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Shameless plug

Nuclear Physics Conference 2025

23–25 April 2025
University of Manchester, UK

Abstract submission is extended until January 31st

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Proposals at ISOLDE (career reflections of a soon to be MCR)

- *Overview of career*
  - *Proposals at stable beam facilities*
    - *Neutrinoless double beta decay*
    - *Evolving shell structure*
  - *Proposals at ISOLDE*
    - *Evolving shell structure*
    - *Island of inversion*
    - *Constraining nuclear models*
    - *Transfer-induced fission*

CV of a non-travelling (maybe a little institutionalised) physicist

- *Undergraduate MPhys Manchester 2004-2008*
- *PhD Experimental Nuclear Physics Manchester 2008-2012*
- *R&D Scientist Smiths Detection 2012-2013*
- *PDRA Manchester 2013-2020*
- *STFC Ernest Rutherford Fellow 2020-present*

CV of a non-travelling physicist

- *Undergraduate MPhys Manchester 2004-2008*
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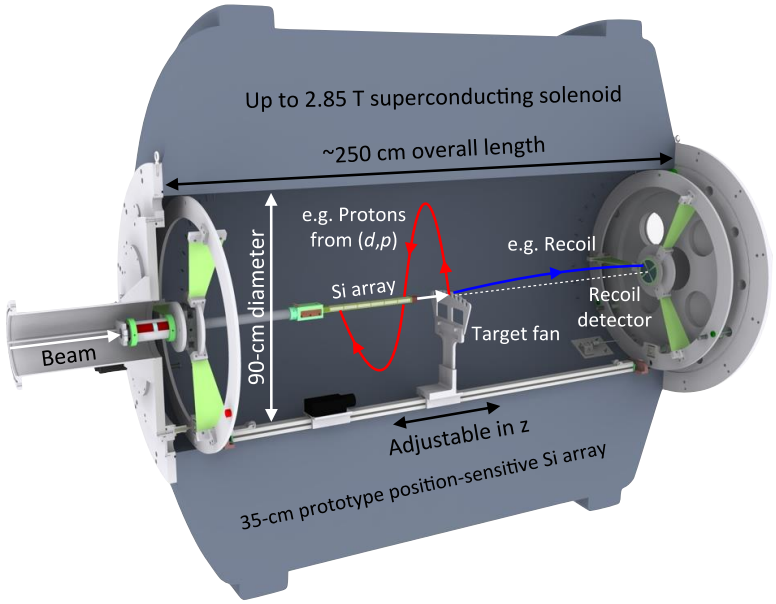
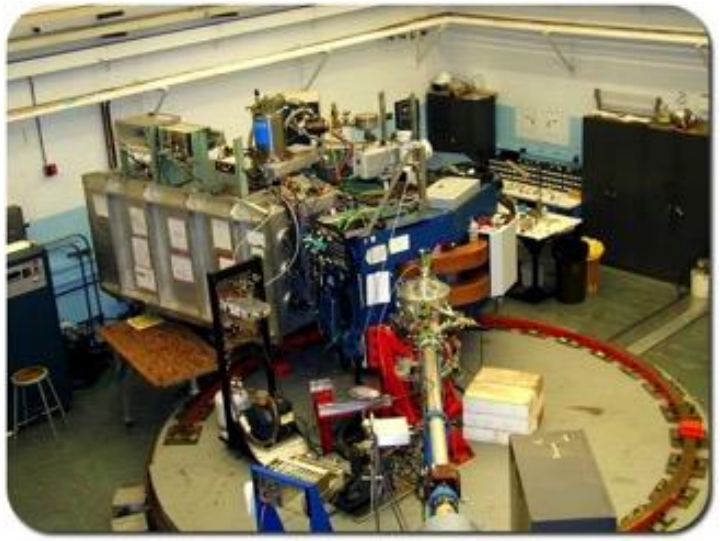
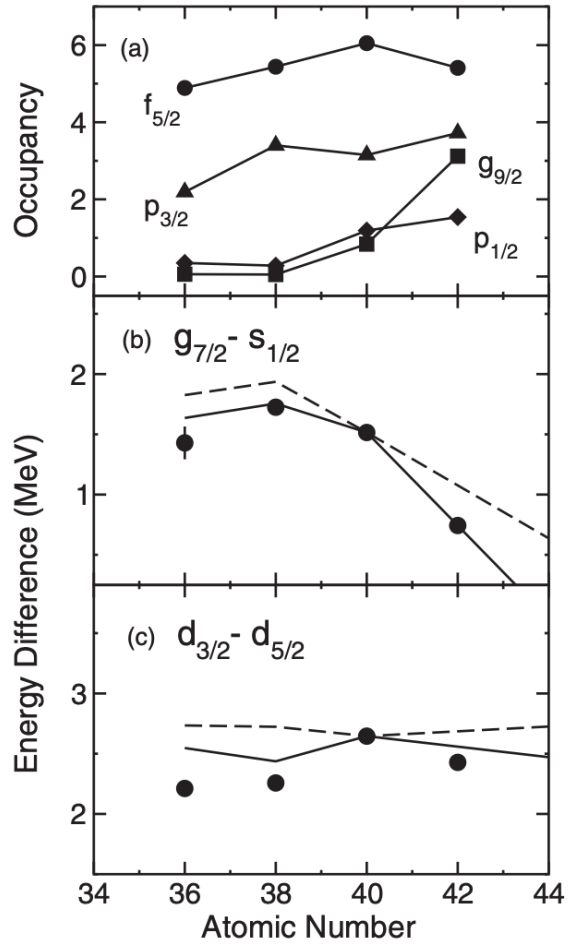
Physics during PhD

