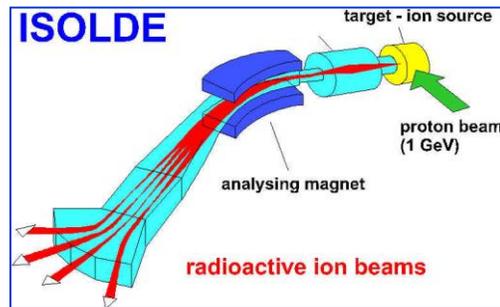


ISOLDE = Isotope Mass Separator On-Line Device



CERN's Radioactive Ion Beam Facility



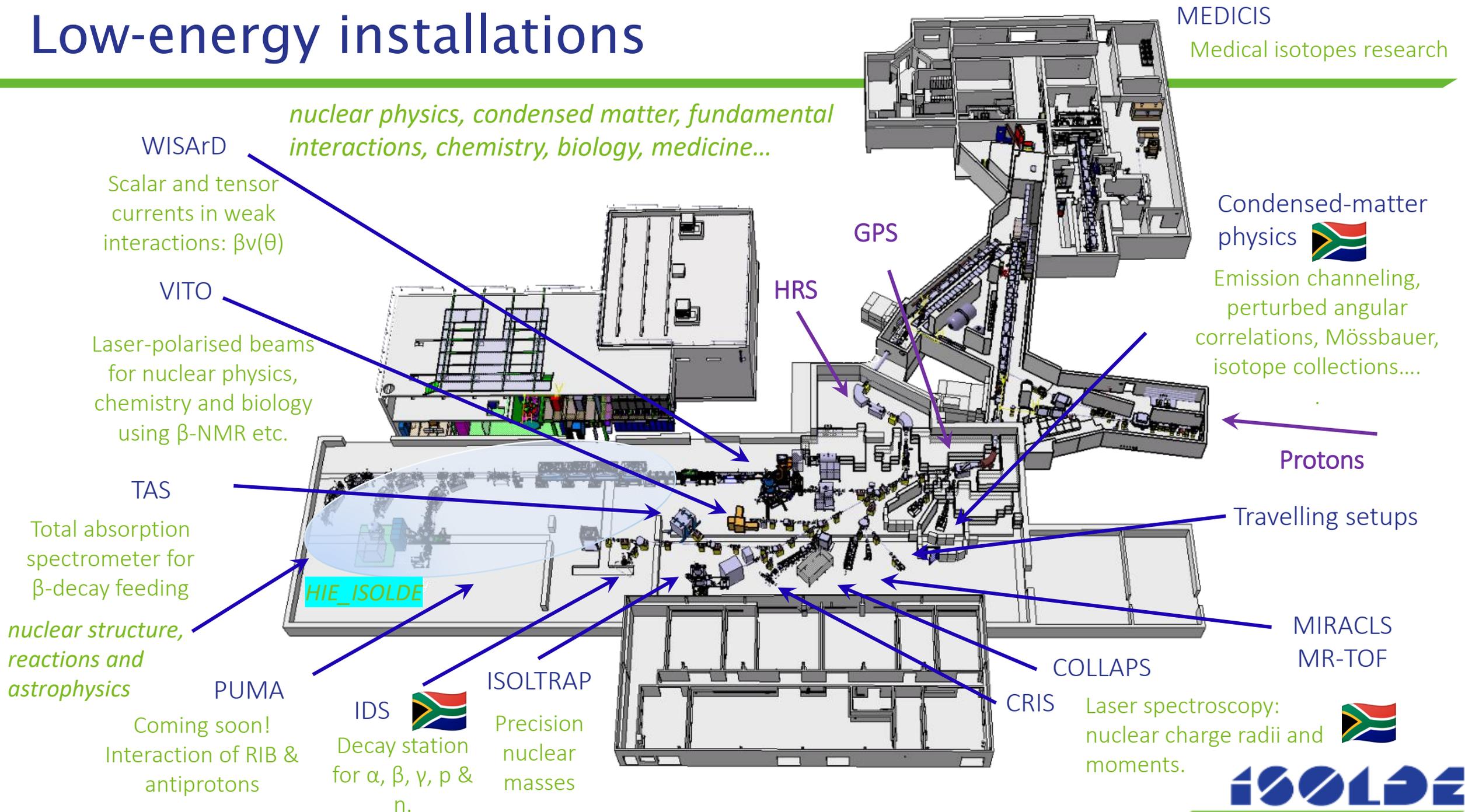
RESEARCH = FUNDAMENTAL SCIENCE => INSTRUMENTATION/COMPUTATION => EXPERIMENTS
=> NEW PHYSICS

KNOWLEDGE AND TECHNOLOGY SKILLS TRANSFER => INNOVATION

EDUCATION AND TRAINING

SA-ISOLDE Coordinator: Professor Deena Naidoo

Low-energy installations



South Africa - Involvement - ISOLDE



Current Principal Investigators, Researchers and Human Capacity Development

University of Witwatersrand: *Professor Deena Naidoo, *Dr Hilary Masenda

University of Western Cape: Professor Nico Orce and Dr Lucky Makhathini

University of Zululand: Professor Sifiso Ntshangase

iThemba Laboratory: Drs Rob Bark, Pete Jones

Stellenbosch University: Dr Christine Steenkamp

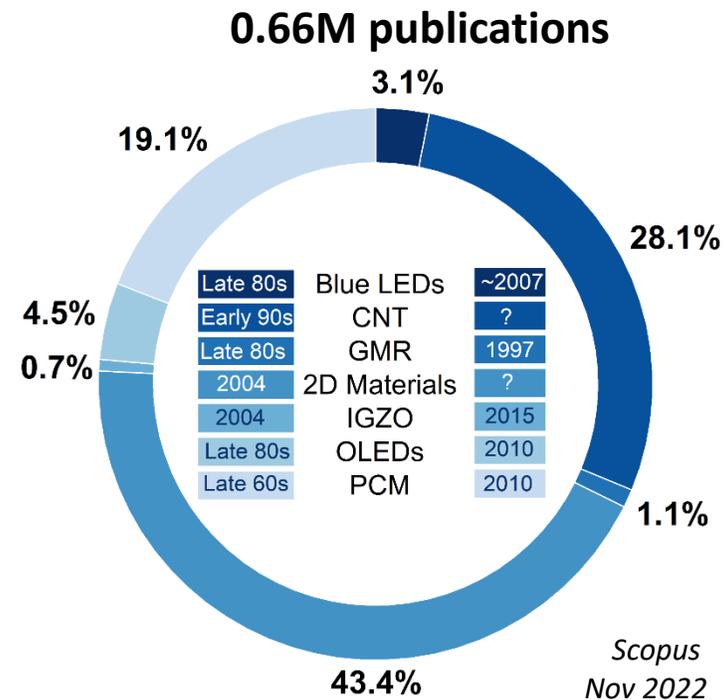
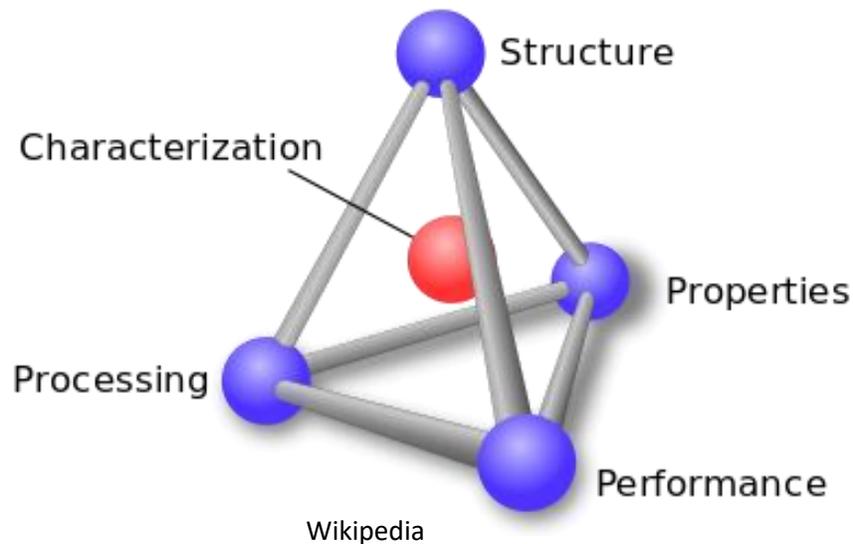
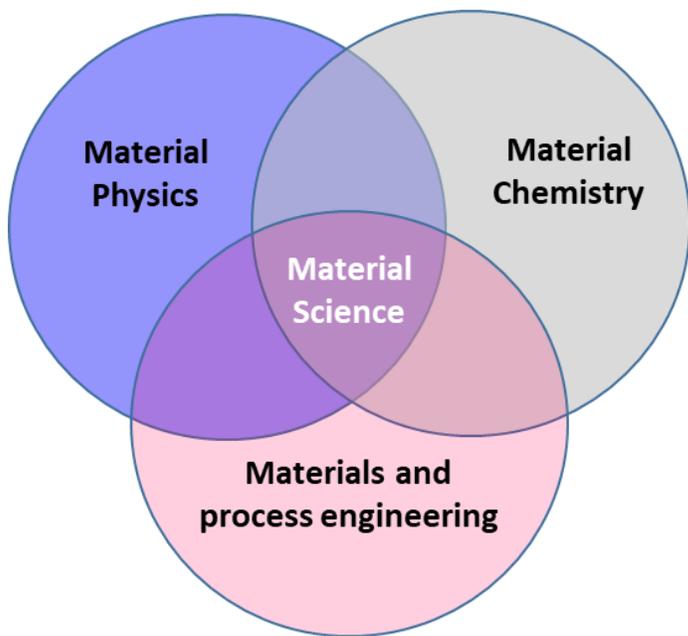
University of Kwazulu-Natal/Durban University of Technology: Emeritus Professor Krish Bharuth-Ram

