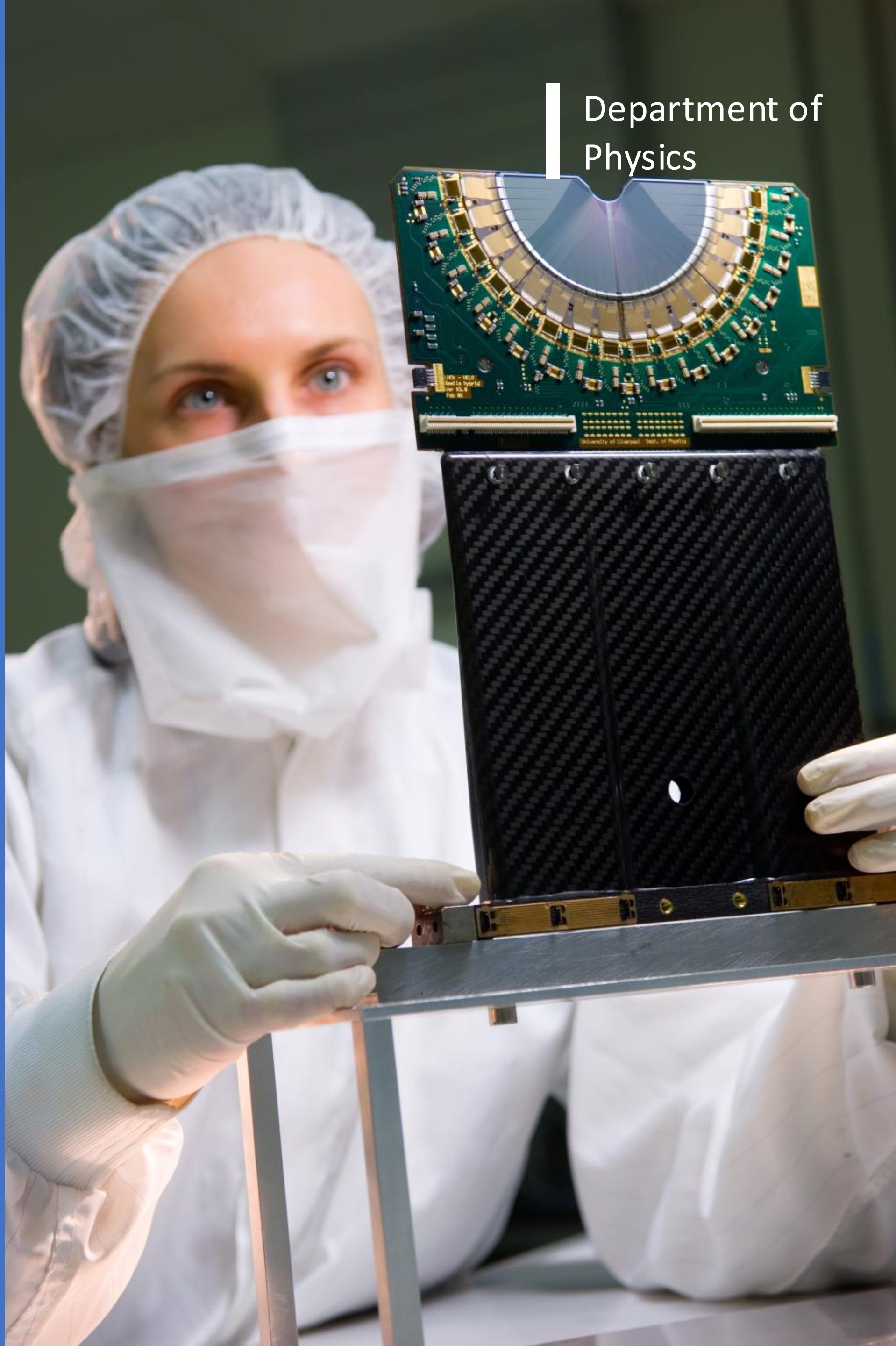
UNIVERSITY OF
LIVERPOOL

PHYSICS

AT THE UNIVERSITY OF LIVERPOOL

Prof Tim Veal

Head of Department


Department of Physics

UNIVERSITY OF LIVERPOOL

OUR DEPARTMENT

- UK Top 10 for research quality & environment (Research Excellence Framework 2021); key partner of CERN
- Academic Ranking of World Universities: Top 100 Globally, UK Top 10
- 50 academic staff
- >100 research staff
- 120 Postgraduate Research PhD students
- 120 Postgraduate Taught MSc students
- 360 Undergraduate students
- Physics research areas:

Astrophysics Medical Nuclear
Renewable Energy Biophysics Particle
Materials Accelerators

EQUITY, DIVERSITY AND INCLUSIVITY

- We hold a Juno Practitioner award in the Institute of Physics' flagship gender equality scheme

IOP Institute of Physics
Juno Practitioner

Physics Inclusion Award
