NUCLEAR DATA IN UK
ACADEMIA
(NON-EXHAUSTIVE!)

PROF PAUL STEVENSON

UNIVERSITY OF SURREY

@JEFF MEETING PARIS APR 2026

UNIVERSITY OF SURREY

Nuclear Physics News
Volume 35/No. 4

meeting report

University of Glasgow Workshop on Nuclear Data

Nuclear data are at the core of many modern endeavors in the civil and defense nuclear sectors, driven by the needs for the design and construction of new modern nuclear fission and fusion reactors, radiation safety, the needs of safe treatment and disposal of radioactive waste, and a wide variety of healthcare, material science, security and defense applications.

While a number of international databases containing nuclear data exist, their content often falls short in, for example, precision, energy range, and angular coverage. Similarly, the production of new and more precise were provided by speakers from AWE, UK NNL, UKAEA, and NPL defining the data needs for the defense and civil nuclear sectors, fusion research, and healthcare. UK research capabilities were shown in presentations on nuclear data relevant fundamental research, UK-hosted neutron sources, and accelerator mass spectroscopy for nuclear data.

The role of the UK academic nuclear theory community was discussed as part of the meeting. The critically small proportion of theorists in the UK community compared with most other countries active in nuclear research

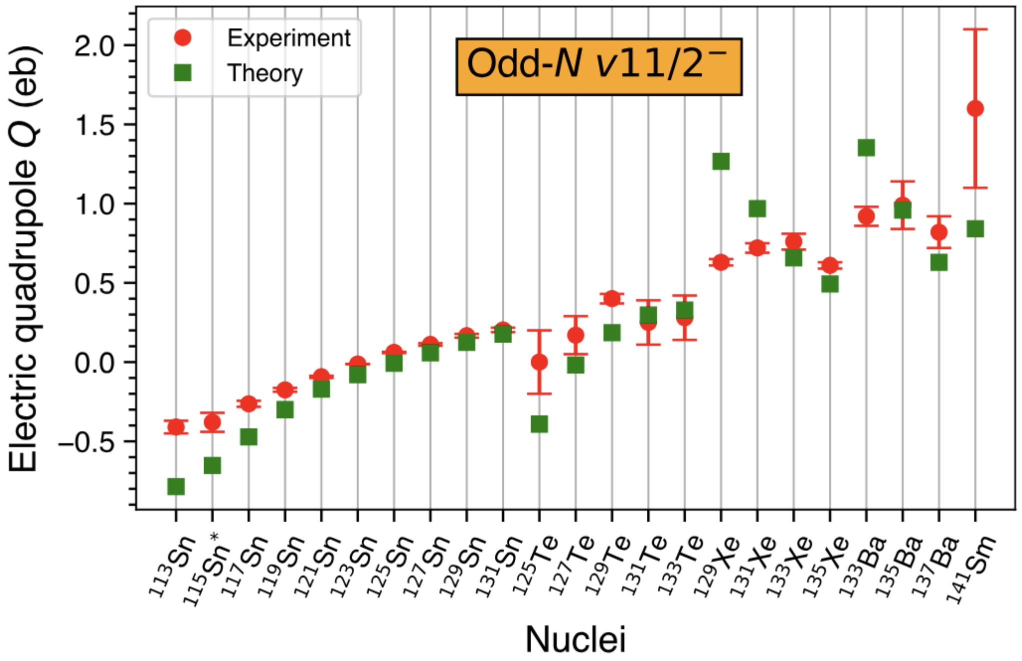
The meeting concluded with a roundtable discussion on future action in the field, feeding into future United Kingdom–hosted nuclear data efforts. As a follow-up, a larger conference is being organized with the Institute of Physics for the week of 7 September 2026.

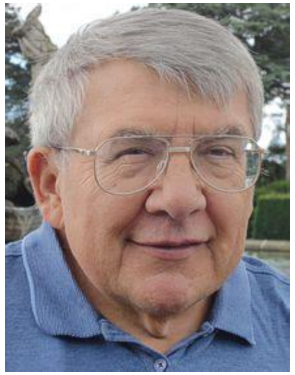
Disclosure Statement

No potential conflict of interest was reported by the author(s).

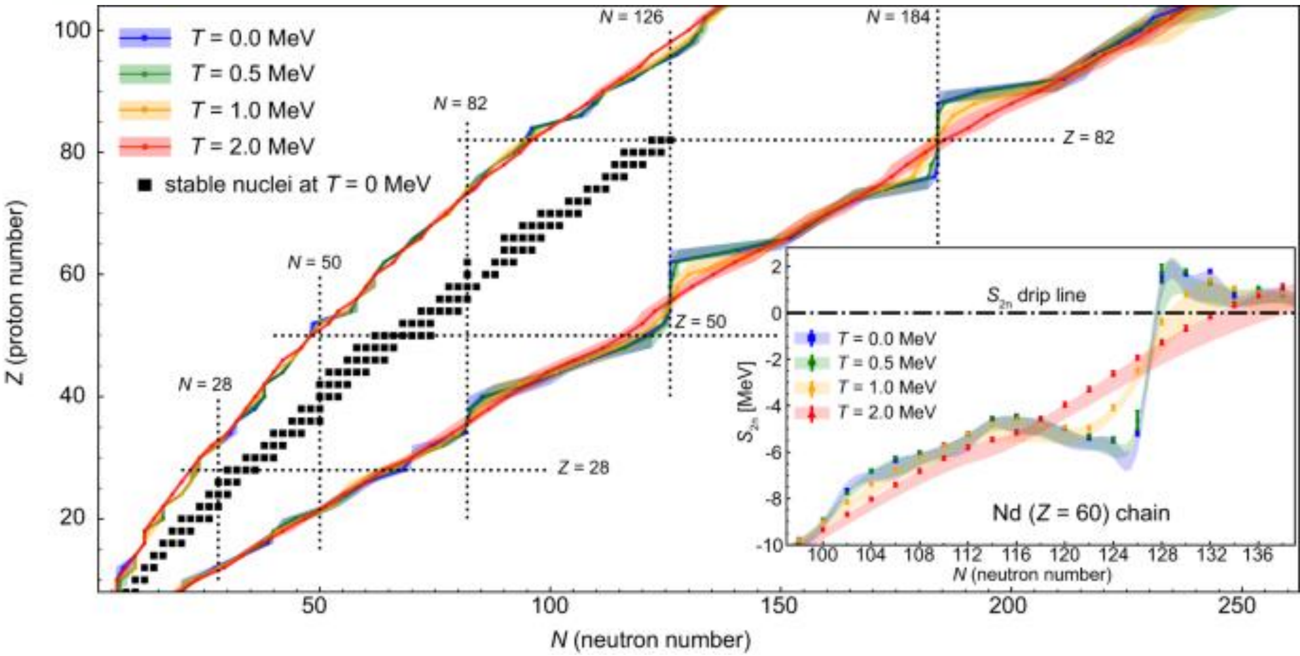
DFT for extensive studies of data

J. Phys. G: Nucl. Part. Phys. **52** (2025) 065104 H Wibowo *et al*





Group of Dobaczewski at York



Article | Open access | Published: 10 August 2023

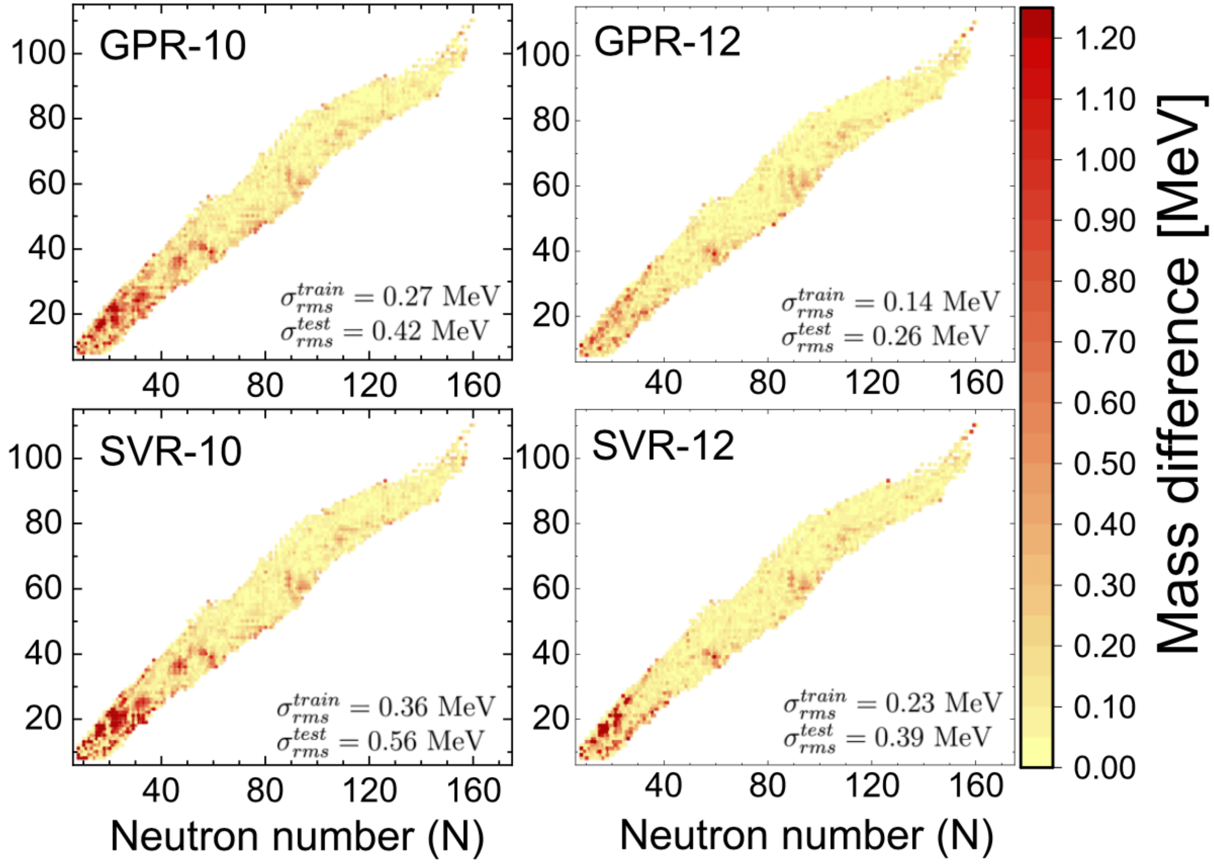
Expanding the limits of nuclear stability at finite temperature