INVOLVED IN 20 Active experiments

New LOI and INTC Proposals currently being reviewed.

Researchers: *Drs Wendy Dlamini (UKZN), Sanele Dlamini (DUT), Daphney Bucher (UCT), Siya Majola (UJ)

SA_ISOLDE Membership includes: *Technical staff, Postdoctoral Fellows and Postgraduate students



Functional Materials – How?

...modify structure of materials...



....enhance electrical, optical, magnetic properties....



... to realize functional materials ...

...for optoelectronic, spintronic, photovoltaic, quantum ... applications

...dopants ...

During material growth

Diffusion

Nuclear reaction

via proton or neutron irradiation

Ion implantation

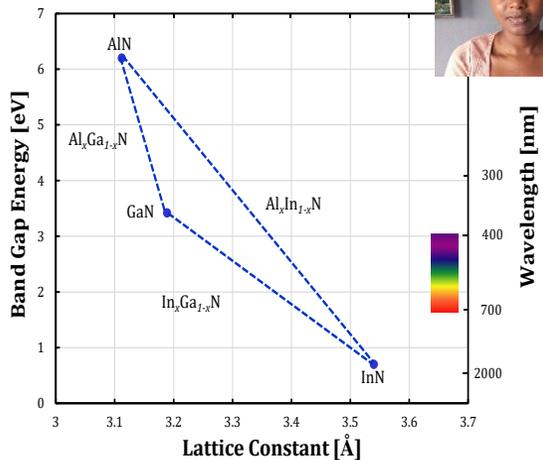
Devices

- ✓ smaller
- ✓ faster
- ✓ more efficient
- ✓ new functionalities

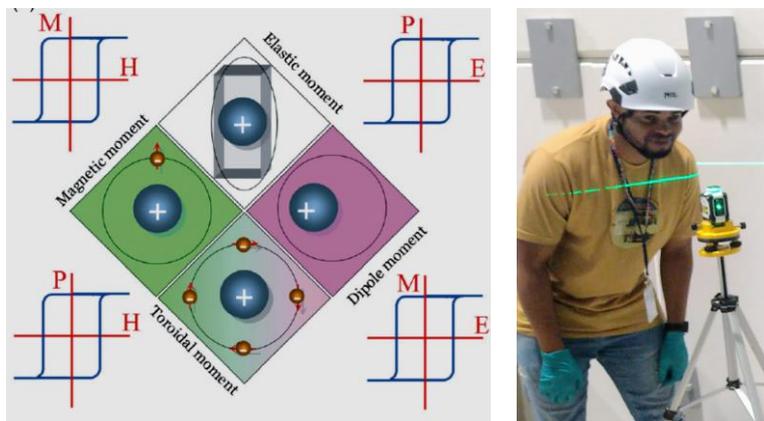


....for tomorrow and the day after

Nitrides

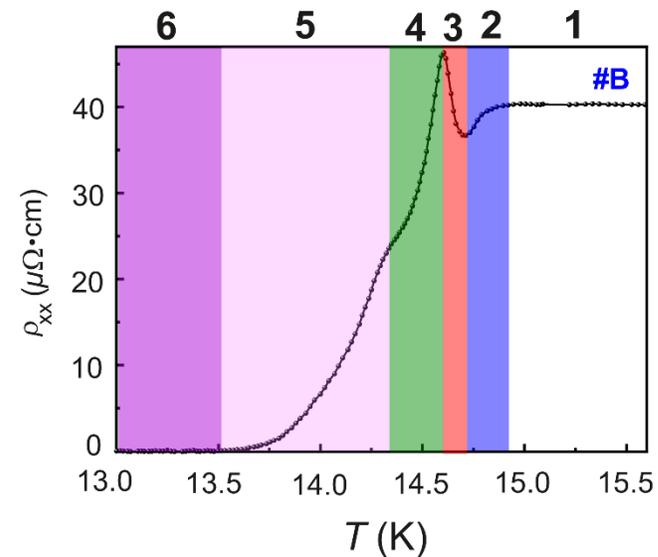


Multiferroics: RFe₂O₄ + vdW HS



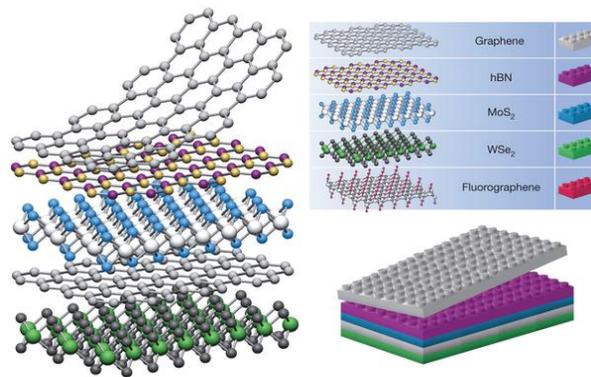
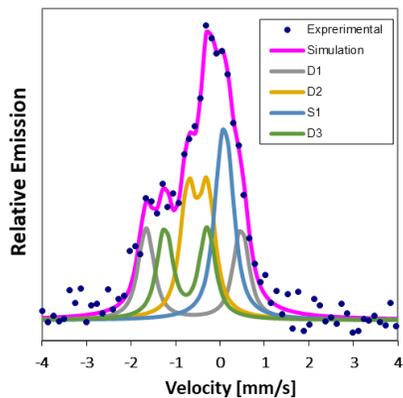
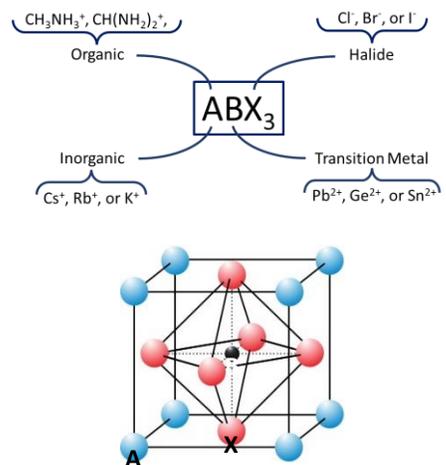
S. Dong et al., *Advances in Physics* 64 (2015) 519 - 626