IOP Institute of Physics

- We are working towards a Physics Inclusion Award, the IoP's new broader EDI scheme

- We recently hosted the Conference for Undergraduate Women and Non-binary Physicists (CUWiP+)

- Our PhD students and staff established the Women and Non-binary Doctoral Researchers in STEM

POSTGRADUATE RESEARCH TEACHING ASSISTANTS

For our BSc and MPhys undergraduate degree programmes in Physics, Physics with Nuclear Science, Physics with Medical Applications and Astrophysics, PhD students have the opportunity to teach in undergraduate laboratories and problem classes

PhD student teaching assistants are paid for teaching at ~£18/hour (option typically to do between 3 and 6 hours per week for 24 weeks per year)

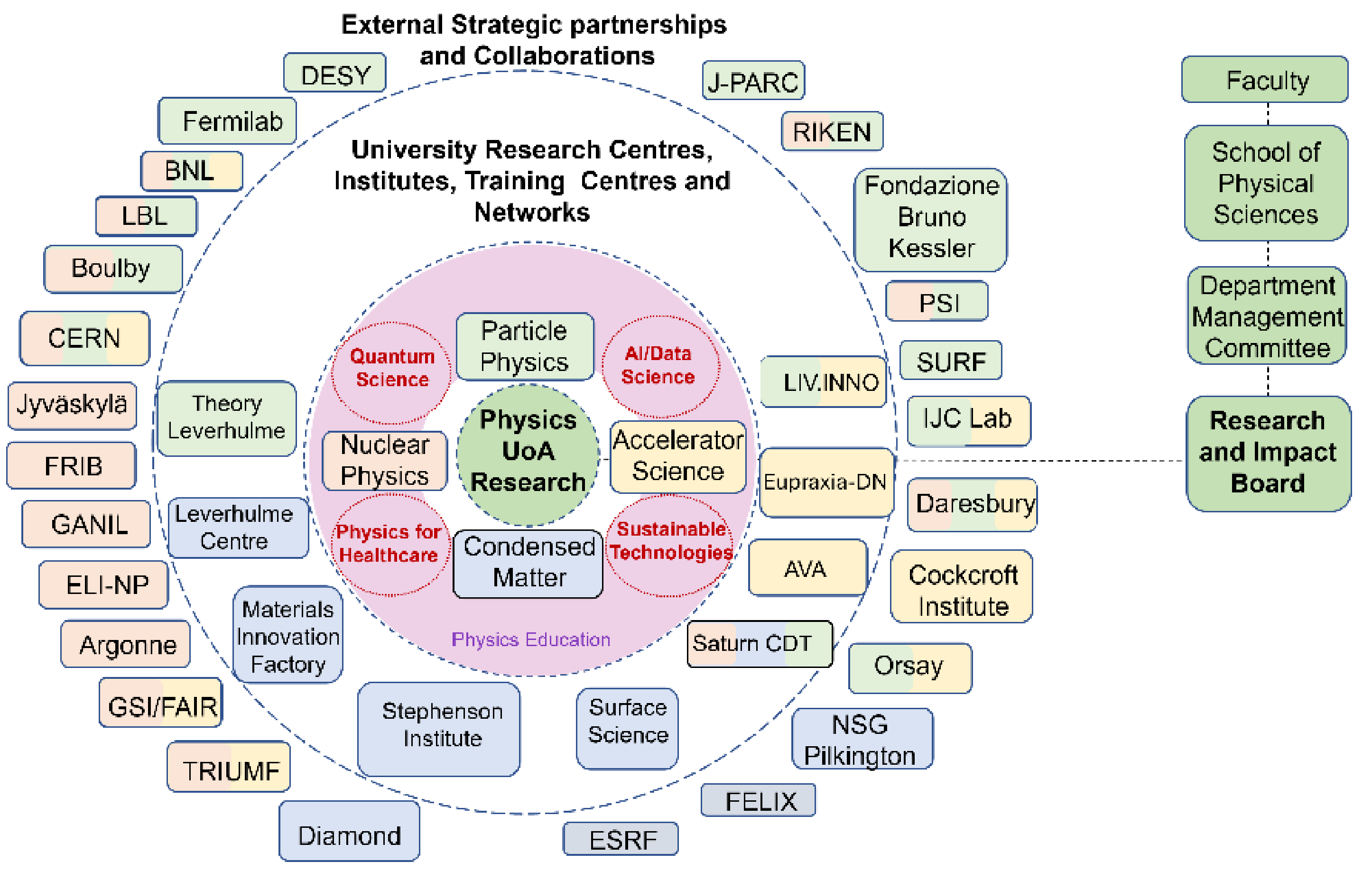
Opportunity to obtain Associate Fellowship of the Higher Education Academy

