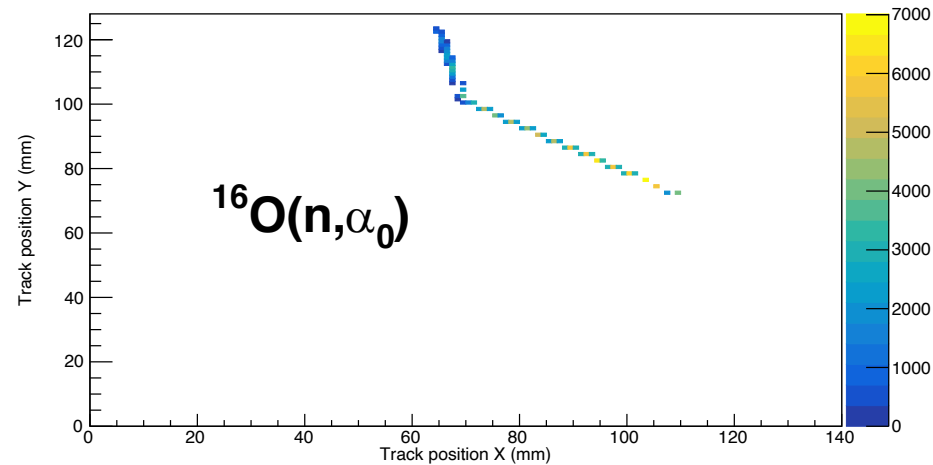
- Measuring $^{16}\text{O}(n, \alpha)$ using Texas Active Target TPC

- ATTIKUS – A Thick Target Inverse Kinematics Detector by Universities in Sheffield



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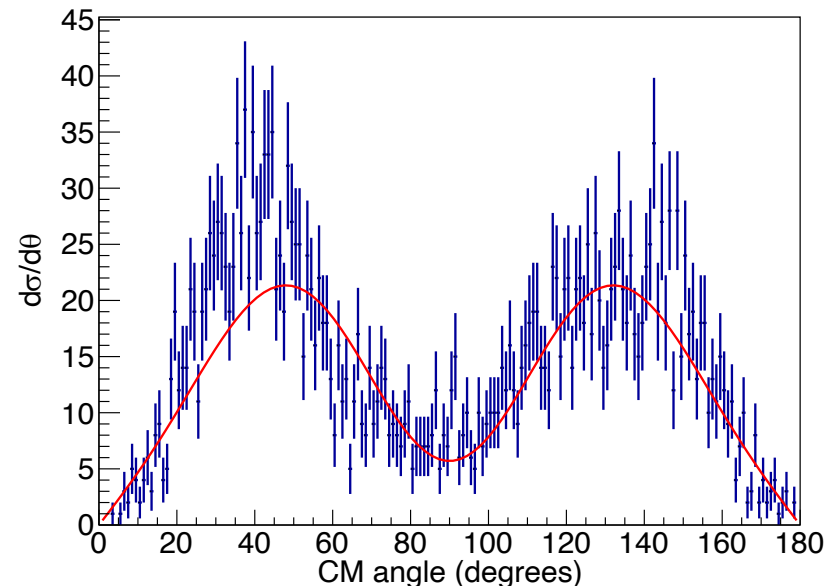
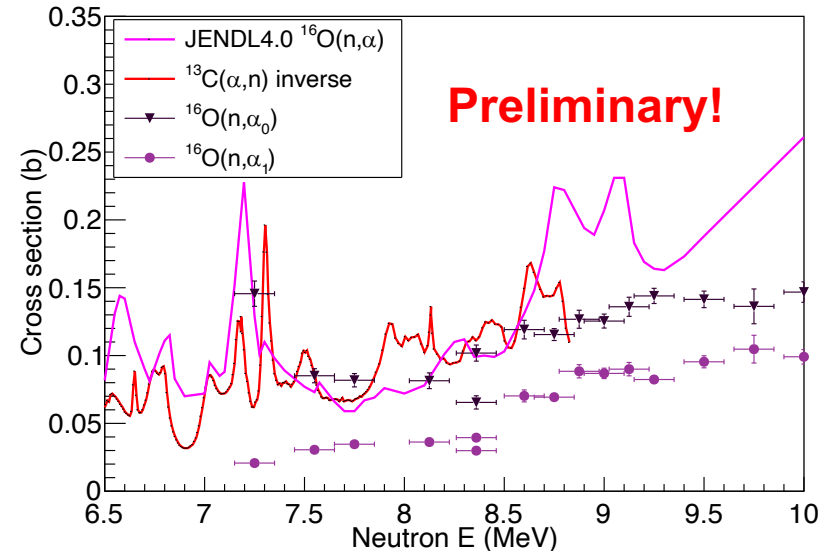