Fe implanted NbN



Perovskites: New experiment

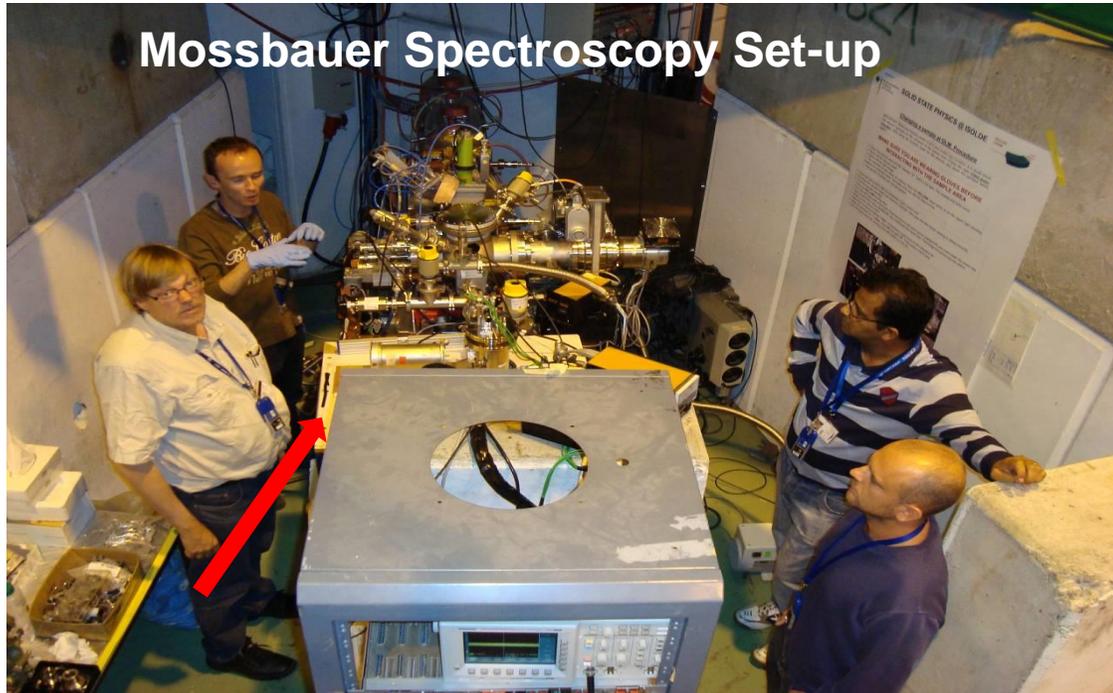
2D materials + hetero/hybrid structures



A. K. Geim and I. Grigorieva, *Nature* 499, 419 (2013)

...plus more... more ...
more ...

Materials Science Experiments

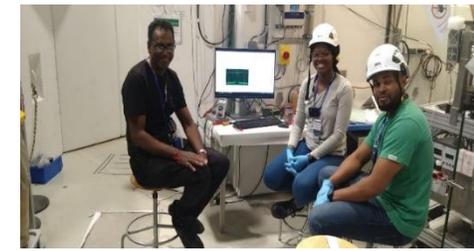


Durban

K. Bharuth-Ram, S. Dlamini,
W. B. Mdlalose, V. Masondo

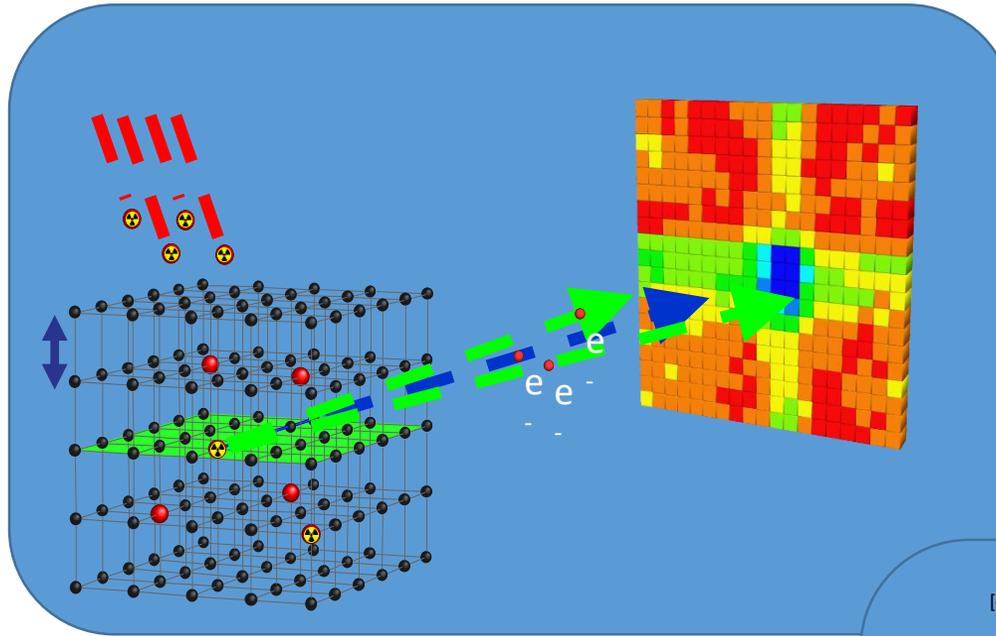
Johannesburg

D. Naidoo, H. Masenda, G.
Peters, O. Mpatani, L.I.
Lisema



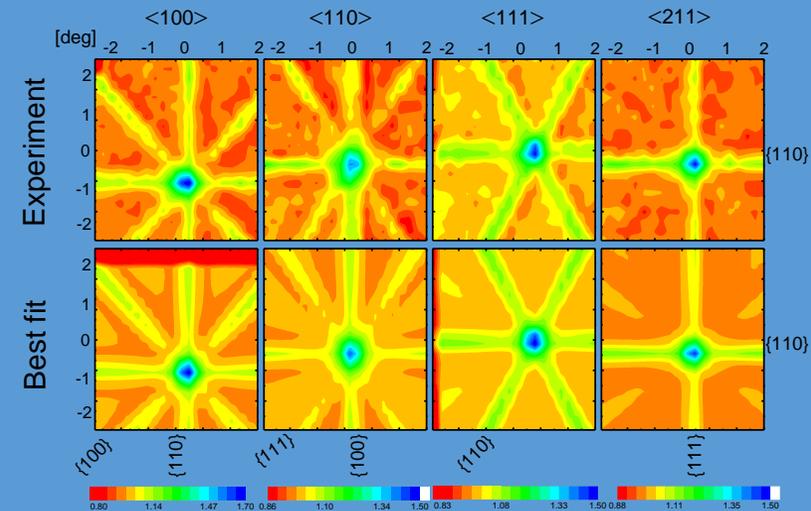
Emission Channeling - Principles

(Acknowledgements: Hans Hofsäss, Uli Wahl)



1. **Implant** radioactive parent isotope into single crystal sample.
2. **Measure channeling patterns** of conversion electrons or β - particles detected in 2-D detector

3. **Many-beam simulations** of channeling patterns.
4. **Fits** to experimental patterns yields sites and fractions.