PHYSICS DEPARTMENT RESEARCH

Monica D’Onofrio

Head of Research & Impact, DHoD, Physics

Research in the Department at a glance



External Strategic partnerships and Collaborations

DESY
Fermilab
BNL
LBL
Boulby
CERN
Jyväskylä
FRIB
GANIL
ELI-NP
Argonne
GSI/FAIR
TRIUMF
Diamond
ESRF
FELIX
NSG Pilkington
Orsay
Cockcroft Institute
Daresbury
IJC Lab
SURF
PSI
Fondazione Bruno Kessler
RIKEN
J-PARC

University Research Centres, Institutes, Training Centres and Networks

Theory Leverhulme
Leverhulme Centre
Materials Innovation Factory
Stephenson Institute
Surface Science
Saturn CDT
AVA
Eupraxia-DN
LIV.INNO

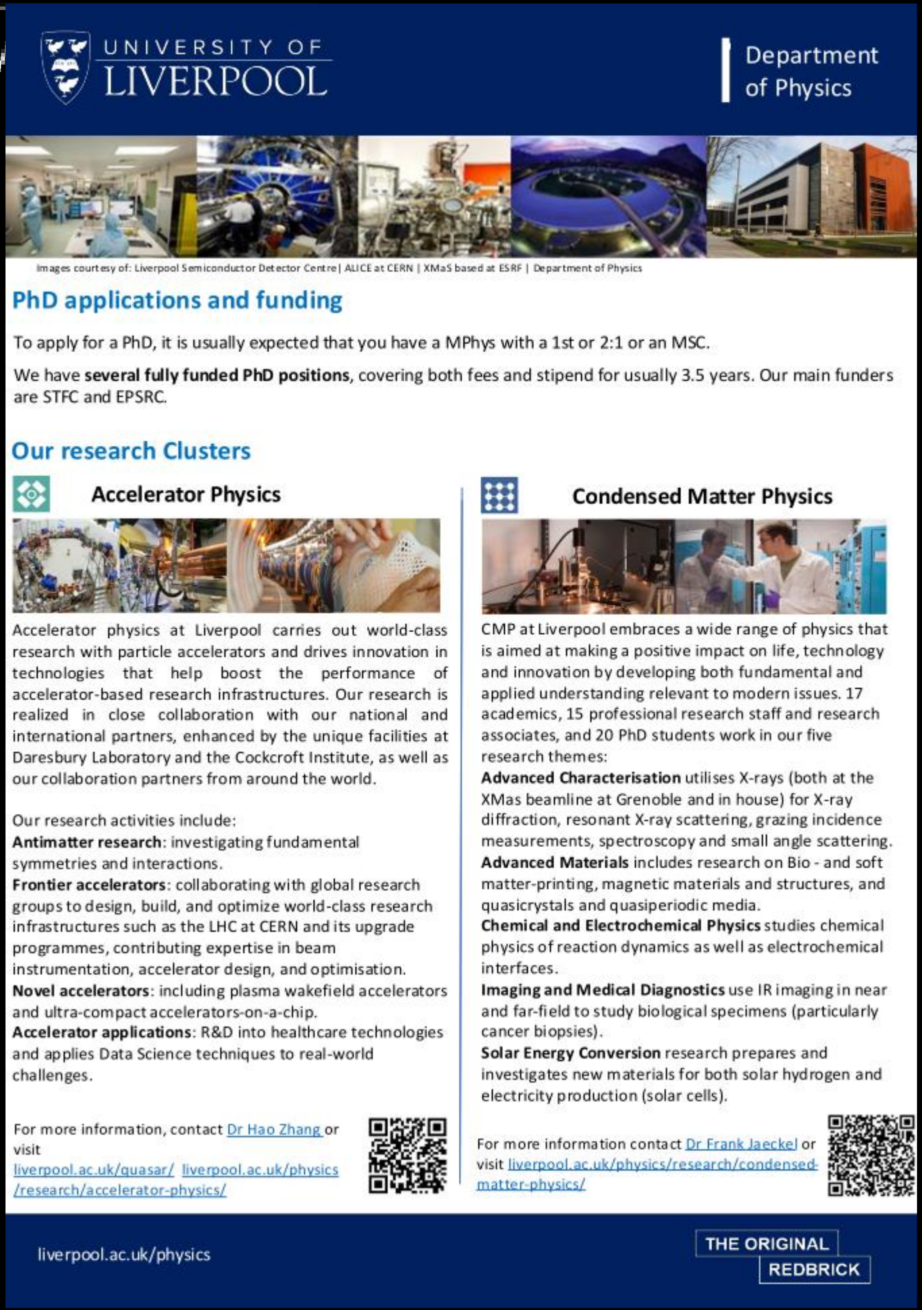
Physics UoA Research

Particle Physics
Nuclear Physics
Accelerator Science
Condensed Matter
Quantum Science
AI/Data Science
Physics for Healthcare
Sustainable Technologies
Physics Education

Faculty
School of Physical Sciences
Department Management Committee
Research and Impact Board

- **Research clusters:** Particle Physics, Nuclear Physics, Accelerator Science, Condensed Matter.
- Physics Education overarching (research and enhancement)
- Research in **AI/data science, quantum, sustainable technologies, medical physics** underpinned by all clusters

- **PhD students (~120)** enrolled in our programmes (in addition to STFC and EPSRC quota studentships: STFC CDT Innovation in Data Intensive Science (LIV.INNO), EPSRC CDT's on New and Sustainable Photovoltaics and Risk & Uncertainty, EU ITN Medical Accelerators and Antimatter Physics).



UNIVERSITY OF LIVERPOOL

Department of Physics

Images courtesy of: Liverpool Semiconductor Detector Centre| ALICE at CERN | XMaS based at ESRF | Department of Physics

PhD applications and funding

To apply for a PhD, it is usually expected that you have a MPhys with a 1st or 2:1 or an MSC.

We have **several fully funded PhD positions**, covering both fees and stipend for usually 3.5 years. Our main funders are STFC and EPSRC.