Ante Ravlić, Esra Yüksel, Tamara Nikšić & Nils Paar

Nature Communications **14**, Article number: 4834 (2023) | Cite this article

Machine Learning in Nuclear Theory: Yüksel (Surrey)

Esra Yüksel, Derya Soydaner and Hüseyin Bahtiyar, Phys. Rev. C 109, 064322 (2024)



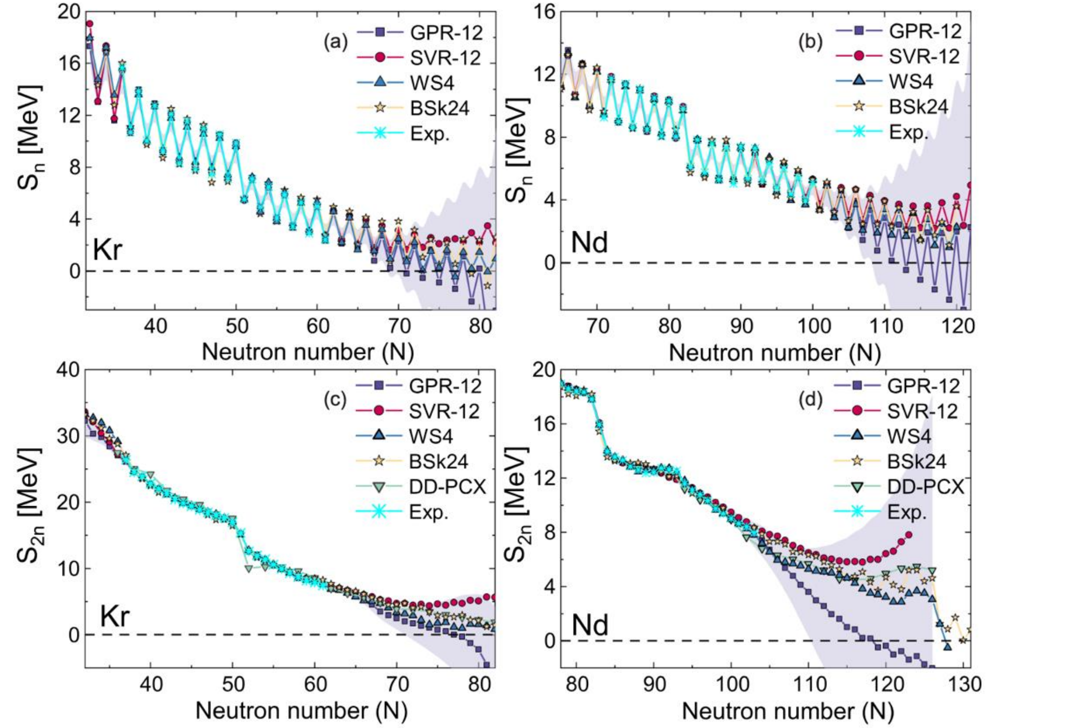


FIG. 5. Upper panels: one-neutron separation energies for Kr (a) and Nd (b) isotopic chains using GPR-12 and SVR-12 models. Lower panels: two-neutron separation energies for Kr (c) and Nd (d) isotopic chains. The blue shaded region represents the 95.0% confidence interval. Theoretical model calculations (WS4, BSk24, DD-PCX) and experimental data are also provided when available [4].

Machine learning: Nuclear Data application

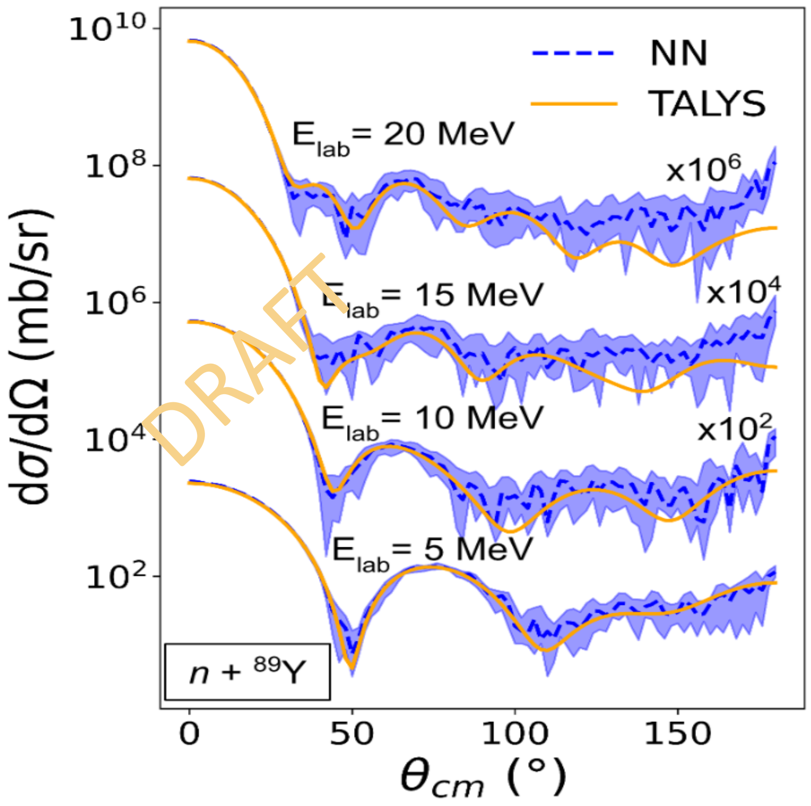


Figure 1: Representative example of DNN emulator ensemble performance. Ensemble predictions are shown in blue, TALYS calculations in orange. Shaded region indicates 1σ.

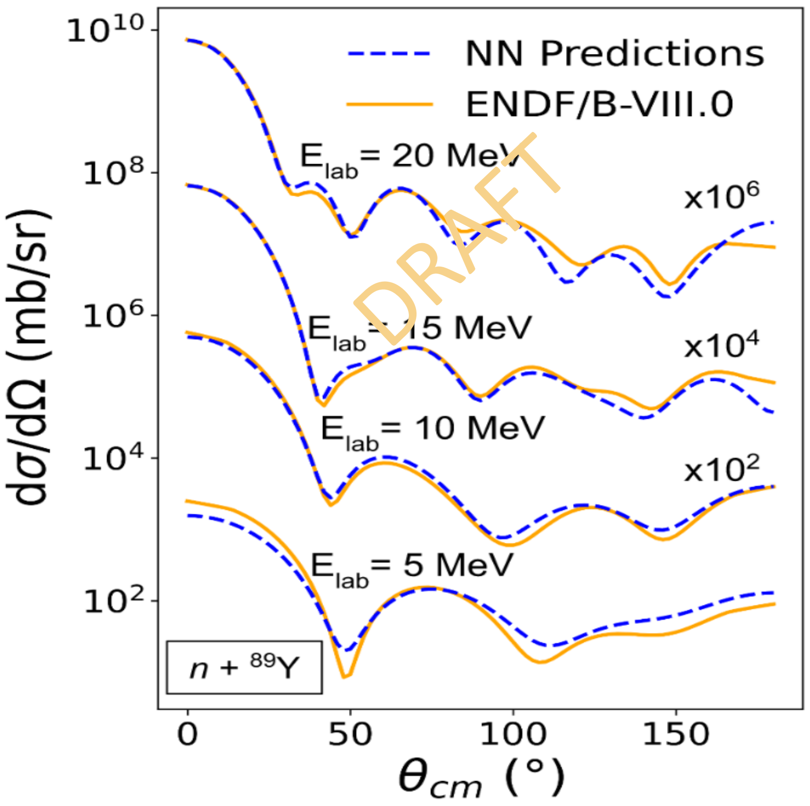


Figure 2: Results of DNN-informed TALYS calculations of ^{89}Y elastic scattering (blue) compared with ENDF/B-VIII.0 nuclear data (orange).

Sullivan (Surrey), Stevenson (Surrey), Benstead (AWE), Morgan (AWE)

ND2025 presentation, to appear in proceedings

Presentation at UK IoP nuclear physics conference this week

Bayesian Calibration of a Regional Optical Potential and Uncertainty-quantified Predictions for Compound Nucleus Reactions

Samuel Sullivan[1], Kyle Beyer[2], Filomena Nunes[2,3],
Paul Stevenson[1,4], James Benstead[4,1], Lee Morgan[4,1]
[1]Department of Physics, University of Surrey, Guildford, Surrey, GU2 7XH, UK. [2]Facility for Rare Isotope Beams, Michigan State University, East Lansing, Michigan, 48824, USA. [3]Department of Physics and Astronomy, Michigan State University, East Lansing, Michigan, 48824, USA. [4]AWE Nuclear Security Technologies, Aldermaston, Berkshire, RG7 4PR, UK

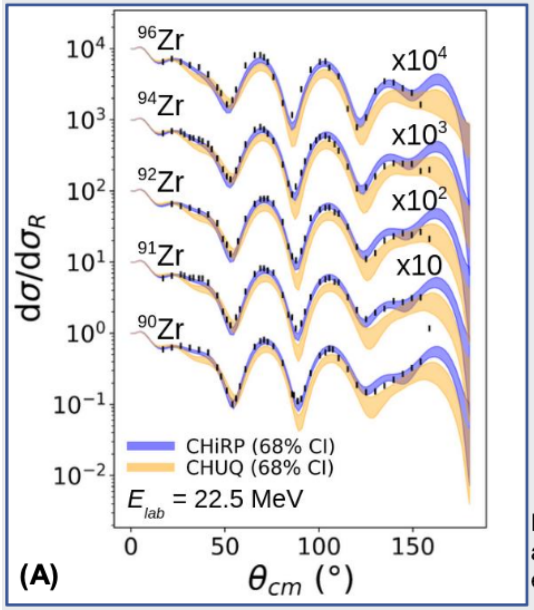
Introduction

Nuclear physics applications (e.g. the energy sector, national defence programs) rely on accurately modelling neutron-rich reaction networks, including key processes such as compound nucleus (CN) formation and decay. Optical model potentials (OMPs) describe the effective interaction involved in these CN reactions. Global OMPs, such as the Chapel Hill potential (CH89) [1], have been developed to predict observables across the nuclear chart, however global OMPs primarily excel at reproducing average trends. In addition, modern applications demand uncertainty-quantified potentials, of which there are few global OMP examples. A key exception to this is **CHUQ** [2], a Bayesian calibration of the CH89 potential.