Nuclear Physics Experiments

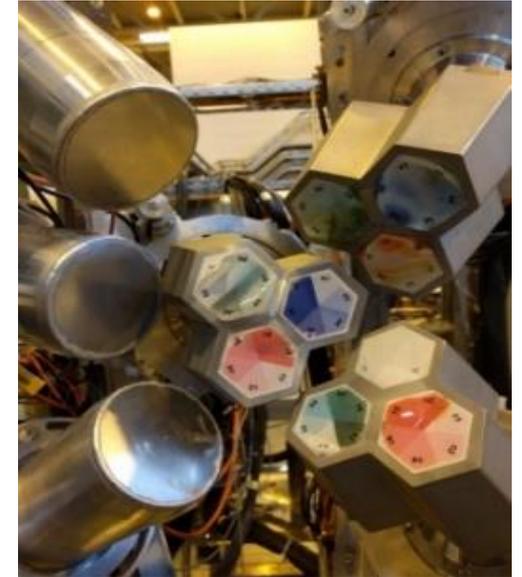
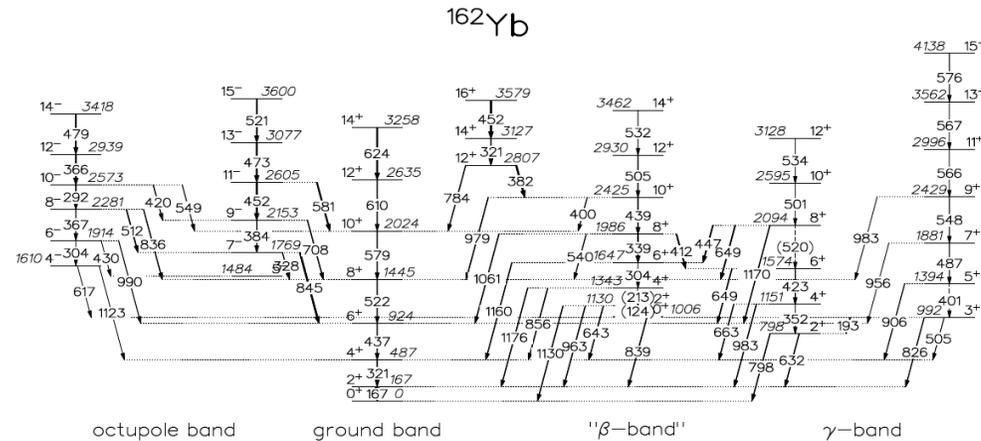
Dr Christine Steenkamp (US)

Decay assisted high resolution
collinear resonance laser
spectroscopy



The new tape station and
decay measurement setup
that was commissioned
and successfully used.

R.A. Bark¹, C. Fransen², A.N. Andreyev³, M.G. Borge⁴,
D. Bucher⁵, J.C. Cubiss³, F. Dunkel², L. Gaffney⁶, J.
Gerl⁷, K. Hadyńska-Klęk⁸, H. Hess², R. Hirsch², E. Ince⁹,
J. Jolie², P. Jones¹, T. Kröll¹⁰, C. Lackenbrink², E.
Lawrie¹, J.J. Lawrie¹, Z. P. Li¹¹, S. Majola¹², B.O.
Mampaso⁴, S.M. Mullins¹³, C. Müller-Gatermann¹⁴, P.J.
Napiorkowski⁸, G. O'Neill, S. Ntshangase¹⁵, C. Page³, J.
Pakarinen¹⁶, L. Pellegrini¹, P. Reiter², A. Ilana¹⁷, J. Srebrny⁸,
M. Stryczyk¹⁶, J.F. Sharpey-Schafer, F. von Spee², N.
Warr², K. Wrzosek-Lipska⁸, M. Wiedeking¹, Z. Yue³ and
S.Q. Zhang¹⁸



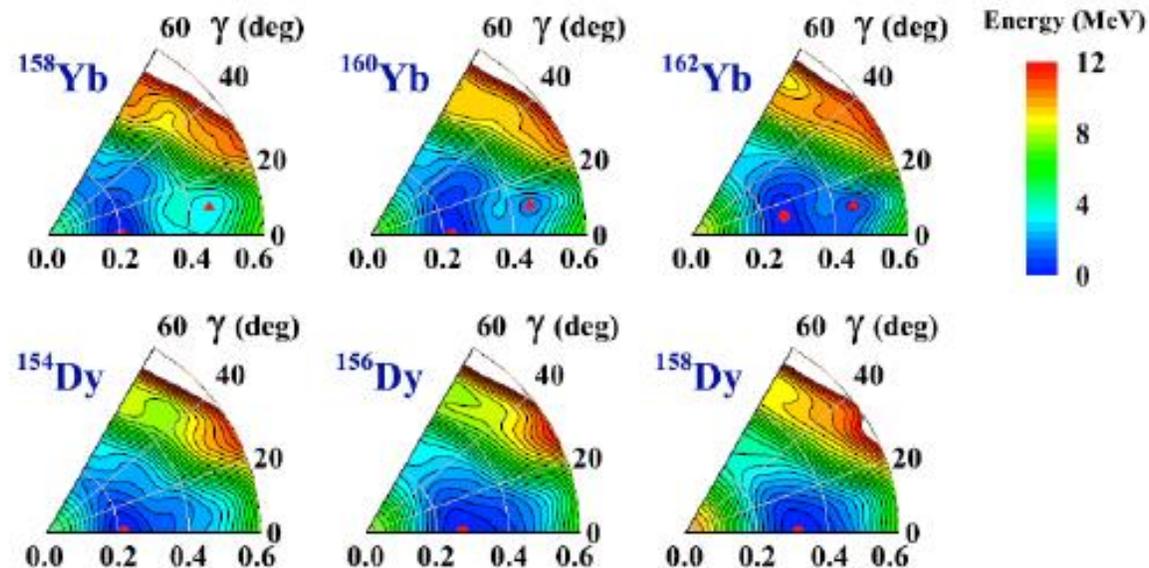
Nuclear Physics Related Experiments

Successful Letters of Intent (to test beam intensities)

- **LoI 226** Development of 160,162,164Yb beams: Coulomb Excitation of Triaxial Superdeformed “beta-bands” in light Yb isotopes (6 shifts)
- **INTC-I-268** Coulomb Excitation of a Triaxial Superdeformed “b-band” in 162Yb (2 shifts)

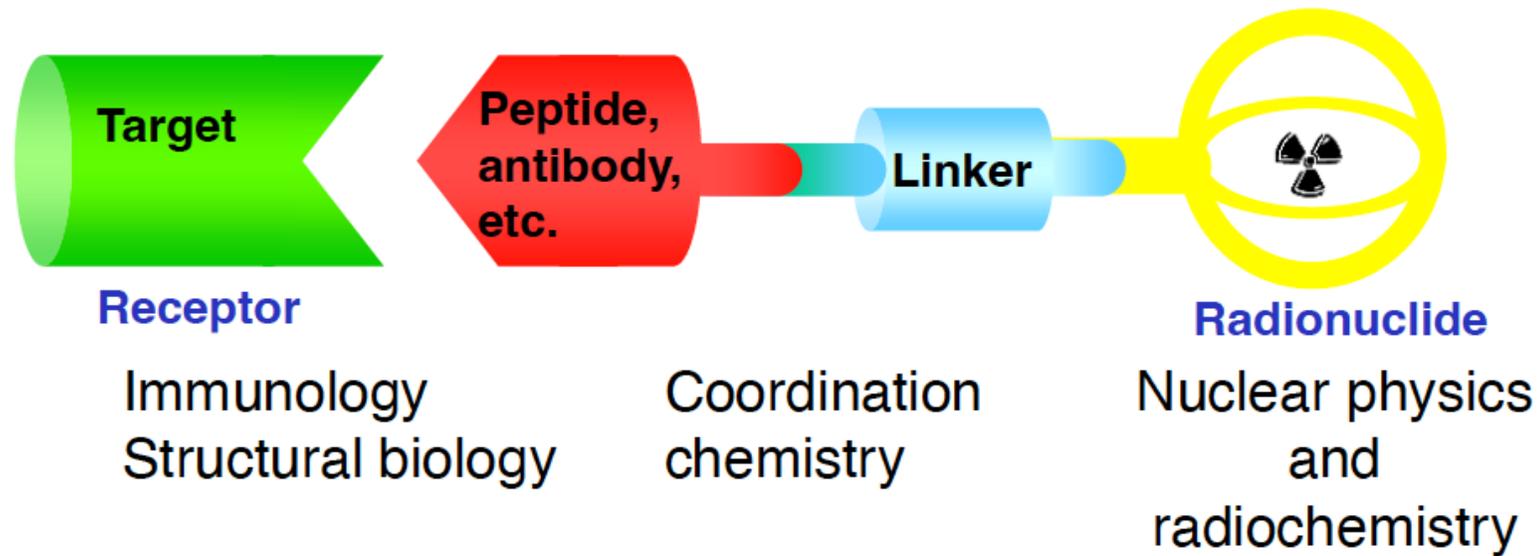
Successful Proposal (to perform experiment)

INTC-P-708 Coulomb Excitation and RDDS measurement of a Triaxial Superdeformed Band in 162Yb (15 shifts)



Nuclear Physics Related Experiments

Multidisciplinary collaboration
to fight cancer



Nuclear Physics Related Experiments

NEW OPPORTUNITY?