Evolving shell structure

- *Studies of stable isotones to investigate the role of the tensor interaction in driving single-particle evolution along N=51.*
- *Measurements made at Yale using tandem accelerator and split pole spectrograph.*
- *Thesis also made use of HELIOS for gaseous ^{86}Kr measurement.*
- *In flight beams and stable beams with HELIOS.*







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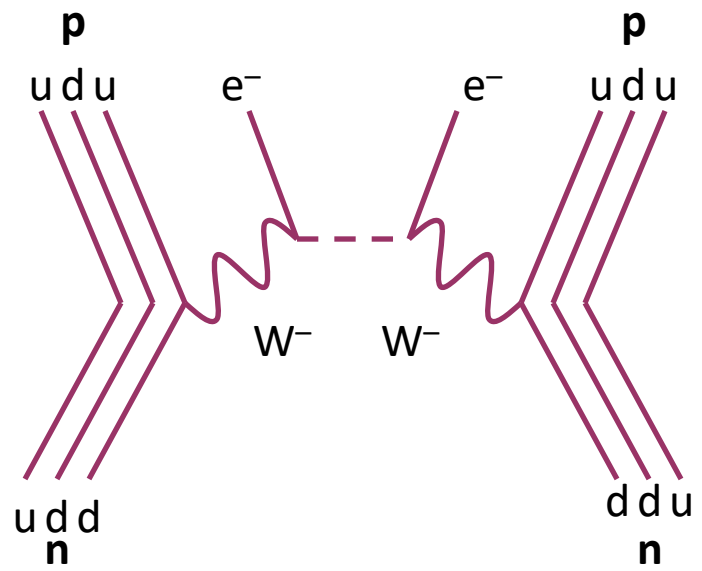
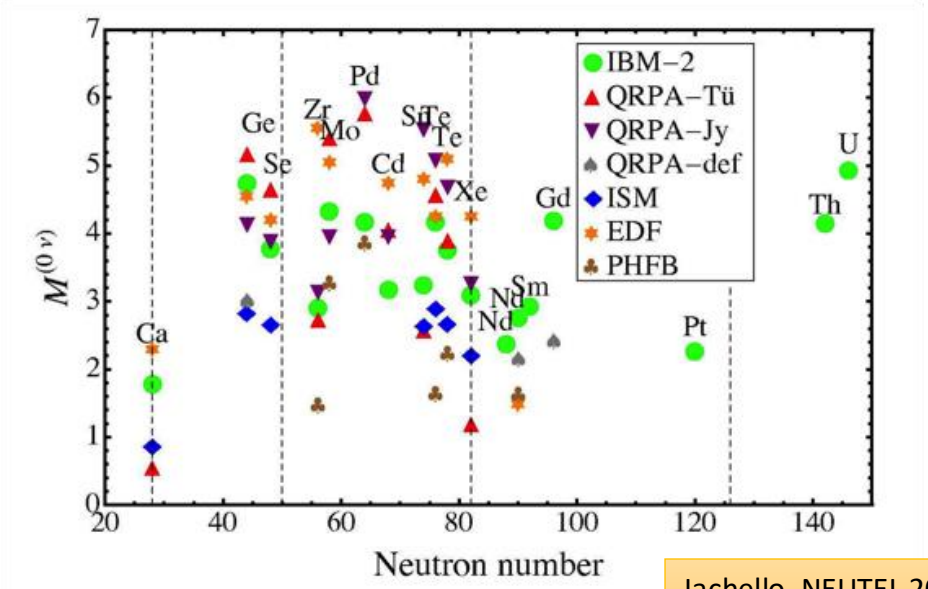
Physics during PhD