We propose a *regional* approach to the optical potential, calibrated along isotopic chains to enable better extrapolations away from stability. This uncertainty-quantified, OMP calibration is called the Chapel Hill Regional Potential (**CHiRP**).

Methodology

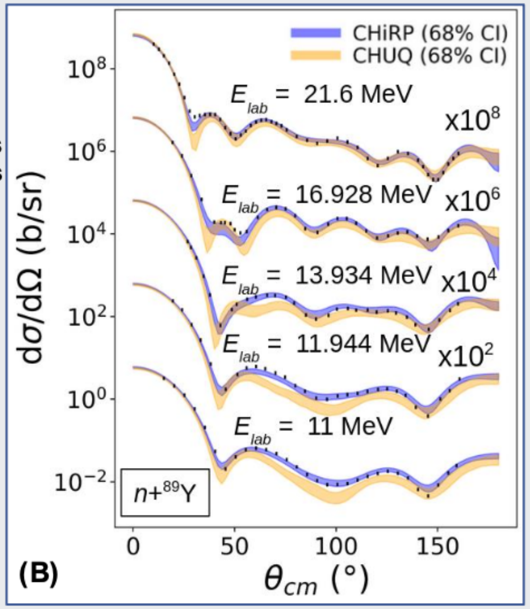
CHiRP was calibrated using differential elastic scattering cross sections and analysing power angular distributions from the **zirconium isotopic chain**. It uses the CH89 form of the OMP, and the statistical model used to produce **CHUQ**. This model was implemented using *rxmc* [3]. Optical model calculations were performed using the *R*-matrix solver *jitR* [4].

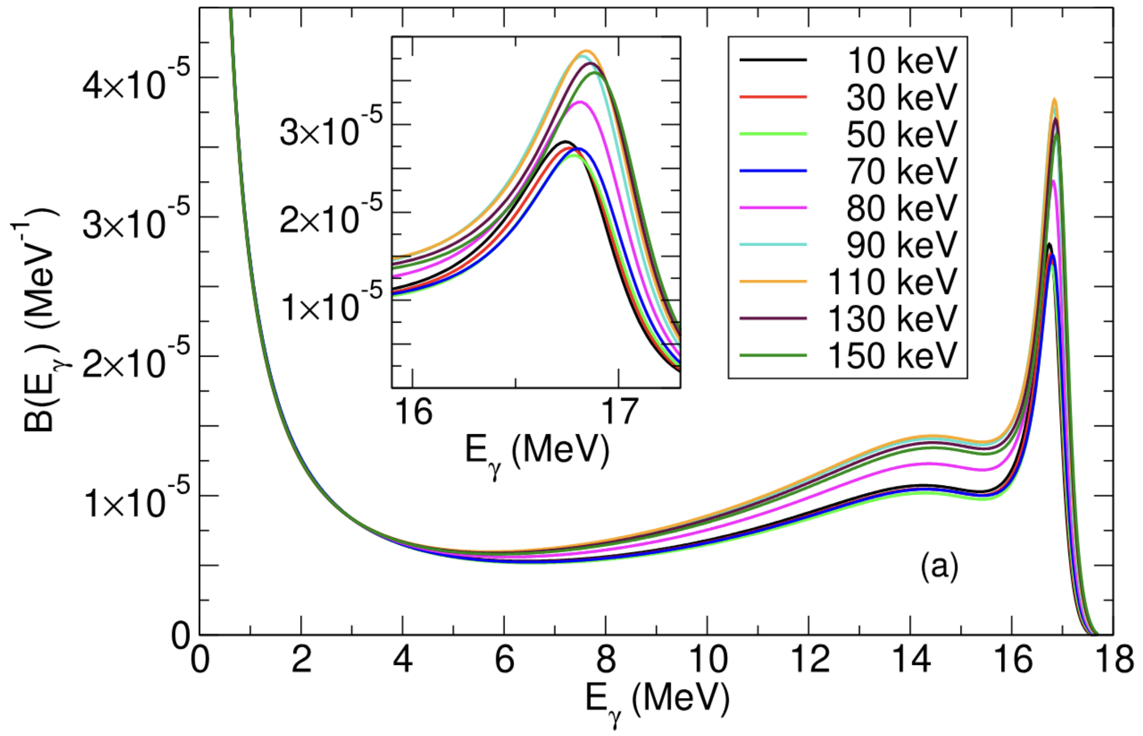


Calibration Results

- **CHiRP** differs from **CHUQ** in the energy dependence and isospin dependence of its imaginary components. **CHiRP** predicts greater surface absorption but overall less absorption than **CHUQ**.
- **CHiRP** uncertainties are smaller than **CHUQ**'s when calculating observables.
- **CHiRP** displays improved accuracy on data around $E_{lab} \approx 10$ MeV, while the regional and global approach offer similar levels of agreement to elastic data at higher energies.
- **CHiRP** extrapolations to ^{89}Y reactions improve on **CHUQ** predictions.

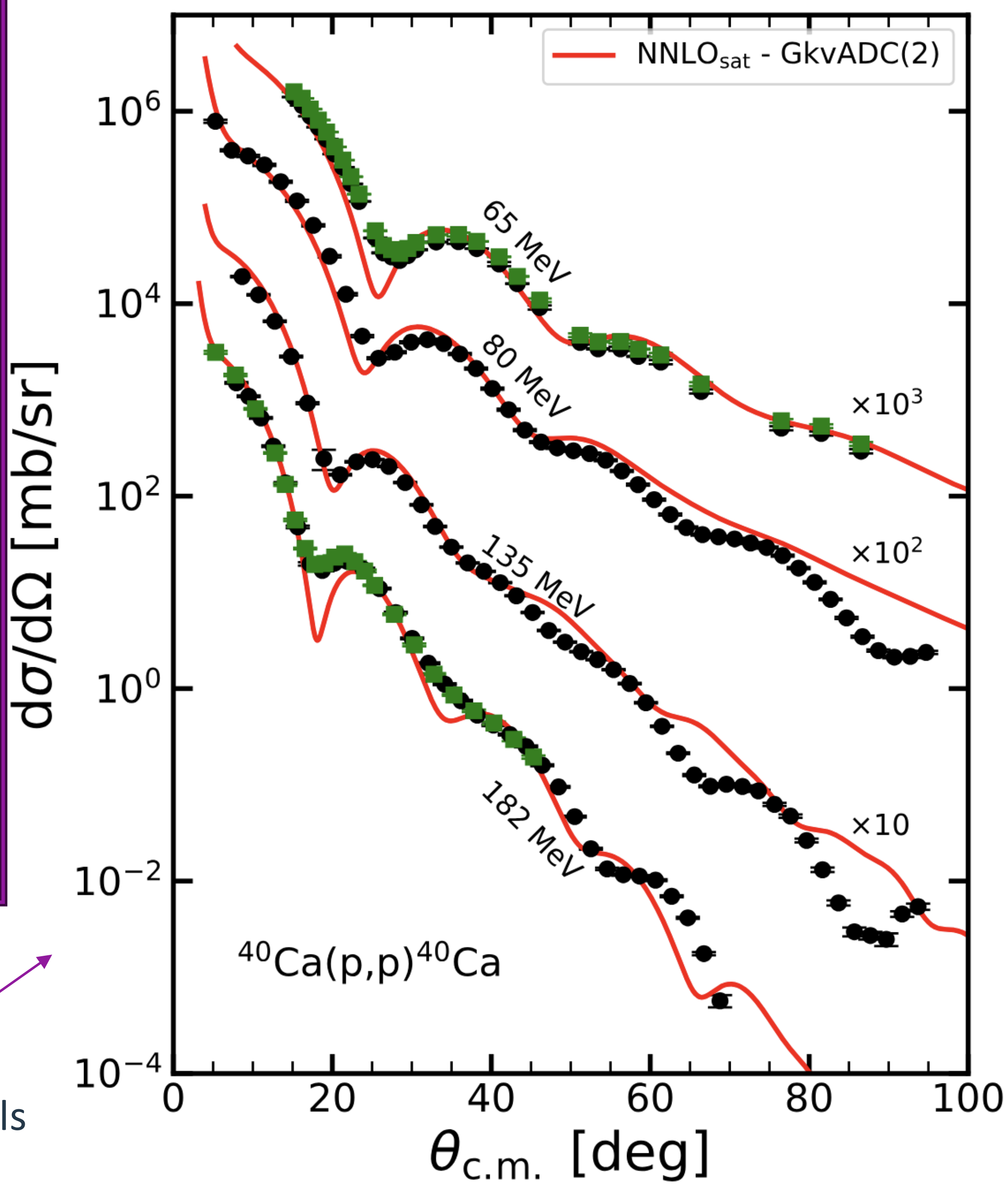
Figure **A** show Rutherford ratios calculations at E_{lab} = 22.5 MeV. Figure **B** shows ^{89}Y neutron elastic scattering predictions.