Production of highly targeted radiopharmaceuticals with the potential to meaningfully improve the treatment of people living with cancer

THERANOSTICS = therapy + diagnostics

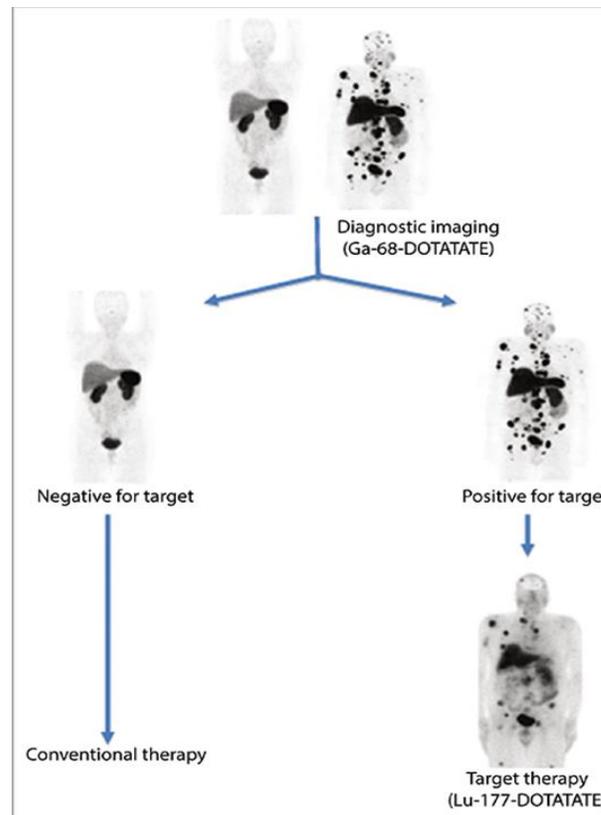
Alpha-emitting radionuclides

^{225}Ac ^{149}Tb

Theranostic Nuclides

^{149}Tb , ^{152}Tb , ^{155}Tb

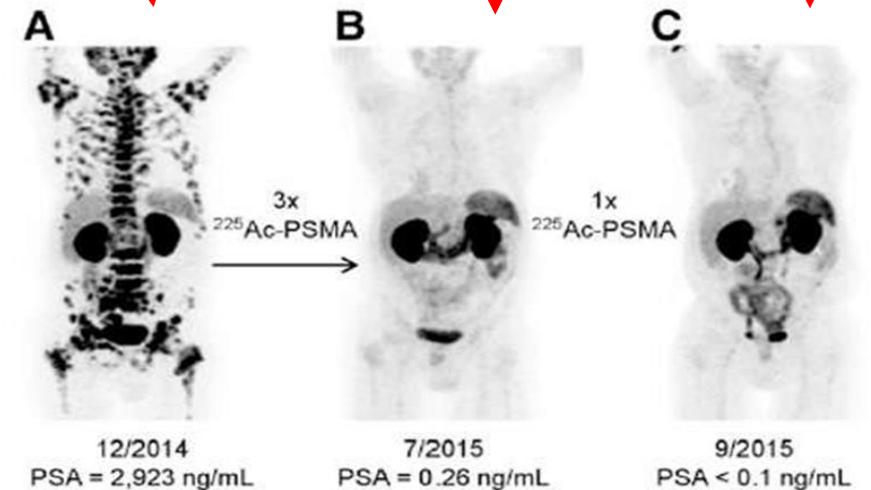
Require mass separation



Cancer metastasized

^{225}Ac treatment

Cancer cured

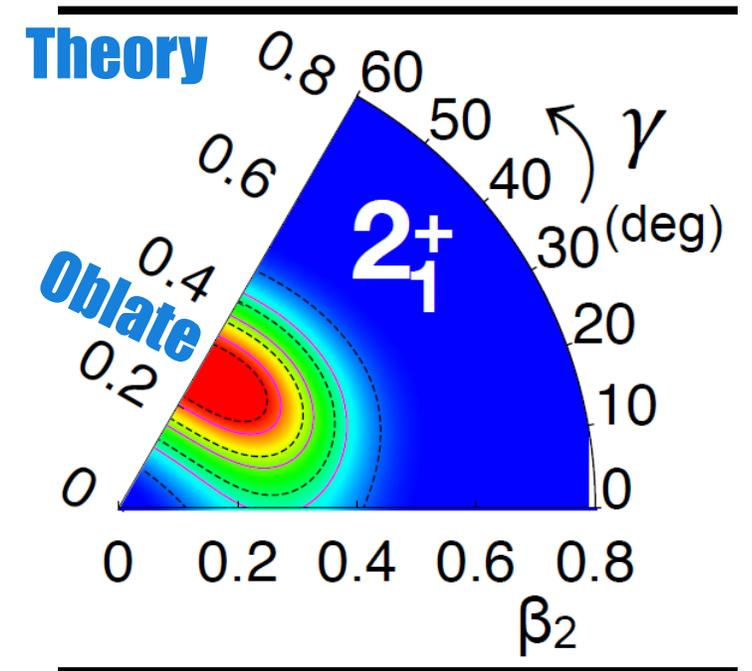
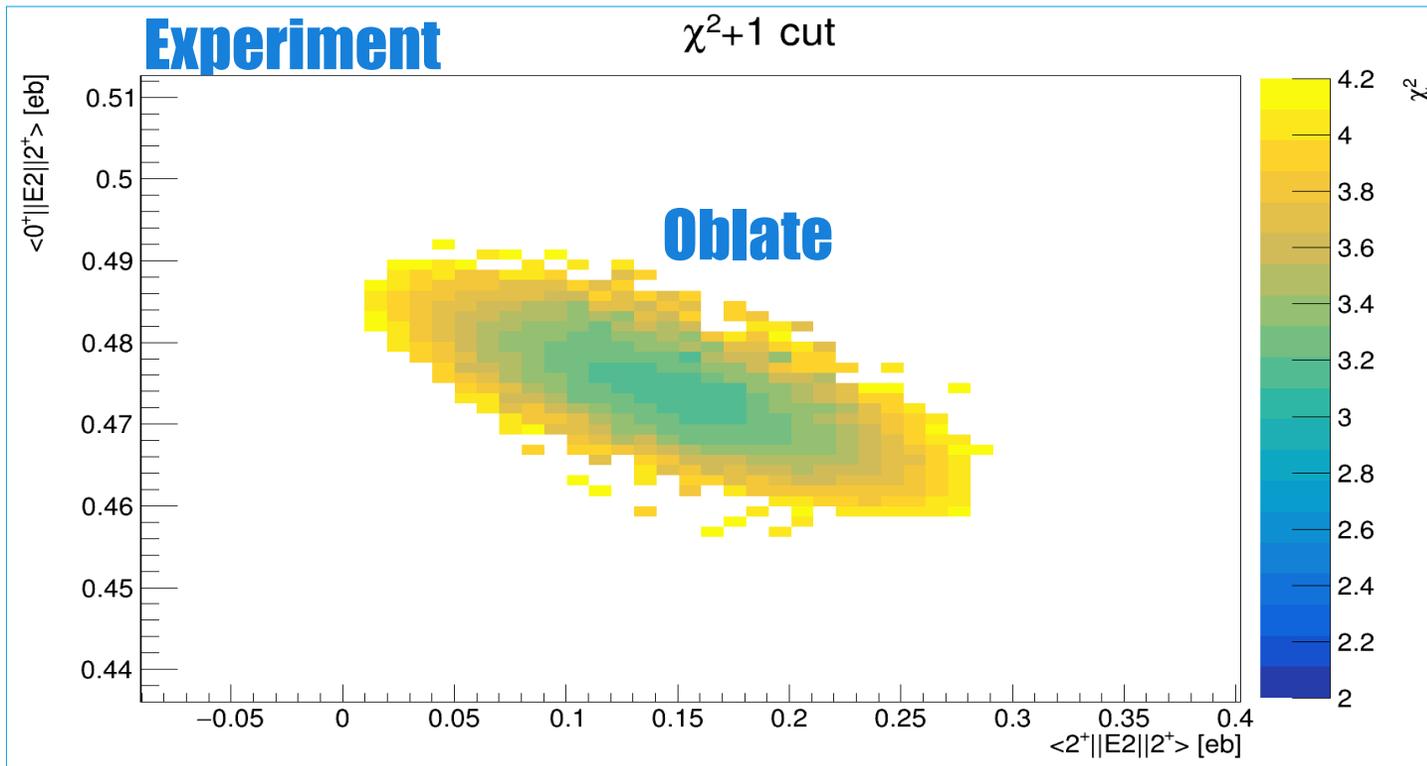