Our research Clusters

Accelerator Physics

Accelerator physics at Liverpool carries out world-class research with particle accelerators and drives innovation in technologies that help boost the performance of accelerator-based research infrastructures. Our research is realized in close collaboration with our national and international partners, enhanced by the unique facilities at Daresbury Laboratory and the Cockcroft Institute, as well as our collaboration partners from around the world.

Our research activities include:

Antimatter research: investigating fundamental symmetries and interactions.

Frontier accelerators: collaborating with global research groups to design, build, and optimize world-class research infrastructures such as the LHC at CERN and its upgrade programmes, contributing expertise in beam instrumentation, accelerator design, and optimisation.

Novel accelerators: including plasma wakefield accelerators and ultra-compact accelerators-on-a-chip.

Accelerator applications: R&D into healthcare technologies and applies Data Science techniques to real-world challenges.

For more information, contact Dr Hao Zhang or visit liverpool.ac.uk/quasar/ liverpool.ac.uk/physics/research/accelerator-physics/

Condensed Matter Physics

CMP at Liverpool embraces a wide range of physics that is aimed at making a positive impact on life, technology and innovation by developing both fundamental and applied understanding relevant to modern issues. 17 academics, 15 professional research staff and research associates, and 20 PhD students work in our five research themes:

Advanced Characterisation utilises X-rays (both at the XMas beamline at Grenoble and in house) for X-ray diffraction, resonant X-ray scattering, grazing incidence measurements, spectroscopy and small angle scattering.

Advanced Materials includes research on Bio - and soft matter-printing, magnetic materials and structures, and quasicrystals and quasiperiodic media.

Chemical and Electrochemical Physics studies chemical physics of reaction dynamics as well as electrochemical interfaces.

Imaging and Medical Diagnostics use IR imaging in near and far-field to study biological specimens (particularly cancer biopsies).

Solar Energy Conversion research prepares and investigates new materials for both solar hydrogen and electricity production (solar cells).

For more information contact Dr Frank Jaeckel or visit liverpool.ac.uk/physics/research/condensed-matter-physics/

liverpool.ac.uk/physics

THE ORIGINAL REDBRICK

UNIVERSITY OF LIVERPOOL

Department of Physics

Nuclear Physics

Nuclear Physics at Liverpool encompasses many areas of research that range from enhancing fundamental understanding of the laws of physics by driving it to the extremes, to creating a positive impact on present issues such as medical treatment and preservation of the environment.

Our fundamental science aims to understand how nuclei can support the highest values of angular momentum; how single-particle and collective structure of nuclei evolve near the drip lines; the phenomenon of reflection asymmetry and shape coexistence in nuclei; the behaviour of the heaviest nuclei; and the phase equilibria of hadronic matter at extreme energy densities.

We perform our research at accelerator laboratories around the world, including those in Canada, Finland, Germany, Italy, Switzerland (CERN) and the USA. In many cases it exploits instrumentation that we have developed, such as AGATA, ALICE and the ISOLDE Solenoidal Spectrometer. This expertise in developing novel instrumentation underpins our applied research through projects like SIGMA and GRI+.

For more information contact Prof Robert Page or visit liverpool.ac.uk/nuclear-physics

Physics Education

The Physics Education cluster studies how students learn physics and how teaching practices affect outcomes. Comprising 2 academic staff and 2 PhD students, current research focuses on using machine learning to analyse socio-demographic disparities in degree outcomes, exploring AI's role in education, examining how institutional culture and psychology shape student identity and belonging, and developing inclusive public engagement experiences.

For more information contact Dr Chris Edmonds or visit liverpool.ac.uk/physics/research/physics-education-research/