Nuclear Reactions

Timofeyuk, Bailey and Gilbert, Phys. Rev. C **110**, 014612 (2024)
UKAEA collaboration on D-T fusion
Gamma-branching ratios in D-T fusion as diagnostic



Ab-initio structure and reactions: Vorabbi (Surrey)

Vorabbi *et al.*, Physical Review C **109**, 034613 (2024): Optical potentials derived from ab initio structure model: essentially model free from interaction to scattering data

Gamma-ray strength functions via RQRPA

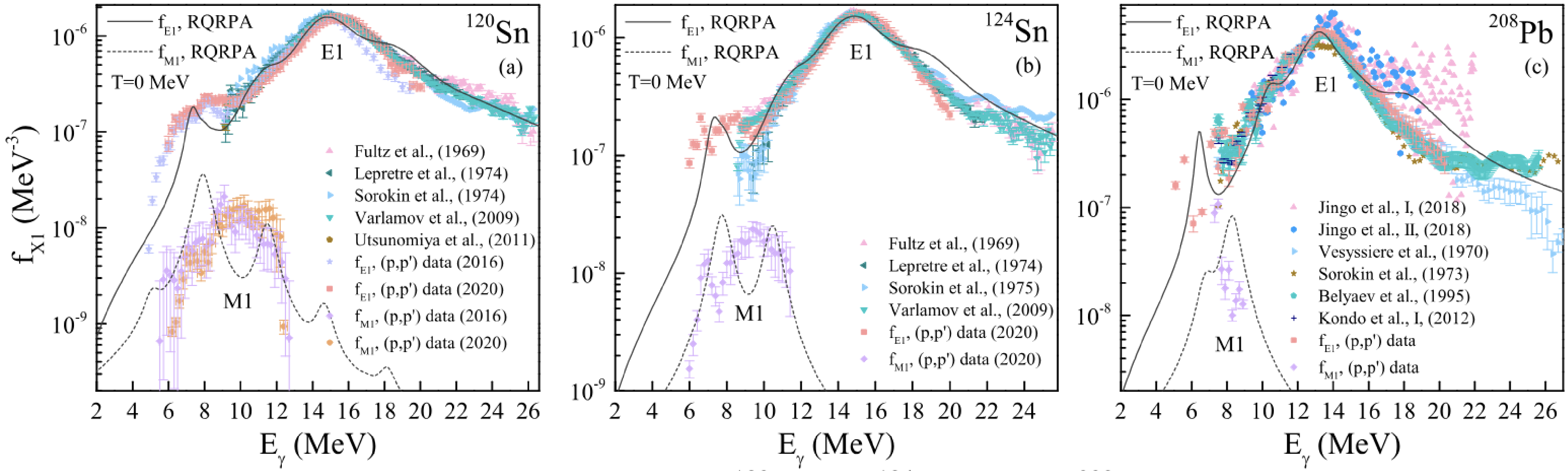


FIG. 2: The γSFs for E1 and M1 transitions in (a) ^{120}Sn, (b) ^{124}Sn, and (c) ^{208}Pb nuclei calculated within the RQRPA framework at $T = 0$ MeV, and compared with the experimental photoabsorption/photoneutron γSFs by Fultz *et al.* [38], Lepretre *et al.* [39], Sorokin *et al.* [40], Varlamov *et al.* [41], Utsunomiya *et al.* [42], Jingo *et al.* I and II [43], Vesyssiere *et al.* [44], Belyaev *et al.* [45], Kondo *et al.* [46]; and (p, p') data from Refs. [8, 47, 48].

Kaur, Yüksel and Paar, Phys. Rev. C 112, 014307 (2025)

Gamma-ray strength functions via TDHF

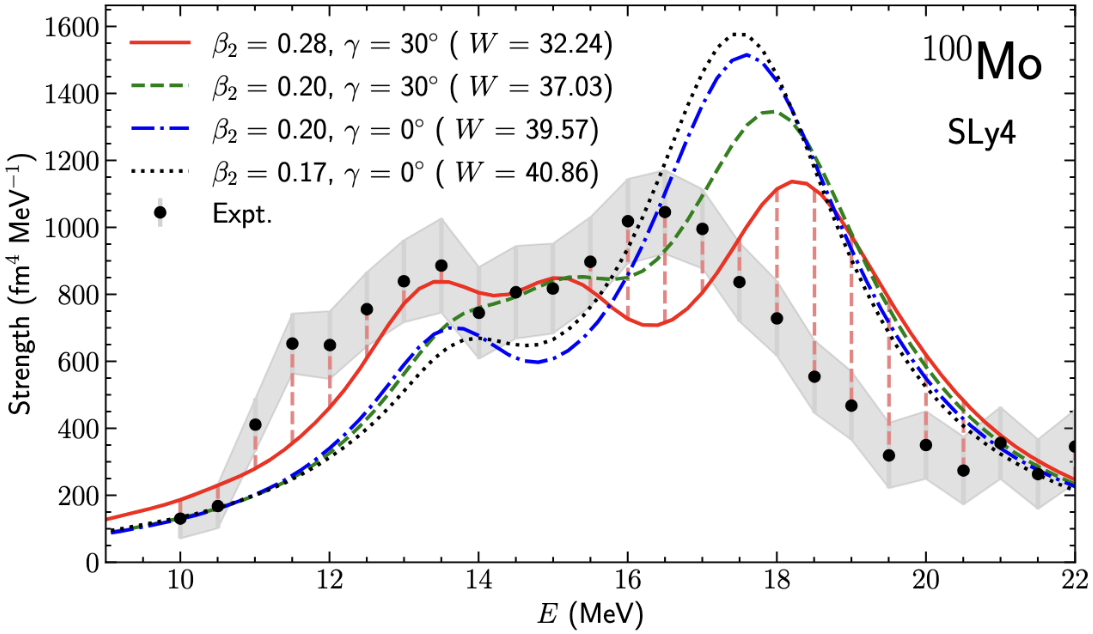


Fig. 1. – Theoretical (lines) and experimental (points with errorbars and shaded error envelope) strength functions for the isoscalar giant monopole resonance in Mo-100. Theoretical values are labelled with ground state deformation paramters β_2 and γ along with weighted error values W.

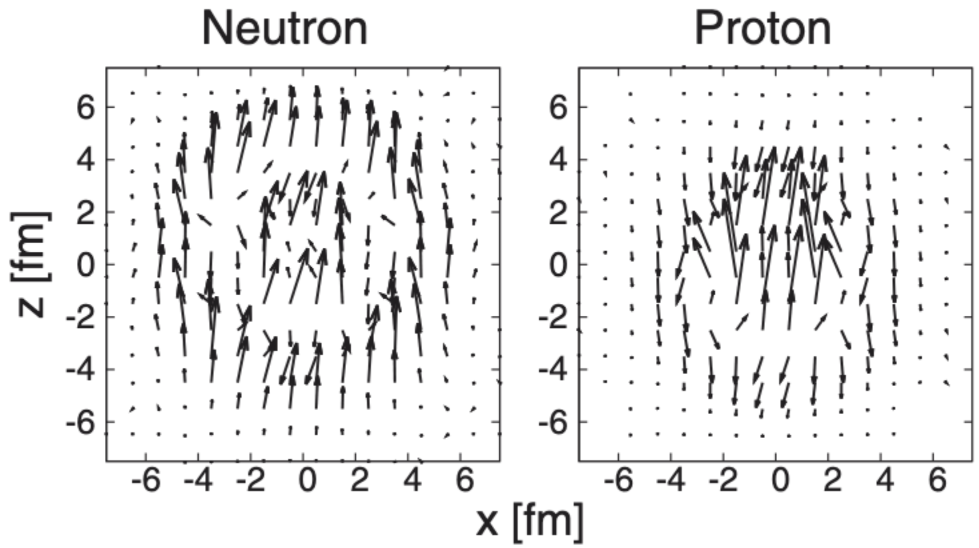
PD Stevenson, Abhishek, Y Shi
Nuovo Cimento C 47 (2), 26

PHYSICAL REVIEW C **88**, 064308 (2013)

Dipole response of ^{76}Se above 4 MeV

P. M. Goddard,[1,2] N. Cooper,[2] V. Werner,[2] G. Rusev,[3,4,*] P. D. Stevenson,[1] A. Rios,[1] C. Bernards,[2] A. Chakraborty,[5] B. P. Crider,[5] J. Glorius,[6] R. S. Ilieva,[1,2] J. H. Kelley,[4,7] E. Kwan,[3,4,†] E. E. Peters,[5] N. Pietralla,[6] R. Raut,[3,4,‡] C. Romig,[6] D. Savran,[8,9] L. Schnorrenberger,[6] M. K. Smith,[2] K. Sonnabend,[6,10] A. P. Tonchev,[3,4,§] W. Tornow,[3,4] and S. W. Yates[5]

[1]*Department of Physics, University of Surrey, Guildford, GU2 7XH, United Kingdom*
[2]*A. W. Wright Nuclear Structure Laboratory, Yale University, New Haven, Connecticut 06520, USA*
[3]*Duke University, Durham, North Carolina 27708-0308, USA*
[4]*Triangle Universities Nuclear Laboratory, Durham, North Carolina 27708, USA*
[5]*Departments of Chemistry and Physics & Astronomy, University of Kentucky, Lexington, Kentucky, 40506, USA*
[6]*Institut für Kernphysik, TU Darmstadt, Schlossgartenstraße 9, D-64289 Darmstadt, Germany*
[7]*Department of Physics, North Carolina State University, Raleigh, North Carolina 27695, USA*
[8]*ExtreMe Matter Institute and Research Devision, GSI, Planckstraße 1, 64291 Darmstadt, Germany*
[9]*Frankfurt Institute for Advanced Studies, Ruth-Moufang-Straße 1, 60438 Frankfurt, Germany*
[10]*Goethe Universitt Frankfurt, 60438 Frankfurt am Main, Germany*



Mixture of Experts for Cross-Section Evaluation

Smoothly blend specialised models across the energy range

Each expert handles the regime it suits best. The system learns the transitions from data and produces a single prediction with honest uncertainty.