Minimization method vs Modern Theory

(Final results to be submitted to HIE-ISOLDE collaboration)

TME = 0.4915(29) eb \rightarrow B(E2; $2_1^+ \rightarrow 0^+$) = 30.5(36) W.u.

DME = $0.09^{+0.05}_{-0.04}$ eb \rightarrow $Q_S(2_1^+) = +0.07_{-0.03}^{+0.04}$ eb

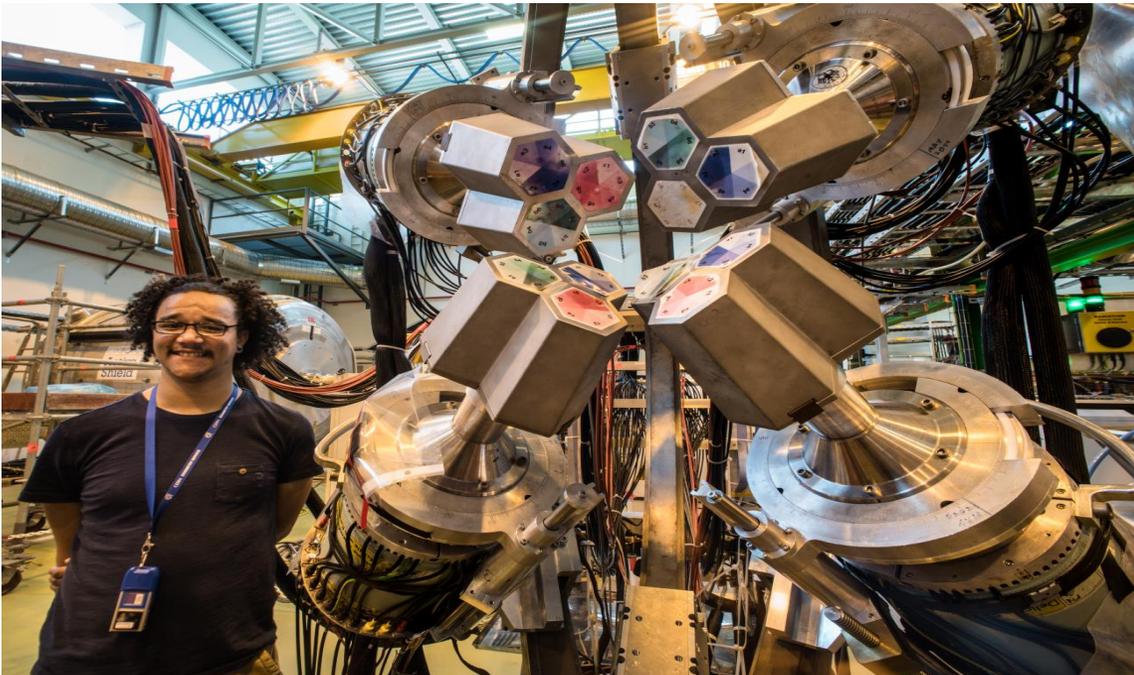




UNIVERSITY of the
WESTERN CAPE

Discovery of enhanced of oblate collectivity in nuclei Shape Coexistence in the neutron-deficient $A \sim 70$ Mass Region

Nico Orce @ HIE-ISOLDE Workshop
Institute of Physics, London, 25 May 2023



News · News · Topic: Experiments

Ubuntu* - a powerful motto for an important experiment

The first African-led experiment has taken place at CERN

24 JULY, 2017 | By Stephanie Hills

First African-led experiment at CERN

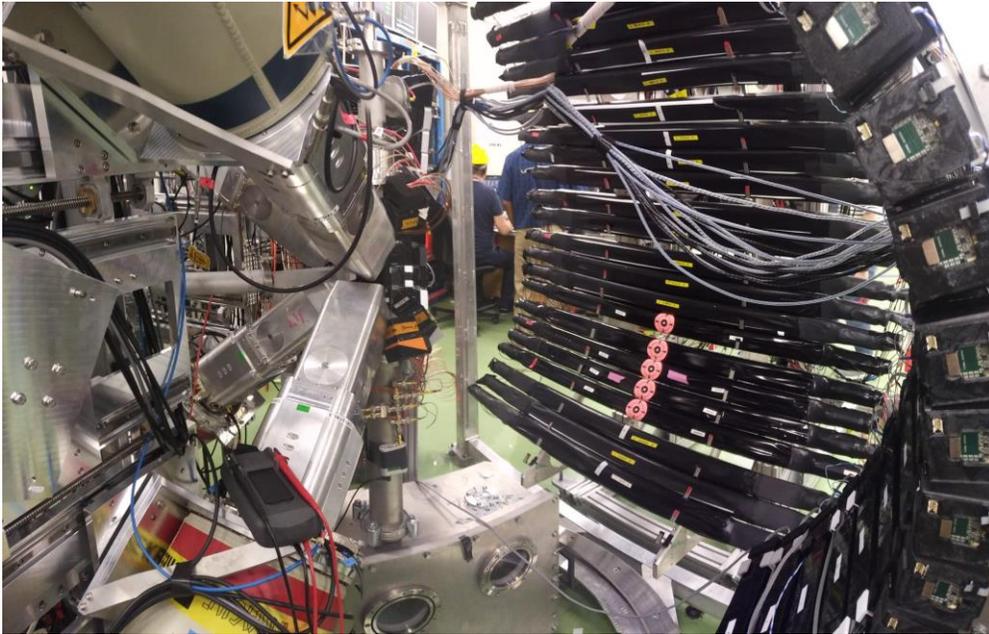


The first African-led experiment has taken place at CERN, supported by UK researchers. Students and staff from the University of the Western Cape, South Africa, have investigated the isotope Selenium 70 using Isolde, CERN's nuclear physics facility. (Video: Christoph Madsen/CERN)

09 Students were @CERN: The Ubuntu experiment. PhD awarded to Kenzo Abrahams (2021), who is currently working doing Machine Learning.