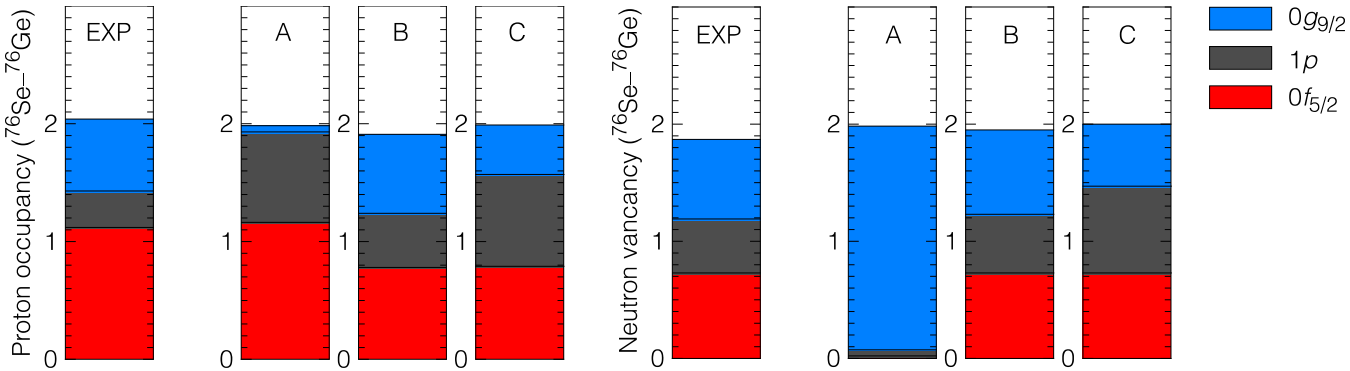
Neutrinoless double beta decay

- *Constraining theoretical frameworks used to calculate nuclear matrix elements for neutrinoless double beta decay.*
- *Used changes in nucleon occupancy obtained from transfer reactions.*
- *Also at Yale*

$$\left[T_{1/2}^{0\nu}\right]^{-1} = \text{(Matrix Element)} \times \text{(Phase space factor)} \times \langle m_\nu \rangle^2$$



Iachello, NEUTEL 2015.



EXP — J. P. Schiffer *et al.*, Phys. Rev. Lett. **100**, 112501 (2008); BPK *et al.*, Phys. Rev. C **79**, 021301(R) (2009)
A — QRPA by Rodin *et al.*, priv. com., Nucl .Phys. A **766**, 107 (2006)
B — QRPA by Suhonen *et al.*, priv. com., Phys. Lett. B **668**, 277 (2008)
C — ISM by Caurier *et al.*, priv. com., Phys. Rev. Lett. **100**, 052503 (2008)

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Structure of a proposal

Physics

What is the physics question you are trying to answer/address?

How are you going to answer that question? What is needed?

Why is your measurement going to do that?

Is there a track record of success? Proof-of-principle? (within collaboration not necessarily just the PI)

Justification of time

How well do you need to measure what you are going to measure?

What is maximum statistical uncertainty you can handle?

How much beam do you need to do that? (Include time for changes)

Do you need to take background measurements? Quantify contaminants?