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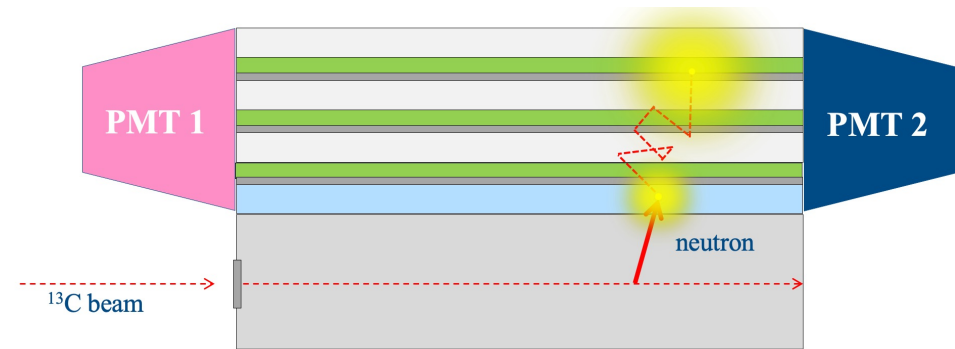
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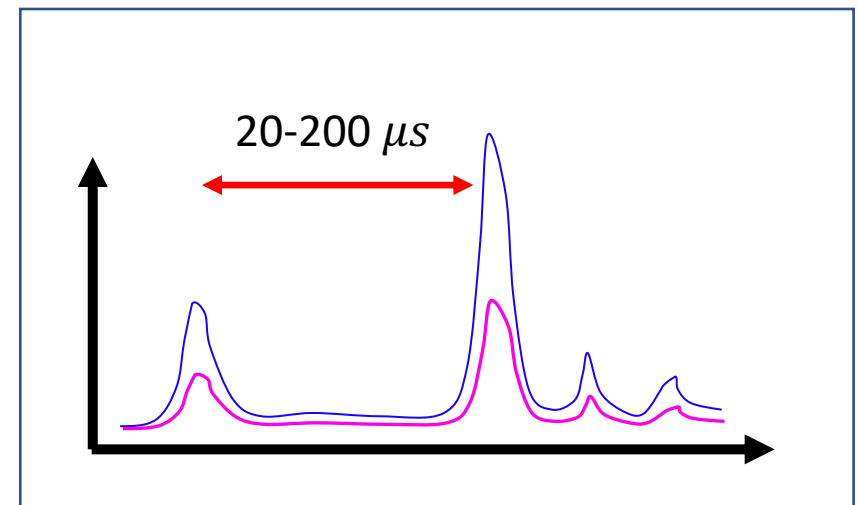