<https://home.cern/news/news/experiments/ubuntu-powerful-motto-important-experiment>

UWC's further involvement @ ISOLDE Decay Station/CERN (IS685, IS662, NDS2024 conference)



Physics Letters B

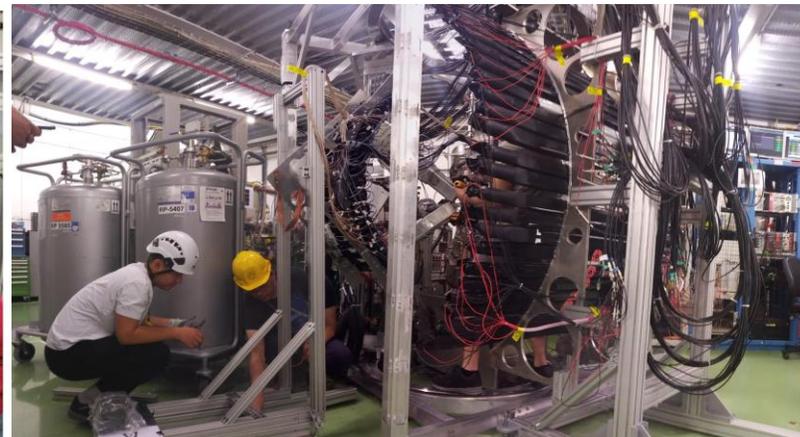
Volume 849, February 2024, 138452



Letter

Magnetic moments of thallium isotopes in the vicinity of magic $N = 126$

Z. Yue ^a ✉, A.N. Andreyev ^{a,b}, A.E. Barzakh ^c, I.N. Borzov ^c, J.G. Cubiss ^a, A. Algora ^d, M. Au ^{b,e}, M. Balogh ^f, S. Bara ^g, R.A. Bark ^h, C. Bernerd ^{b,g}, M.J.G. Borge ⁱ, D. Brugnara ^f, K. Chrysalidis ^b, T.E. Cocolios ^g, H. De Witte ^g, Z. Favier ^b, L.M. Fraile ^j, H.O.U. Fynbo ^k, A. Gottardo ^f, R. Grzywacz ^l, R. Heinke ^b, A. Illana ^{j,m,n}, P.M. Jones ^h, D.S. Judson ^o, A. Korgul ^p, U. Köster ^{b,q}, M. Labiche ^r, L. Le ^b, R. Lica ^{b,s}, M. Madurga ^l, N. Marginean ^s, B. Marsh ^b, C. Mihai ^s, E. Nácher ^d, C. Neacsu ^s, C. Nita ^s, B. Olaizola ^{b,i}, J.N. Orce ^t, C.A.A. Page ^a, R.D. Page ^o, J. Pakarinen ^{b,m,n}, P. Papadakis ^r, G. Penyazkov ^c, A. Perea ^l, M. Piersa-Sitkowska ^{b,p}, Zs. Podolyák ^{b,u}, S.D. Prosnjak ^c, E. Reis ^{b,v}, S. Rothe ^b, M. Sedlak ^f, L.V. Skripnikov ^c, C. Sotty ^s, S. Stegemann ^b, O. Tengblad ^l, S.V. Tolokonnikov ^c, J.M. Udías ^j, P. Van Duppen ^g, N. Warr ^w, W. Wojtaczka ^g



Monthly Notices

of the Royal Astronomical Society



Discovery Breakthrough by SA-CERN team explaining Why we see the same amounts of gold, silver or platinum around our universe

Article Navigation

JOURNAL ARTICLE

Enhanced symmetry energy may bear universality of r-process abundances [Get access >](#)

José Nicolás Orce ✉, Balaram Dey ✉, Cebo Ngwetsheni, Srijit Bhattacharya, Deepak Pandit ✉, Brenden Lesch, Andile Zulu

Monthly Notices of the Royal Astronomical Society, Volume 525, Issue 4, November 2023, Pages 6249–6256, <https://doi.org/10.1093/mnras/stad2539>

Published: 04 September 2023 [Article history ▼](#)

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Leading Science – Cebo Ngwetshni (PhD) presenting @ CERN

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Journal of Physics G: Nuclear and Particle Physics

PAPER • OPEN ACCESS

Electric dipole polarizability of low-lying excited states in atomic nuclei

José Nicolás Orce^{1,2} and Cebo Ngwetsheni¹

Published 12 June 2024 • © 2024 The Author(s). Published by IOP Publishing Ltd

[Journal of Physics G: Nuclear and Particle Physics, Volume 51, Number 7](#)

Citation José Nicolás Orce and Cebo Ngwetsheni 2024 *J. Phys. G: Nucl. Part. Phys.* 51 075105

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José Nicolás Orce and Cebo Ngwetsheni 2024 *J. Phys. G: Nucl. Part. Phys.* 51 075105

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[New measurements of the \$^{19}\text{F}\(p, \alpha_0\)^{16}\text{O}\$ and \$^{19}\text{F}\(p, \alpha_1\)^{16}\text{O}^*\$ reaction cross sections close to the Coulomb barrier](#)