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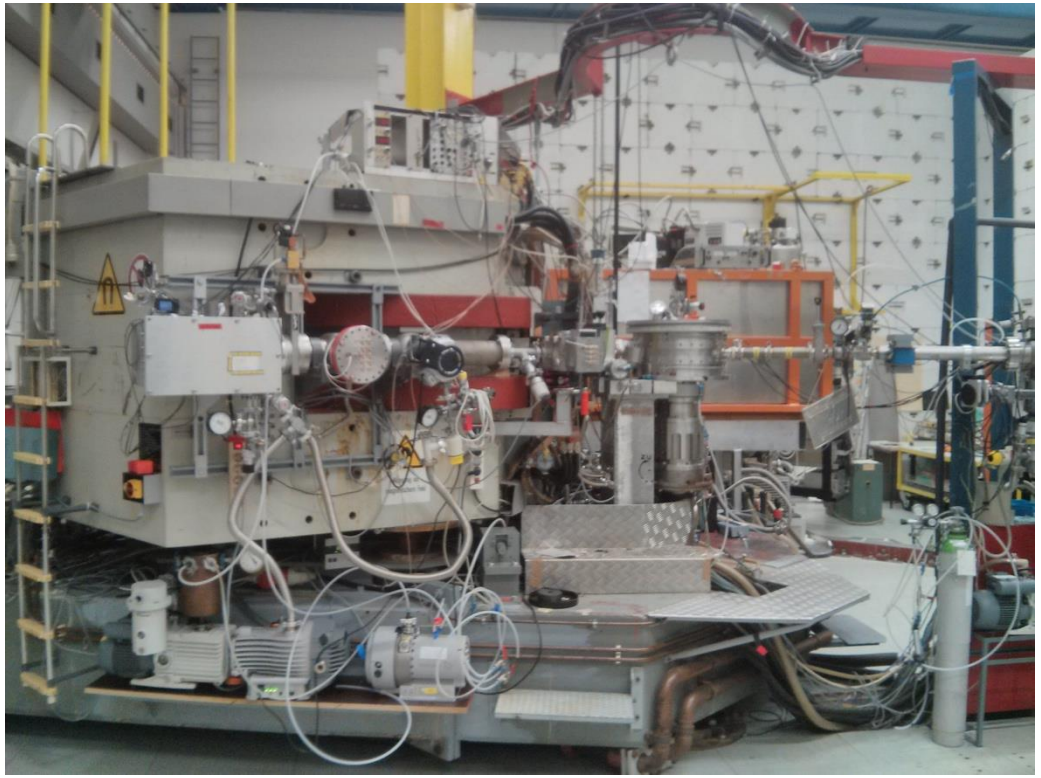
Proposals at stable beam facilities

Maier Leibnitz Laboratorium

- *Lab now shut ☹ was a 12MV tandem with a Q3D spectrometer.*
- *3 calls for proposals a year.*
- *Physics motivation and beamtime request (2 sides).*



- *First proposals as a PDRA focused on neutrinoless double beta decay candidates that had not yet been studies (A=150, A=116 and A=124).*
- *Also evolving shell structure looking at neutron occupancies along Sn isotopes.*
- *So, these proposals were derivative of experiences during PhD.*
- *Soft local PAC. Proposal submitted, approved and experiment run within 3-4 months.*

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Proposals at stable beam facilities

IPN Orsay

- ***1 PAC a year.***
- *Physics justification and justification of beam time. More involved than Munich,* ***5 pages.***
- ***Defense of proposal in person*** *– presentation followed by questions.*

- *Proposals here were related to Munich proposals (tandem plus split pole) but Munich did not have quite as high an energy as Orsay and so here could measure (a,3He) reactions where cross section has strong beam energy dependence. Important for accessing information on high angular momentum states.*
- *Some* ***operational differences*** *(important to understand ahead of time not always important for proposal).*
- *Again two proposals here followed naturally on from Munich (****no big ideas yet****).*
- *But learnt to assess weaknesses in my own proposal and to defend it.*