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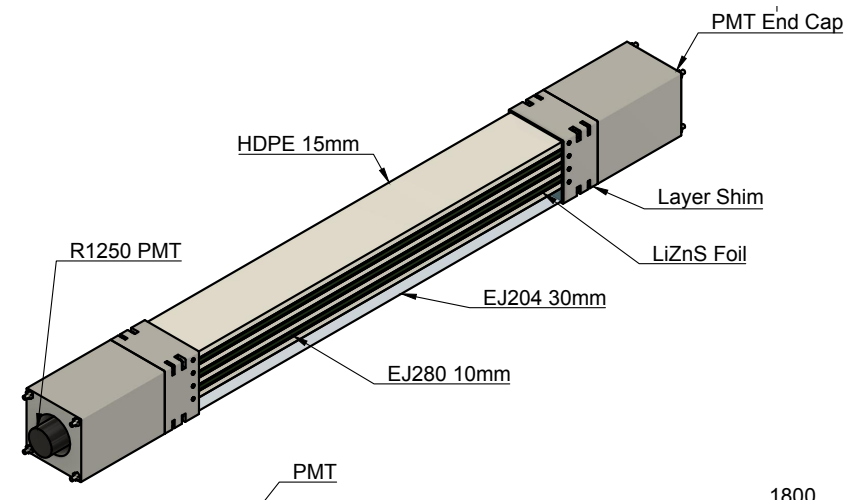


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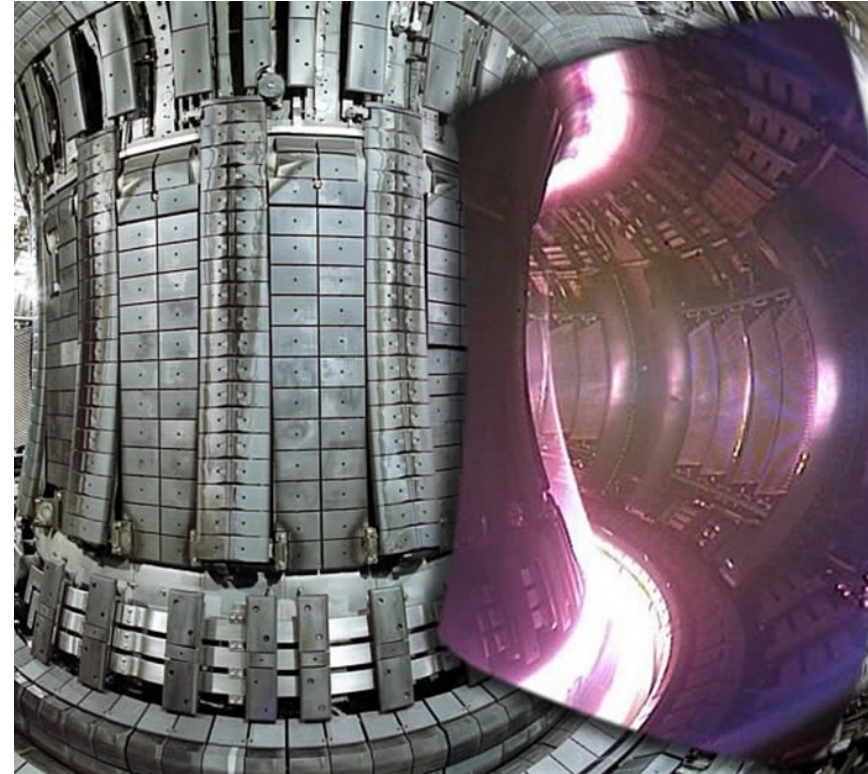
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Nuclear fusion research

- Funding:
 - UK Atomic Energy Authority
 - STFC ISIS
- UK personnel:
 - Chantal Nobs, Alison Bruce, Robin Smith
 - PhD students: Ocean Wong