L Pedigolo et al 2024 *J. Phys. G: Nucl. Part. Phys.* 51 075106

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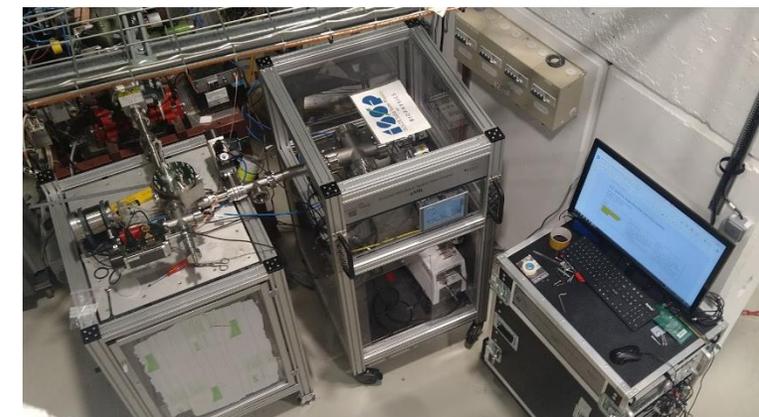
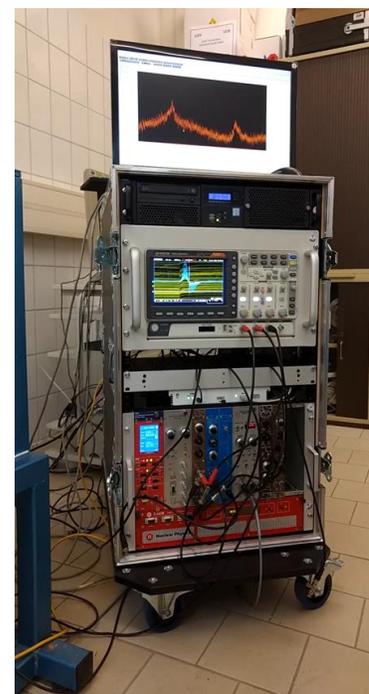
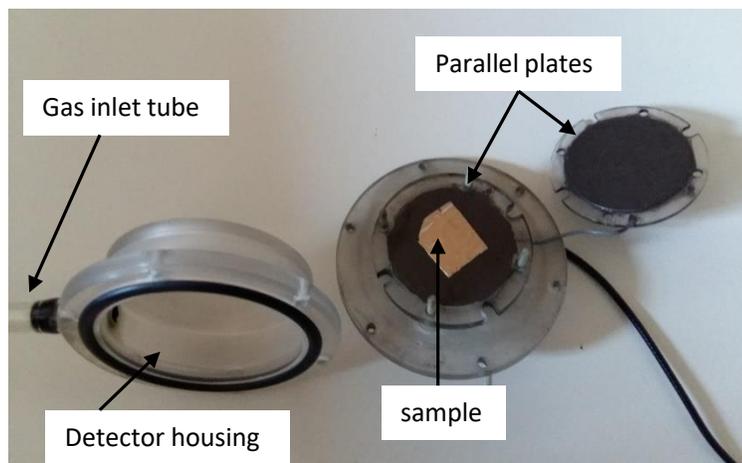
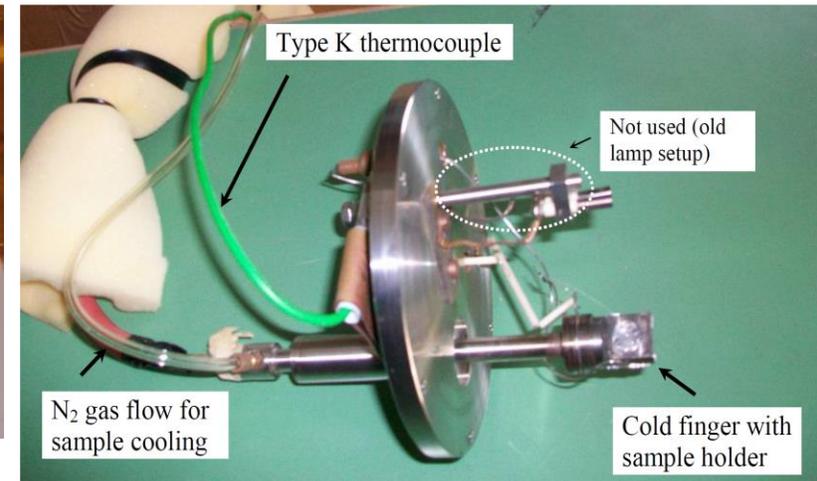
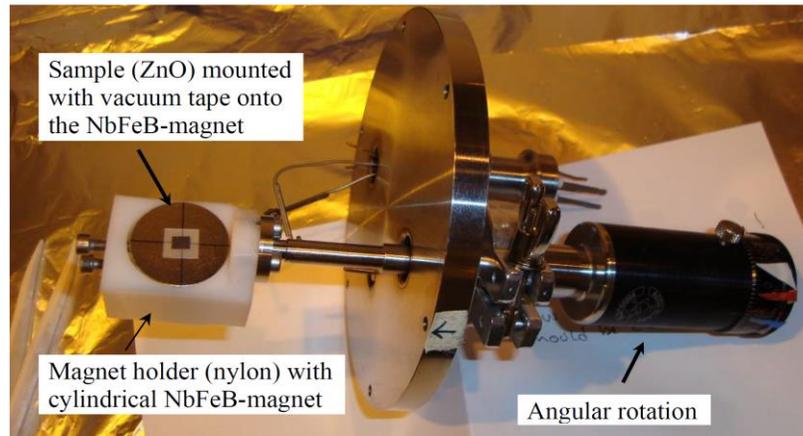
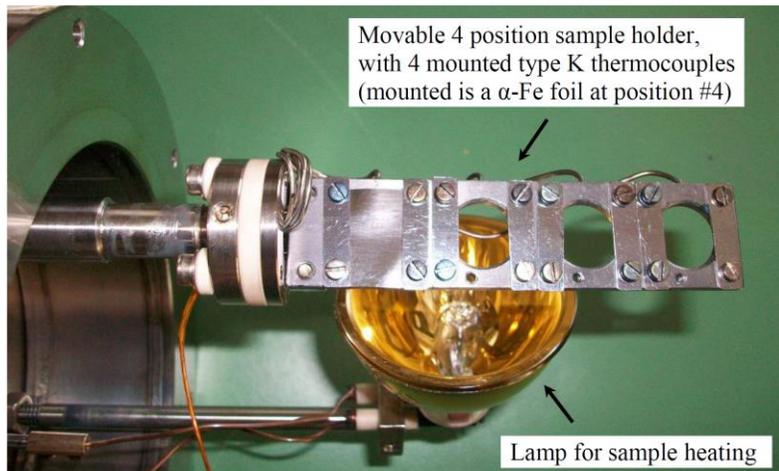
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[Physics beyond colliders at CERN: beyond the Standard Model working group report](#)

J Beacham et al 2020 *J. Phys. G: Nucl. Part. Phys.* 47 010501

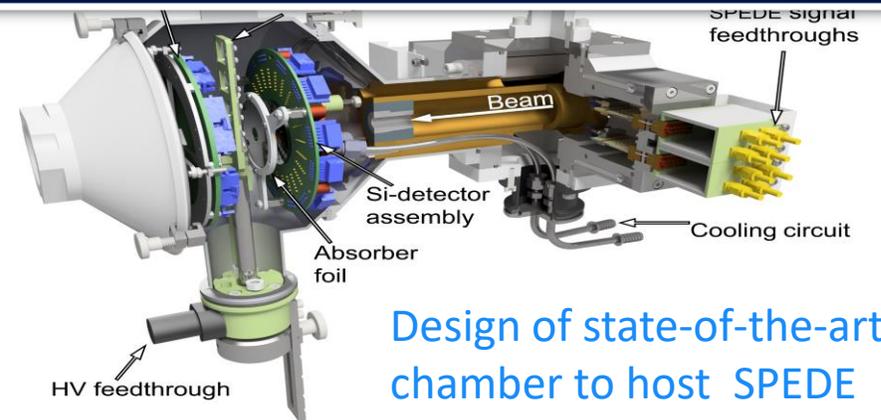
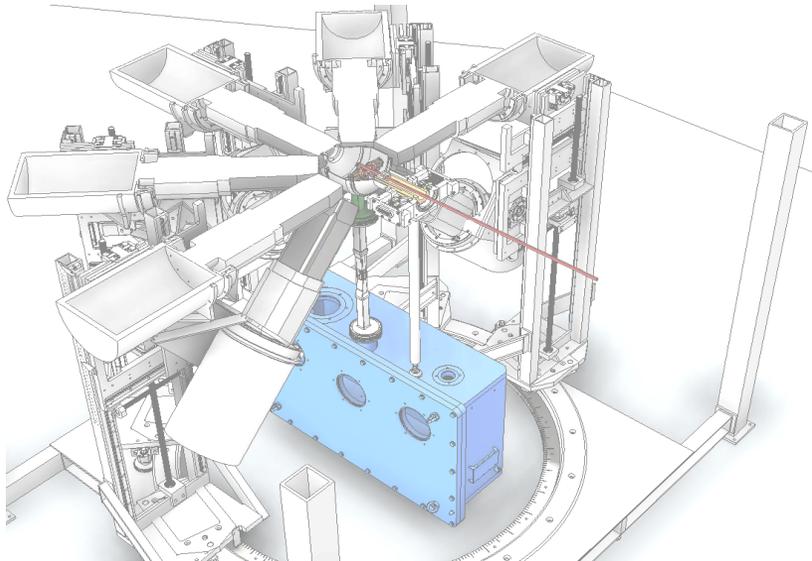
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Technology Development and Transfer

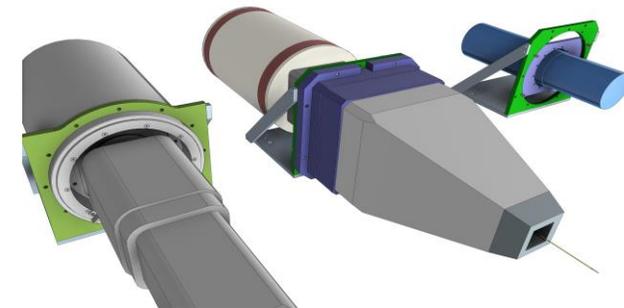


Technology Development and Transfer

ISOLDE Decay Station (IDS) @ CERN



Design of state-of-the-art chamber to host SPEDE electron spectrometer @ IDS



Design and manufacturing of flexible detector plates (HPGe, LaBr₃, Clover and BGOs) @ IDS

Technology Development and Transfer

Development of alpha emitting radionuclides at iThemba LABS using a copy of ISOLDE “FRONT-END” – target/ion-source radioactive-ion beam production station

Collaboration with Thomas Cocolios (KU Leuven) - member of CERN Medicis

Presently developing Terbium and Actinium beams using Front-End at iThemba LABS



SA-CERN 15 Year Celebrations

THANK YOU