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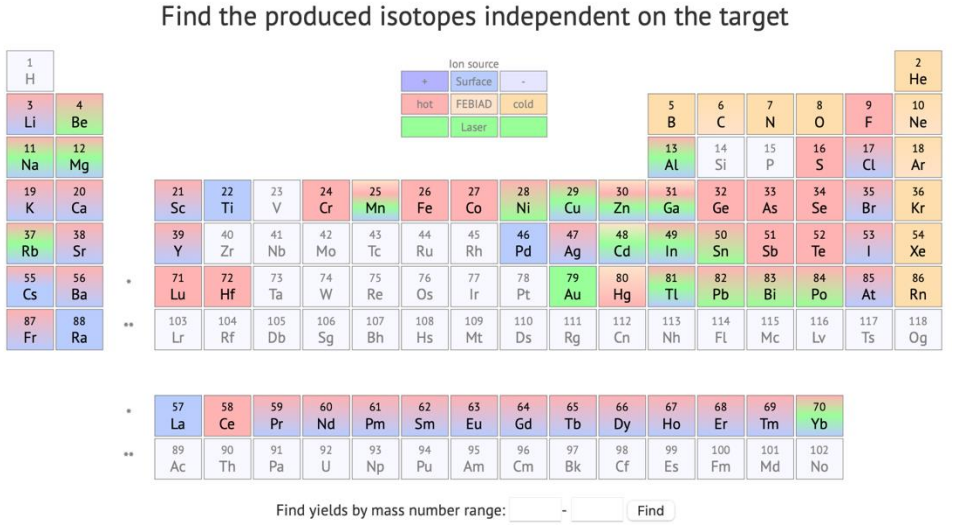
Proposals at ISOLDE – my first ”new” ideas

- ***ISOLDE is a user facility in the extreme**. Only one permanent physicist. CERN resource is focused on beams. External collaborations manage the devices which are usually operating under an MOU.*
- ***3 INTCs per year**. Proposals can take a long time to schedule.*
- *Submission **6 weeks previous**.*
- ***Submission to collaborations ahead of time** (ISS 4 weeks before INTC submission). Devices are externally owned – not by ISOLDE so working with collaboration to understand support is key.*
- *In preparation **attended ISOLDE workshop** to meet local teams.*
- ***Engagement with target group** – advice on beam rates. simon.thomas.stegemann@cern.ch*
- ***Accelerators** – what are limitations in beam/contaminants. What is needed in terms of tuning – different beam sometimes used or stable beam to set up device (users do the tune into the experiment). alberto.rodriguez@cern.ch*
- *Example collaboration contacts:*
  - *ISS Liam Gaffney (also Miniball) or David Sharp*
  - *IDS James Cubiss*
  - *CRIS Kara Lynch*
- *Physics coordinator at ISOLDE can also provide information on who to speak to hanne.heylen@cern.ch*

Proposals at ISOLDE – my first ”new” ideas

- *First ISS proposal ^{28,30}Mg(d,p)^{29,31}Mg (**3 years in to being a PDRA**)*
  - *Without this first proposal ISS had no local CERN support to install or fill magnet.*
  - ***New scheme of research for me**. Was asked to lead as only UK-based PDRA who had experience with HELIOS.*
  - *Outcome of pouring over yield database and papers. Developed many cases and put them to collaboration before final one was selected. (Database is a guide only and yields can vary).*
  - *^{28,30,32}Mg, ^{50}Ca, ^{66,68}Ni, ^{146}Gd, ^{148}Dy, ^{150}Er, ^{206}Hg, ^{212}Rn, ^{214}Ra*
  - ***Started with stuff I was familiar with** (N=50 beams, N=82 beams).*
  - *Then looked at another shell (N=126).*
  - *Then looked at topical regions like island of inversion which was well known at ISOLDE*
  - *Strategically wrote a proposal where some of beamtime could be awarded/sacrificed. Choice was made based on minimizing risk/maximizing chance to get approved.*



https://isoyields2.web.cern.ch

Single-particle behaviour towards the “island of inversion” - ^{28,30}Mg$(d,p)^{29,31}$Mg in inverse kinematics

June 1, 2016

D. K. Sharp[1], S. J. Freeman[1], B. B. Back[2], P. A. Butler[3], W. N. Catford[4], A. N. Deacon[1], L. P. Gaffney[5], C. R. Hoffman[2], R. V. F. Janssens[2], B. P. Kay[2], Th. Kröll[6], M. Labiche[7], G. Lotay[4], A. Matta[4], R. D. Page[3], R. Raabe[8] and D. Steppenbeck[9]