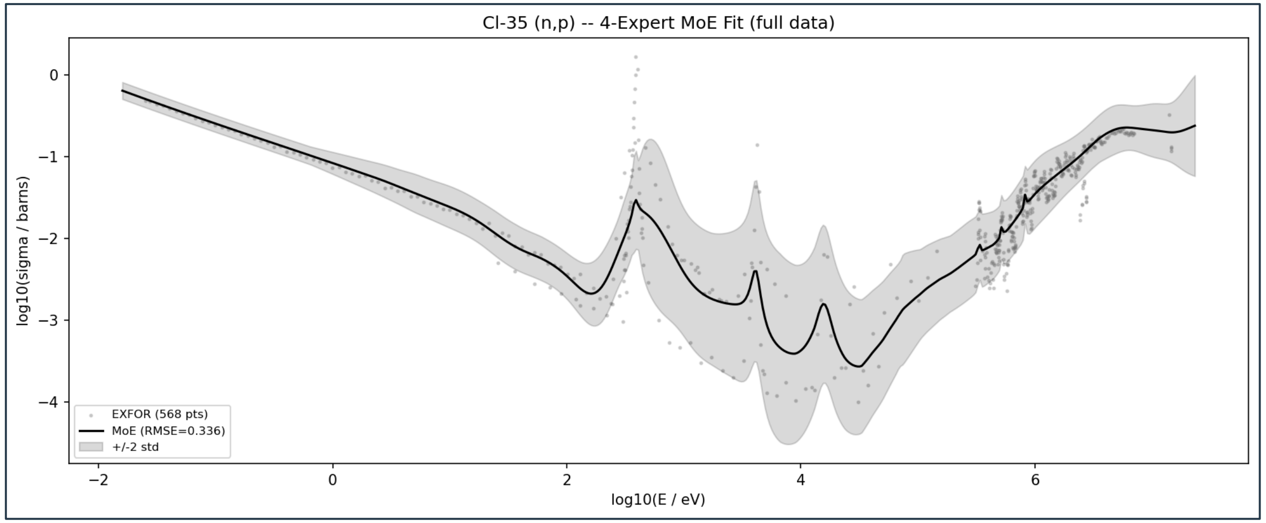
Formalises what evaluators already do

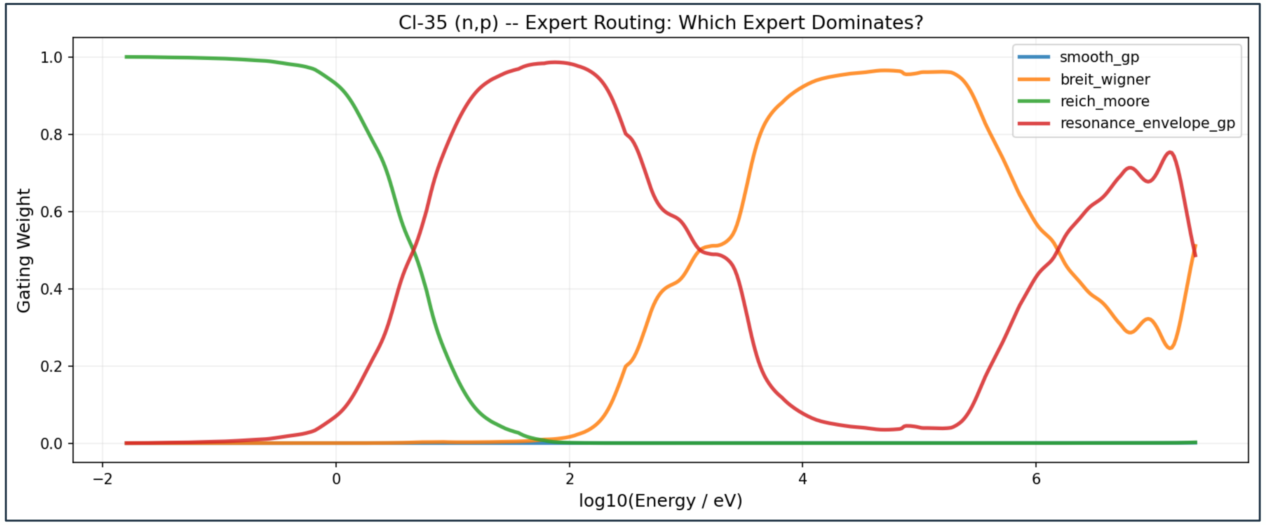
Different formalisms for different regimes is standard in evaluation. The Mixture of Experts makes the partitioning explicit, automatic, and uncertainty-quantified.

Gating network finds the regime transitions from data

Lower panel: each line is one expert model. The network finds where to switch between experts from the data. The current expert library is extensible to any differentiable model.

Evaluation-independent: trained on EXFOR only.





William Hopkins | w.hopkins.1@research.gla.ac.uk

31 May 2022

Quantum computing calculations for nuclear structure and nuclear data

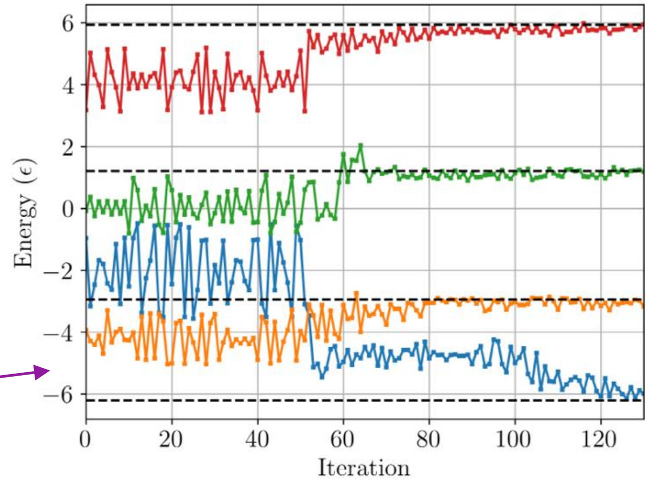
Isaac Hobday, Paul D. Stevenson, James Benstead

Author Affiliations +

Proceedings Volume 12133, Quantum Technologies 2022; 121330J (2022) https://doi.org/10.1117/12.2632782

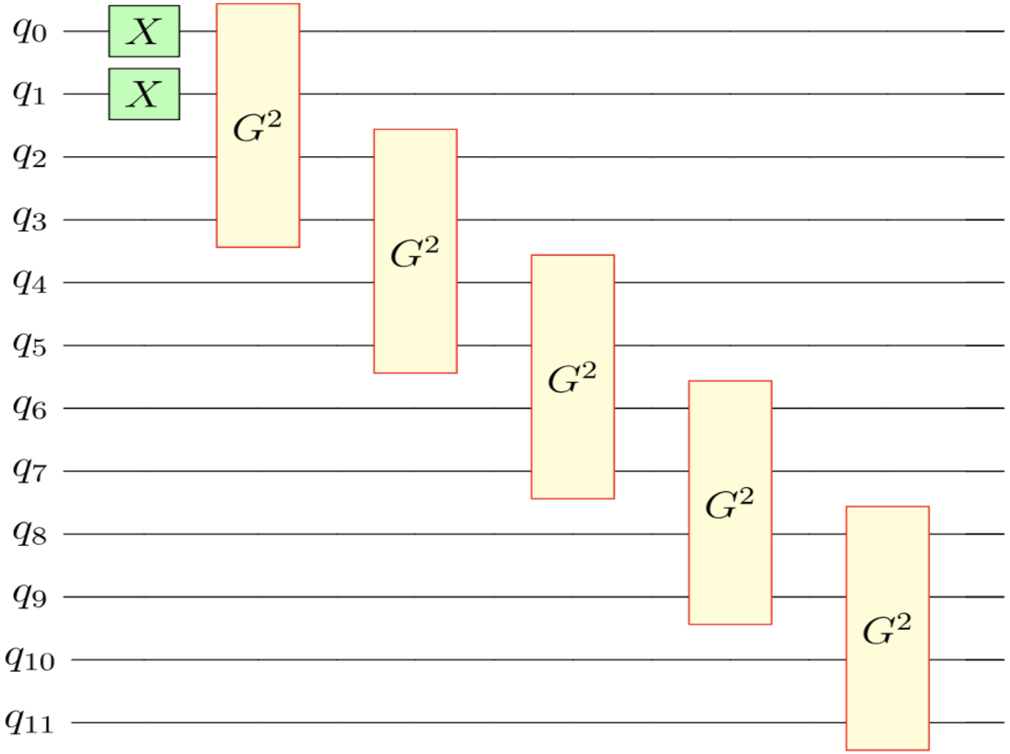
Event: SPIE Photonics Europe, 2022, Strasbourg, France