UK Atomic
Energy
Authority

**Sheffield
Hallam
University**



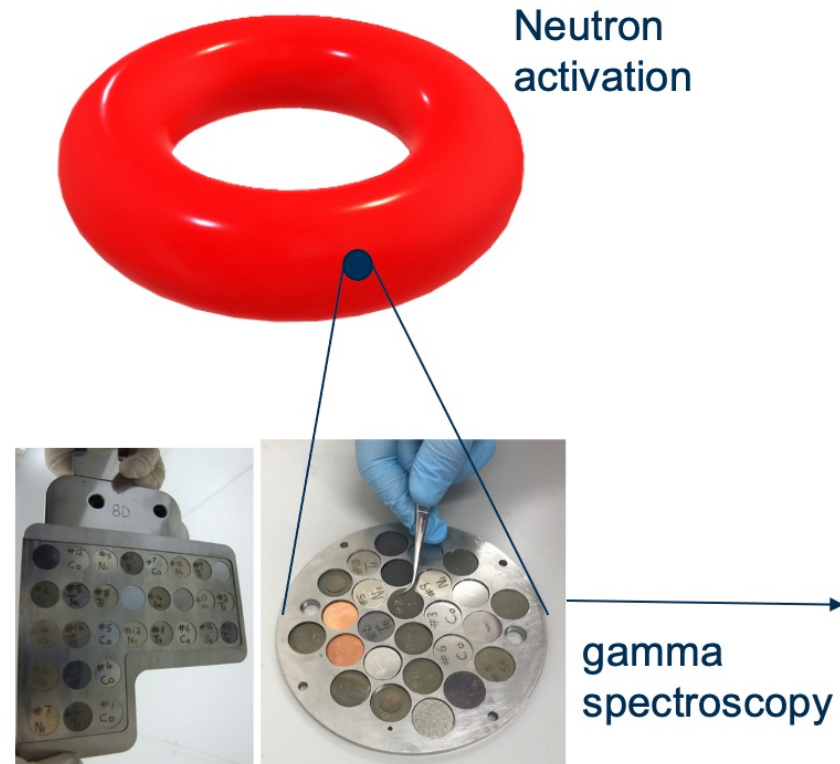
University of Brighton



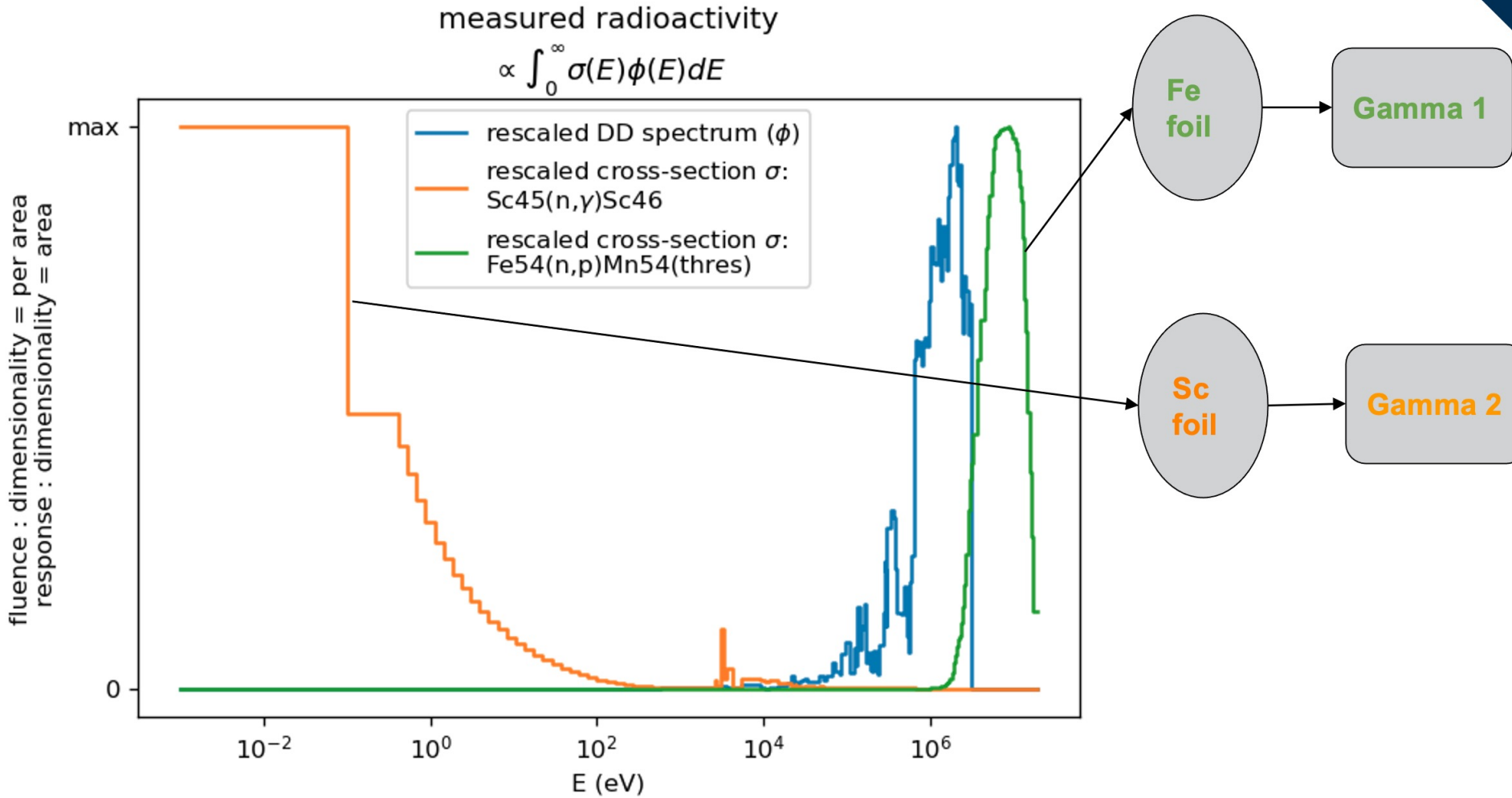
Science and
Technology
Facilities Council