Proposals at ISOLDE – my first ”new” ideas

- *Follo ISS proposal ^{28,30}Mg(d,p)^{29,31}Mg (**3 years in to being a PDRA**)*
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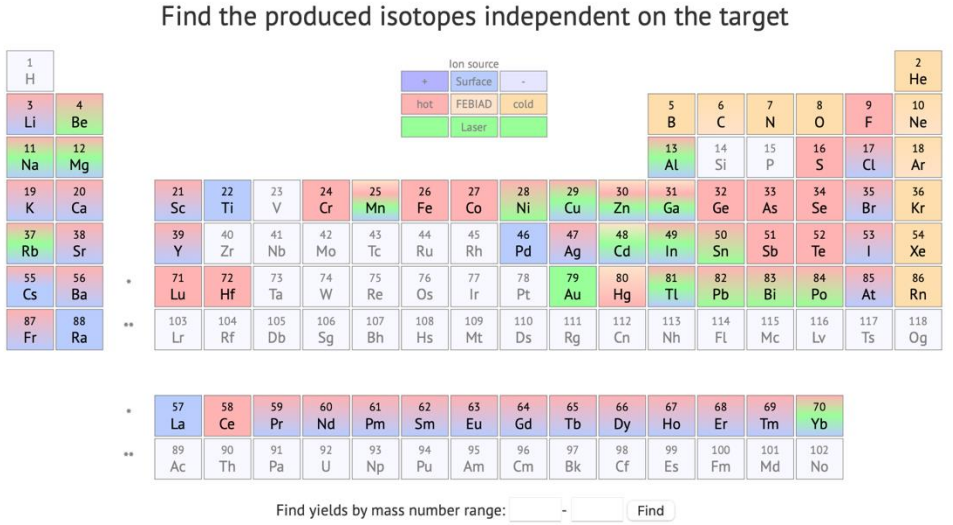


https://isoyields2.web.cern.ch

Based on success of first run follow up with the second part of proposal

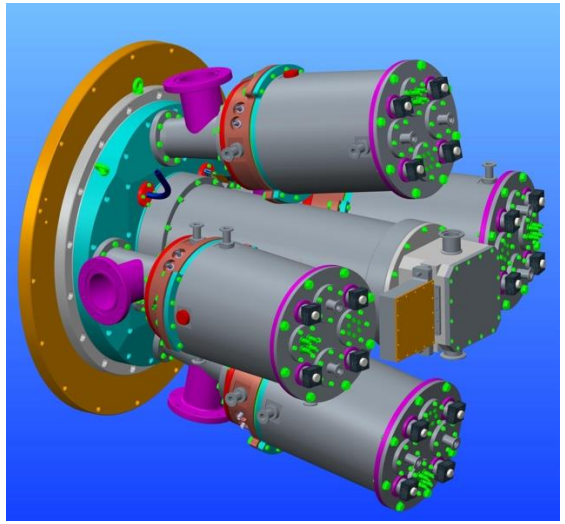
The $d(^{30}\mathrm{Mg},p)^{31}\mathrm{Mg}$ reaction: Probing single-particle behaviour within the “island of inversion”