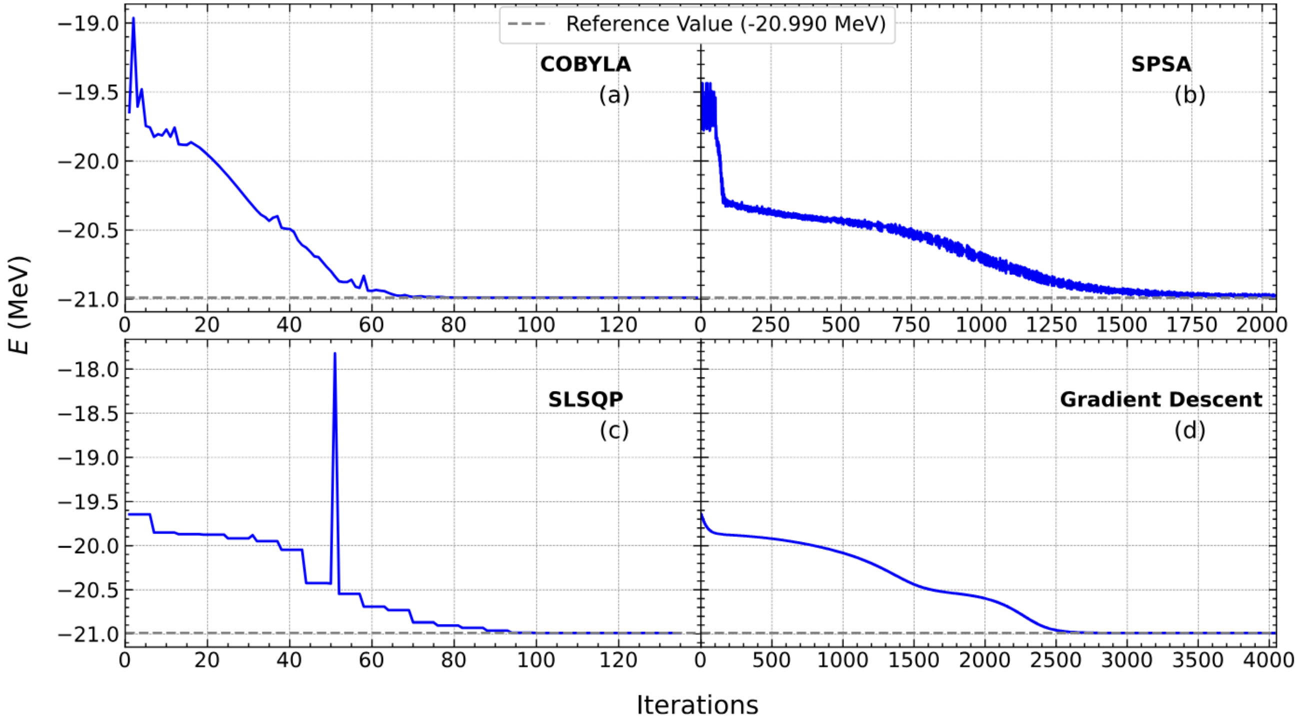
Very "horizon-scanning" activity, esp. as far as nuclear data goes



Hobday, Stevenson & Benstead, arXiv 2403.08625
Variational algorithm to target excited states, on IBM_Nairobi quantum computer

Bhoy and Stevenson, New J Phys **26**, 075001 (2024) quantum circuit to prepare ^{58}Ni state in shell model & variational determination of gate parameters





Nuclear Instruments and Methods in Physics Research Section A: Accelerators, Spectrometers, Detectors and Associated Equipment
Volume 1085, May 2026, 171233

@University of Birmingham

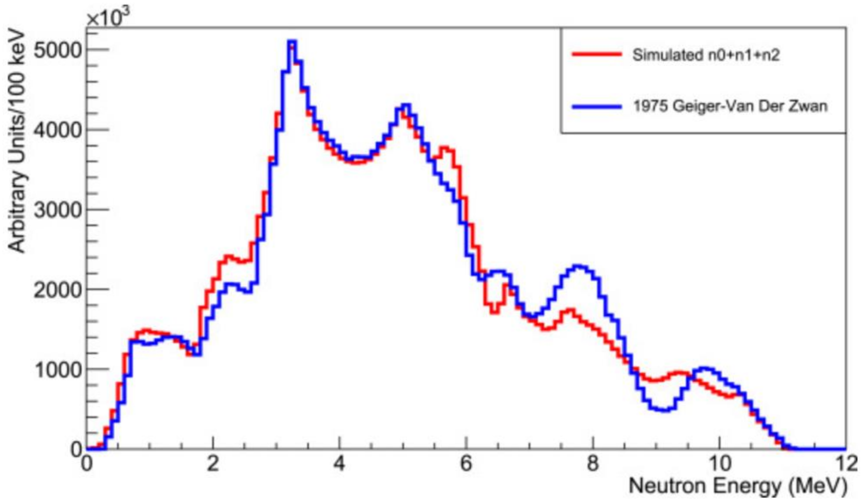
Full Length Article

Simulation and analysis of an AmBe source

Filippo Falezza, Jack Bishop, Tzany Kokalova, Carl Wheldon, Stuart Pirrie, Max Conroy, Neil Curtis

Abstract

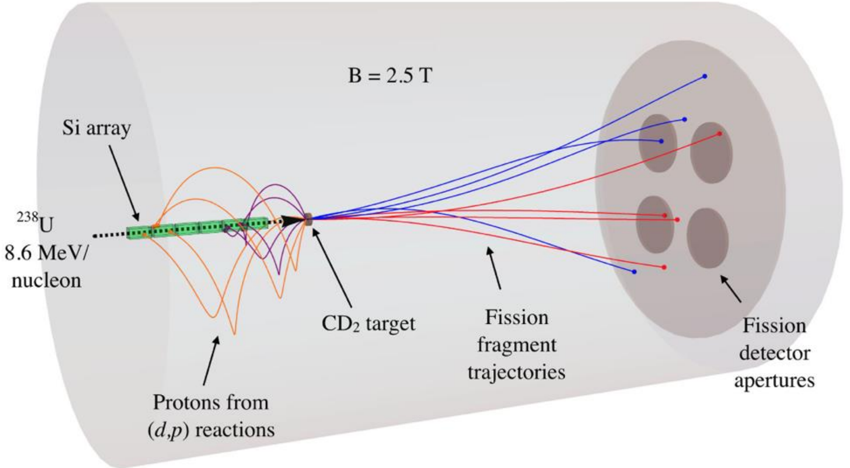
This article details a comprehensive Geant4 simulation based on an analytical approach to the PrimaryGenerator class. Rather than simulating the interaction of ^{241}Am α decay with ^{9}Be through the in-built Geant4 physics list, this simulation uses the differential cross sections of the $^{9}\mathrm{Be}(\alpha, n)^{12}\mathrm{C}$ reaction to directly produce neutrons and ^{12}C ions while simultaneously increasing computational efficiency. The advantage of this is the ability to generate Doppler broadened 4.4 MeV and 3.2 MeV γ rays from ^{12}C decay and hence the verification of the excited states ratio per neutron emission. Each stage of the simulation has been verified against commonly accepted results, including the mass distribution of the ^{241}Am fission fragments. The features of the emerging neutron spectrum have been compared to commonly accepted data, confirming the validity of the simulation. The source term and the simulation template are made publicly available in conjunction with this article. Although not extensively verified, the ^{239}PuBe neutron source has also been implemented, making it a straightforward framework for implementing further sources.



Download: Download high-res image (249KB)
Download: Download full-size image

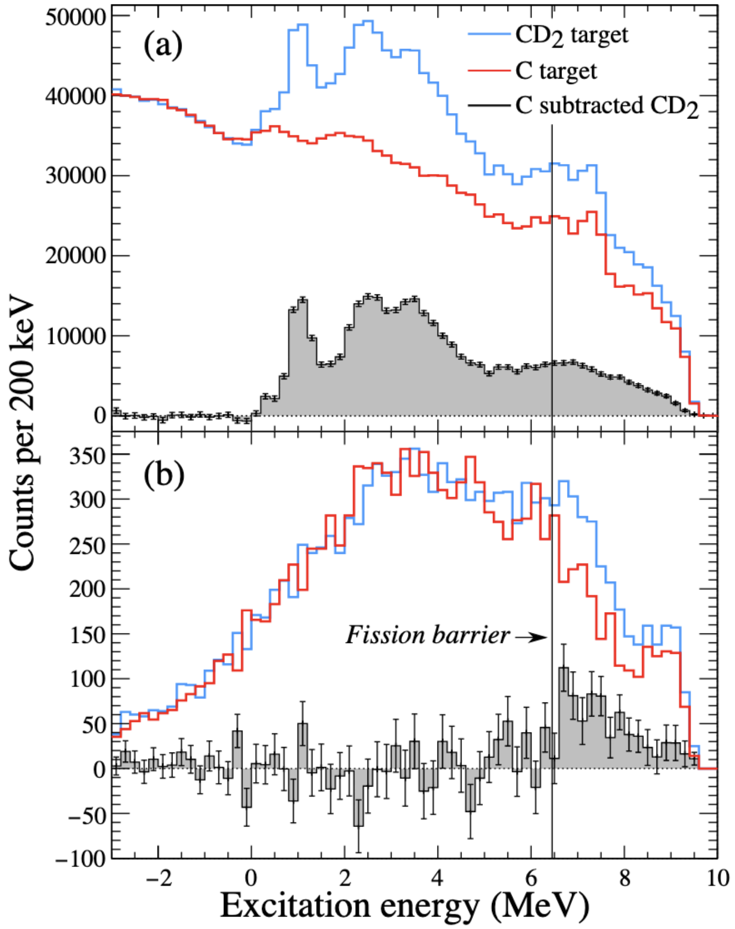
Fig. 8. Comparison between simulated generated initial neutrons (red) and Geiger–Van Der Zwan (blue) primary neutrons. Geiger–Van Der Zwan data are scaled by integral. These simulated neutrons are scored as generated inside the source, not emerging. Note the presence of common features between the two datasets. Geiger–Van Der Zwan data sampled from Fig. 3.