Nuclear fusion research

- What? Improved computational methods
 - New methods for neutron spectrum unfolding with foil activation technique
 - Machine learning for improvements in germanium gamma spectroscopy



Neutron spectrum unfolding using activation foil



Nuclear fusion research

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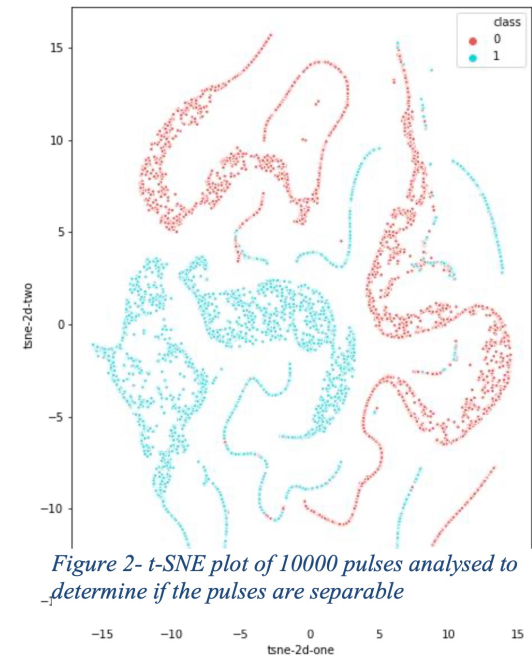
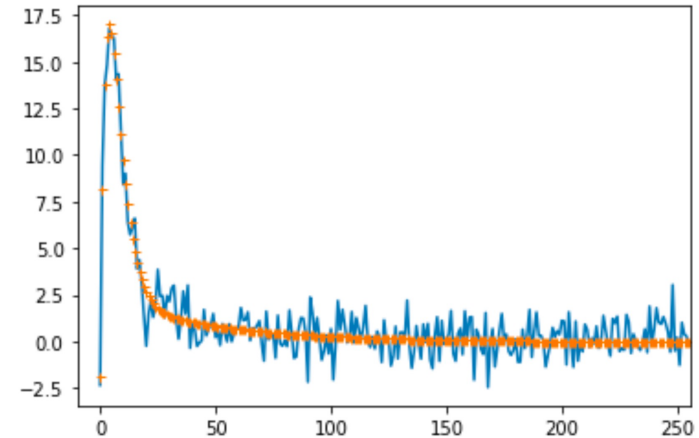


Figure 2- t-SNE plot of 10000 pulses analysed to determine if the pulses are separable

Outlook & next steps

- Grants or fellowship that can buy out my time for research
- Increase PDRA and PhD students
- UKRI future leaders fellowship
- EPSRC
- Build ties with industry – KTP