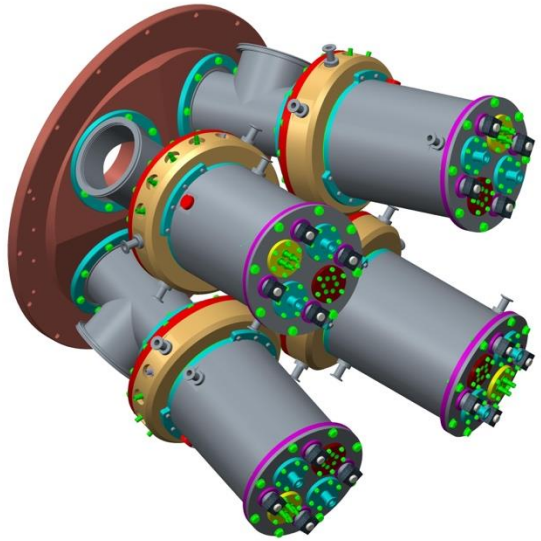
September 22, 2020

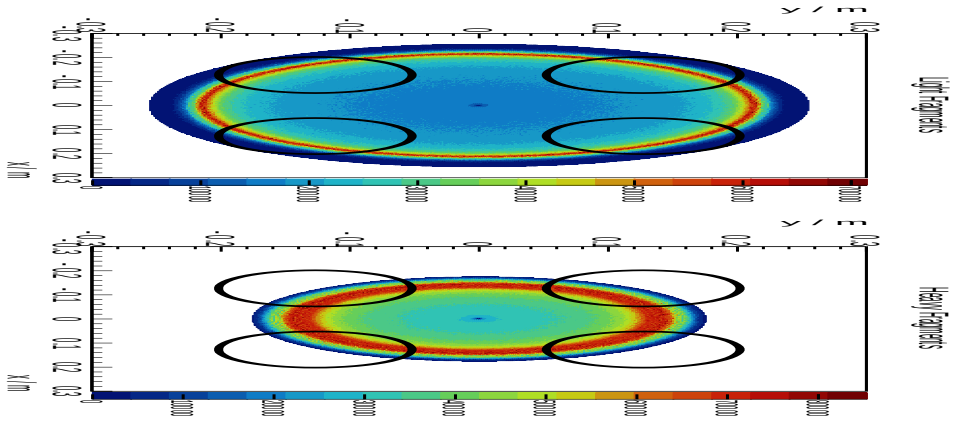
D. K. Sharp[1], S. J. Freeman[1], P. A. Butler[2], W. N. Catford[3], A. Ceulemans[4], L. P. Gaffney[2], C. R. Hoffman[5], R. V. F. Janssens[6,7], B. P. Kay[5], N. Kitamura[8], Th. Kröll[9], M. Labiche[10], I. Lazarus[10], G. Lotay[3], R. Lubna[11], B. Olaizola[12], T. Otsuka[8,13], O. Poleshchuk[4], R. D. Page[2], R. Raabe[4], N. Shimizu[8], T. L. Tang[5] and K. Wimmer[14]

Proposals at ISOLDE – my first ”new” ideas

- *Next new idea was transferred-induced fission*
  - *Not just me, idea developed in discussions over coffee before formal discussions between Argonne and Manchester on a proof-of-principle measurement that could inform future measurements at ANL, FRIB and ISOLDE.*
  - *New detector set up – design engineer crucial to understanding what was feasible. 6 months of design iteration, simulations and proposal writing.*
  - *Successful derisking of the proposal at Argonne led to successful proposals at ISOLDE following on from this. RIB facilities are not always best places for proof-of-concept due to competitiveness of beam time.*
  - *New ideas are hardest to defend due to lack of familiarity.*







Aside CERN Fellowships

Research Fellowship : Experimental Physics

Geneva, Switzerland

Full-time

https://jobs.smartrecruiters.com/CERN/744000032129869-research-fellowship-experimental-physics-

EP Research Fellowship: Applied Physics and Engineering

Geneva, Switzerland

Full-time

https://jobs.smartrecruiters.com/CERN/744000036971495-ep-research-fellowship-applied-physics-and-engineering

- *Fellowship programs at CERN are essentially PDRA positions.*
- *Scientific and applied fellowships.*
- *Posts for 2-3 years.*
- *Maximum 6 years post PhD for experimental physics fellow and max 3 years for applied.*
- *Excellent opportunity to take on more responsibility and demonstrate leadership – local lead for a particular collaboration.*
- *Well paid.*
- *Though CERN is about to go through long shutdown – so you want to make sure you have something to do.*

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Summary

- *Proposals are **often not some grand new idea** but more often than not follow on from previous work (a programme of study). First proposals I wrote were ones I was asked to write rather than my own programme.*

- *Ideas, and in particular new ones, are **not developed in isolation**. Often involve a small group to refine idea and further input from broader collaboration.*

- ***Local knowledge is key**, understanding of what is and is not possible in terms of beams (there is no physics without the beam) and equipment (what are the limits of the experimental apparatus).*

- ***Defending a proposal** can feel like having another (hopefully much shorter) viva but be prepared – identify arguments and be prepared with more information if you can. Some reviewers can get touch ahead of time but not always standard on all PACs. Also **an opportunity to add more detail** you couldn't put in proposal.*

- *Others may be working in same space – easiest way to address this is to **ask them to join proposal.***

- ***Simulations** seem to be more and more important to convince especially for new ideas – must be realistic though.*