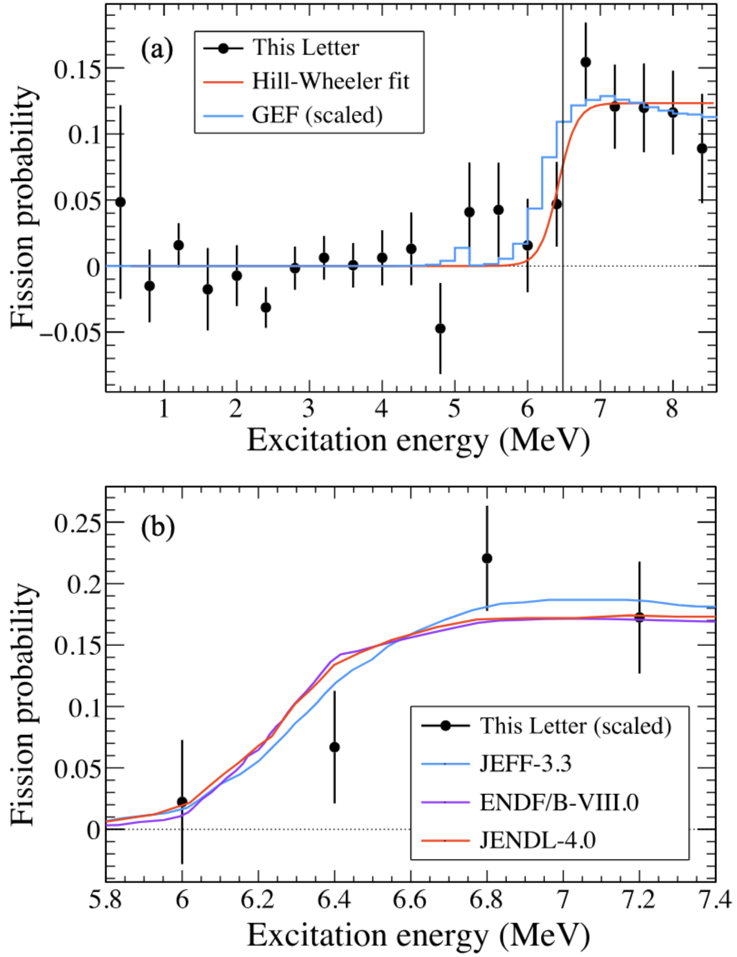
PHYSICAL REVIEW LETTERS **130,** 202501 (2023)



Direct Determination of Fission-Barrier Heights Using Light-Ion Transfer in Inverse Kinematics

S. A. Bennett,[1] K. Garrett,[1] D. K. Sharp,[1,*] S. J. Freeman,[1,2] A. G. Smith,[1] T. J. Wright,[1] B. P. Kay,[3] T. L. Tang,[3,†] I. A. Tolstukhin,[3] Y. Ayyad,[4] J. Chen,[3] P. J. Davies,[5] A. Dolan,[6] L. P. Gaffney,[6] A. Heinz,[7] C. R. Hoffman,[3] C. Müller-Gatermann,[3] R. D. Page,[6] and G. L. Wilson[8,3]

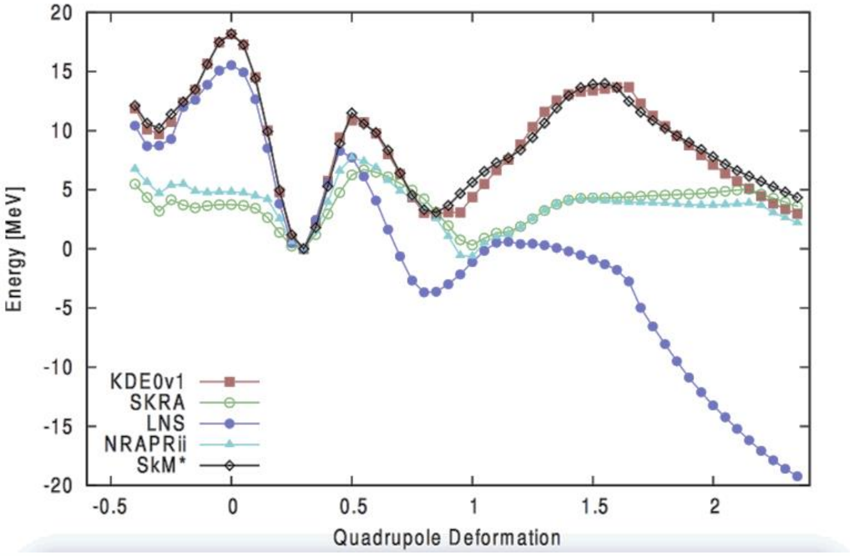


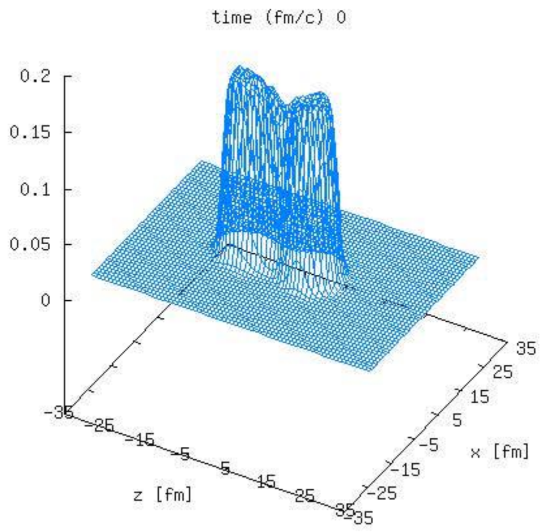


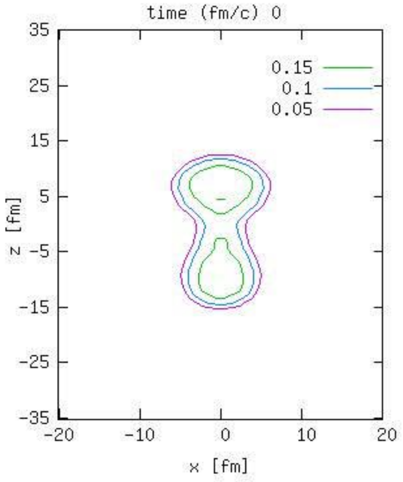
- fission measured following (d,p) reaction.
- this work used U-238 beam at stable beam facility (Argonne) for U-239 fission
- method agrees with existing data
- can be used at radioactive beam facility (e.g. ISS at Isolde, SOLARIS @ FRIB) to study more exotic fissioning nuclei

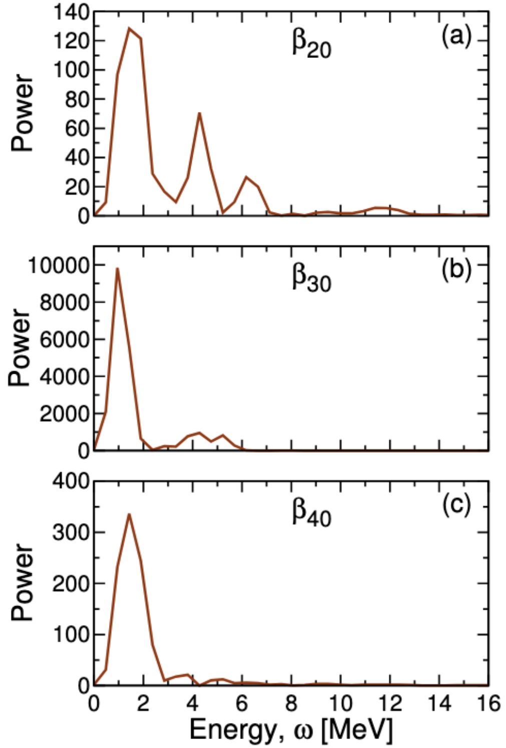
Microscopic theory of fission

Strong link between structure of potential energy surface and fission dynamics









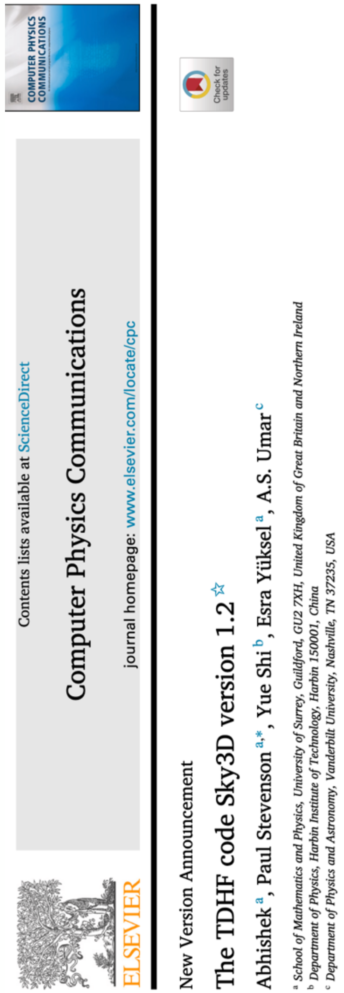
For (much) more, see:

P. M. Goddard, P. D. Stevenson and A. Rios, *Phys. Rev.* **C 93**, 014620 (2016)

P. M. Goddard, P. D. Stevenson and A. Rios, Phys. Rev. C **92**, 054610 (2015)

Tensor force in fusion reactions

T22 (top) vs T24 (bottom) $^{16}O+^{16}O$ @ 68 MeV


Contents lists available at ScienceDirect

Computer Physics Communications

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

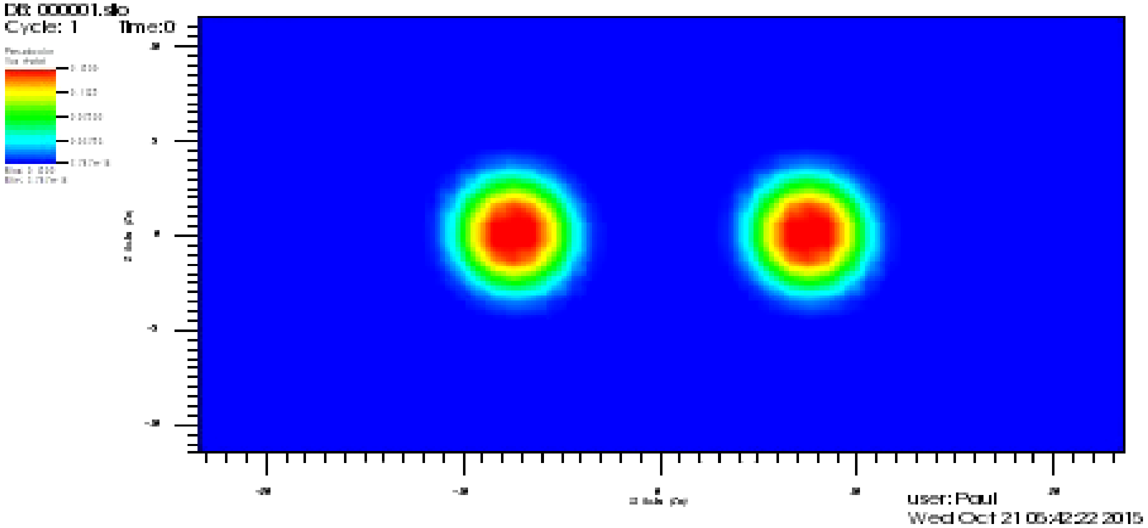
ELSEVIER

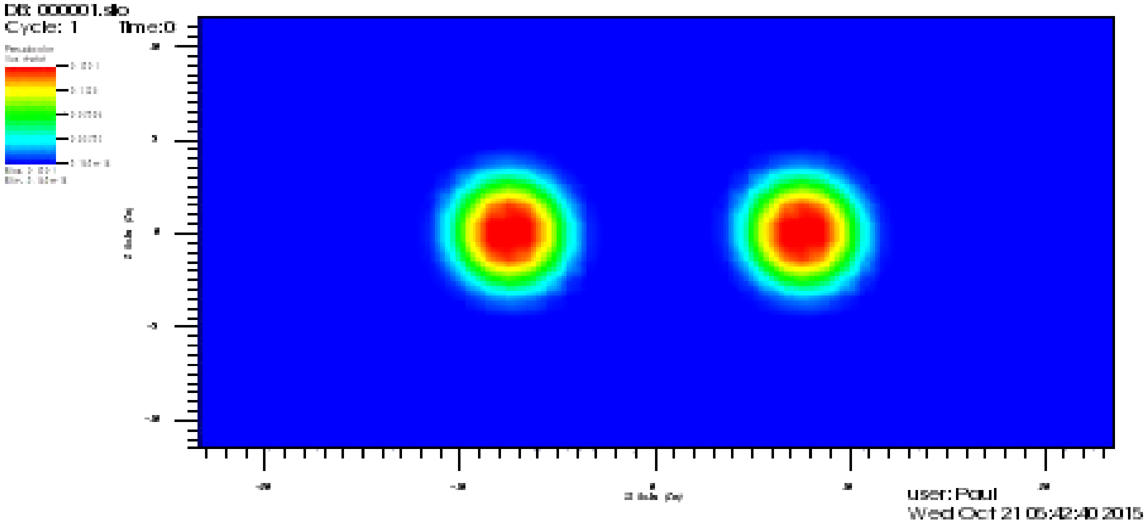
New Version Announcement

The TDHF code Sky3D version 1.2 ☆

Abhishek [a], Paul Stevenson [a,*], Yue Shi [b], Esra Yüksel [a], A.S. Umar [c]

[a] School of Mathematics and Physics, University of Surrey, Guildford, GU2 7XH, United Kingdom of Great Britain and Northern Ireland
[b] Department of Physics, Harbin Institute of Technology, Harbin 150001, China
[c] Department of Physics and Astronomy, Vanderbilt University, Nashville, TN 37235, USA





Doctoral focal award: nuclear skills

Opportunity status:	Closed
Funders:	Engineering and Physical Sciences Research Council (EPSRC), Natural Environment Research Council (NERC), Science and Technology Facilities Council (STFC)
Co-funders:	Department for Energy Security and Net Zero, Ministry of Defence
Funding type:	Grant
Total fund:	£45,000,000
Publication date:	24 July 2025
Opening date:	25 July 2025 9:00am UK time
Closing date:	23 October 2025 4:00pm UK time

Last updated: 18 September 2025 - see all updates

Apply for funding to deliver doctoral focal awards (previously centres for doctoral training), offering high quality, cohort-based doctoral education in nuclear skills for the UK civil and defence sectors to home students.

Timeline

25 July 2025 9:00am
Opening date

31 July 2025 11:00am
Webinar

6 August 2025 1:00pm
Webinar

19 August 2025 2:00pm
Webinar

12 September 2025 4:00pm
Intent to Submit

23 October 2025 4:00pm
Closing date

planet-dfa.ac.uk

Home About PLANET How to apply How to become a partner

PLANET

A doctoral training centre in applied nuclear physics

What is PLANET?

A major £9m initiative is being launched to train at least 80 industry-ready nuclear scientists, serving as a key part of a national drive to quadruple the number of nuclear specialists in the UK.

Industry

Paul Stevenson (Surrey)

Paul Cosgrove (Camb.)*

Adam Featherstone (York)

Taught programme

Daniel Doherty (Surrey)

Valeria Raffuzzi (Camb.)*

Paul Davies (York)

Pankaj Joshi (York)

Research

Malcolm Joyce (Lanc.)

Esra Yüksel (Surrey)

Core Team

Director: David Jenkins (York)

Deputy Director: Alison Laird (York)

Co-lead Cambridge: Geoff Parks

Co-lead Edin: Claudia Led.-Woods

Co-lead Lancaster: Malcolm Joyce

Co-lead Surrey: Esra Yüksel

Project Manager

Admissions/outreach officer

Finance coordinator

EDI

Kate Arnold (York)

Christian Diget (York)

Professional skills and Careers

James Cubiss (Edin)

Jack Henderson (Surrey)*

Outreach

Christian Diget (York)

RRI

Alison Laird (York)

Claudia Led.-Woods (Edin)

Baseline training (M1/2)

- Data-driven nuclear structure
- Hands-on theory
- Nuclear models
- Measurement and metrology

Instrumentation (M3/4)

- Instrumentation
- Radiation detector theory
- AMS
- Hands-on detector work
- Environmental research

Simulation and Modelling (M3/4)

- Reactor physics
- Neutron transport
- LUNar simulator
- GEANT4
- High-performance computing

Nuclear data pipeline (M4/5)

- Nuclear Data
- FISPACT
- TALYS
- ANSWERS
- Statistics
- Data science
- Nuclear forensics

Consolidation (M6)

- Neutron beam experiment (NPL)
- TRIGA reactor experiment

ISOLDE
CERN
nTOF
THE AUSTRALIAN NATIONAL UNIVERSITY
amentum
cividec Instrumentation
createc

TÜV SÜD
Nuclear Waste Services
Sellafield Ltd
LabLogic EXPERIENCE & EXPERTISE
southern scientific
TRIUMF
first light

CORE POWER
UNIVERSITY OF CAMBRIDGE
Lancaster University
UNIVERSITY of York
THE UNIVERSITY of EDINBURGH
UNIVERSITY OF SURREY
ill NEUTRONS FOR SOCIETY

IJCLab Irène Joliot-Curie Laboratoire de Physique des 2 Infinis
NPL
United Kingdom National Nuclear Laboratory
AWE NUCLEAR SECURITY TECHNOLOGIES
UK Atomic Energy Authority
NSG

kromek safer and healthier world
BAE SYSTEMS
UNIVERSITY OF OSLO
IAEA
eDF
Westinghouse
Telix
NRS Dounreay
NEA NUCLEAR ENERGY AGENCY
UKRI Science and Technology Facilities Council ISIS Neutron and Muon Source

TENDL IS IN THE UK!

tendl.imperial.ac.uk/tendl_2025/tendl2025.html

TALYS-based evaluated nuclear data library

Home | Reference & us | Citations | Feedback | TALYS

“We believe that our great goal can be achieved with systematism and reproducibility. We are so outside the box, that the box is a point”

How to reference

Sub-library files

1. Neutron
2. Proton
3. Deuteron
4. Triton
5. He3
6. Alpha
7. Gamma
8. Fission yields

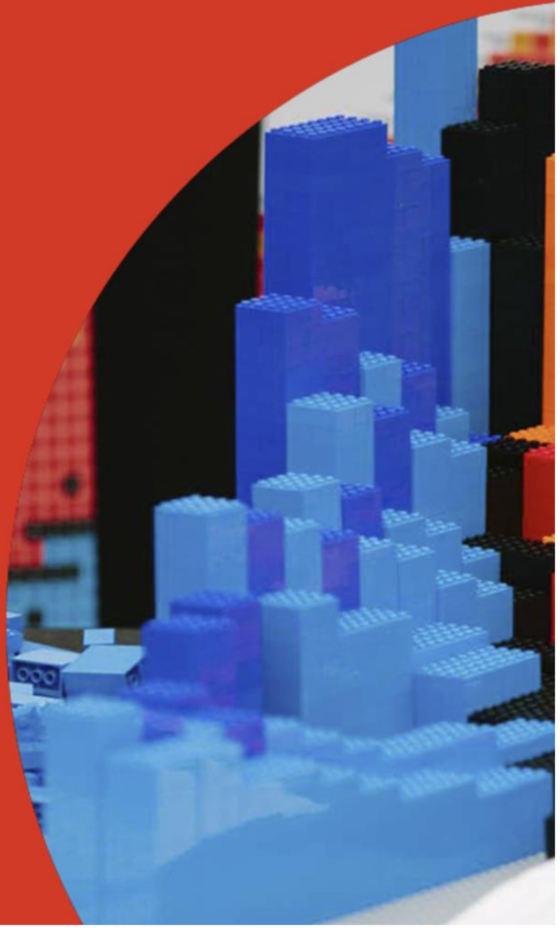
TENDL-2025

Last update: June 28, 2025

TENDL is a nuclear data library which provides the output of the **TALYS** nuclear model code system for direct use in both basic physics and applications. The 13th version is **TENDL-2025**, which is based on both default and adjusted **TALYS** calculations and data from other sources (previous releases can be found here: 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2017, 2019, 2021 and 2023).

Up to 2014, TENDL was produced at NRG Petten. Since 2015, TENDL is mainly developped at PSI and the IAEA (Nuclear Data Section). Still, many people contribute to TENDL with the testing and processing of the files.

UK Nuclear Data 2026: A Renaissance



8–10 September 2026

Institute of Physics, London, UK

Thanks to: Jagjit Singh (Manchester), Gavin Smith (Manchester), David Jenkins (York), Carl Wheldon (Birmingham), Bjoern Seitz (Glasgow), James Benstead (AWE), Samuel Sullivan (Surrey)

UNIVERSITY OF SURREY