Particle Physics

Our particle physics cluster is one of the largest in the UK and we conduct research into a wide range of phenomena at facilities across the globe, including CERN, Fermilab, JPARC, Sandford, Kamioka and PSI. We specialise in physics analysis and the development and delivery of detectors. Our 23 academics, 64 research staff, and 37 PhD students work across areas including: The **ATLAS** experiment at the LHC played a leading role in the discover of the Higgs boson. We now deepen our understanding of the Higgs, search for new physics and develop detectors for the HL-LHC. This is complemented by the **FASER** experiment. **LHCb** studies the behaviour of B mesons and develops future trackers. We study **Neutrino** oscillations at **T2K, Hyper-Kamiokande, SBND** and **DUNE**, and search for neutrinoless double beta decay with **LEGEND**. Our direct **Dark Matter** searches include **LZ** and **Darkside**, and applications of quantum technologies at **Magis** and **AION**. We make precision measurements of **Muon** properties like **g-2** and search for rare decays at **Mu2e** and **Mu3e**. Our research is underpinned by our long-standing expertise in development of new detectors including next generation silicon detectors and liquid argon time projection chambers.

For more information contact Prof Neil McCauley or visit liverpool.ac.uk/physics/research/particle-physics/

From our current PhD students

Sinead Eley (Particle Physics, LIV.INNO)

"I've just completed my second year of my PhD working on dark sector searches with the FASER detector. Having completed my undergraduate degree at Liverpool, I felt comfortable here and knew it was somewhere that I would be supported during my PhD. We have a strong community feeling here where everyone is welcoming and happy to have a chat. There have been countless opportunities; one that stands out is WONDRS, a conference specifically for gender minorities in STEM, this really helped to address the imposter syndrome many of us face as researchers."

liverpool.ac.uk/physics

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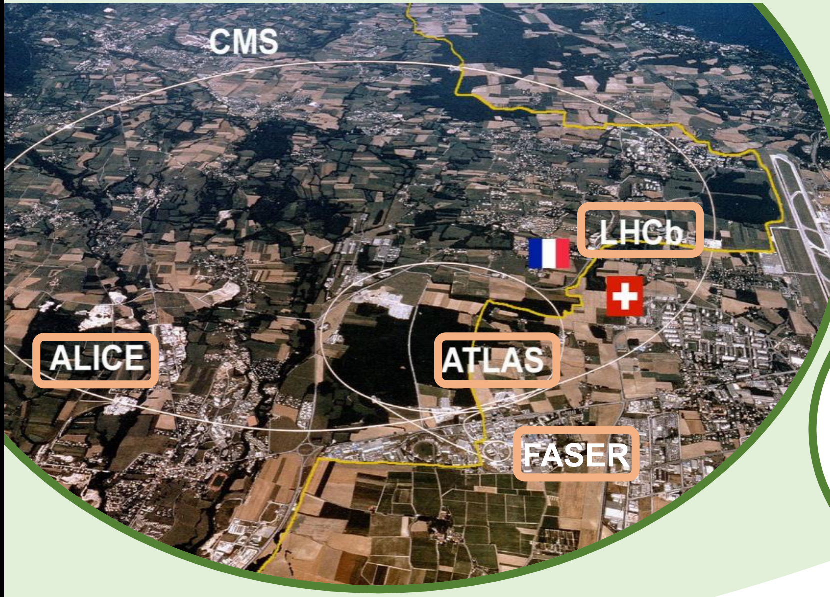
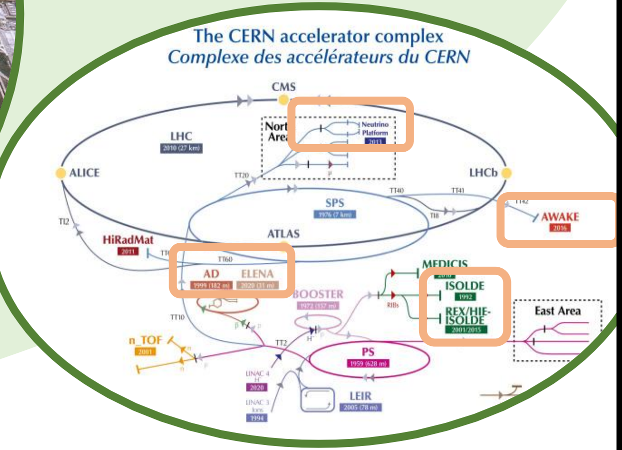
Liverpool @ CERN

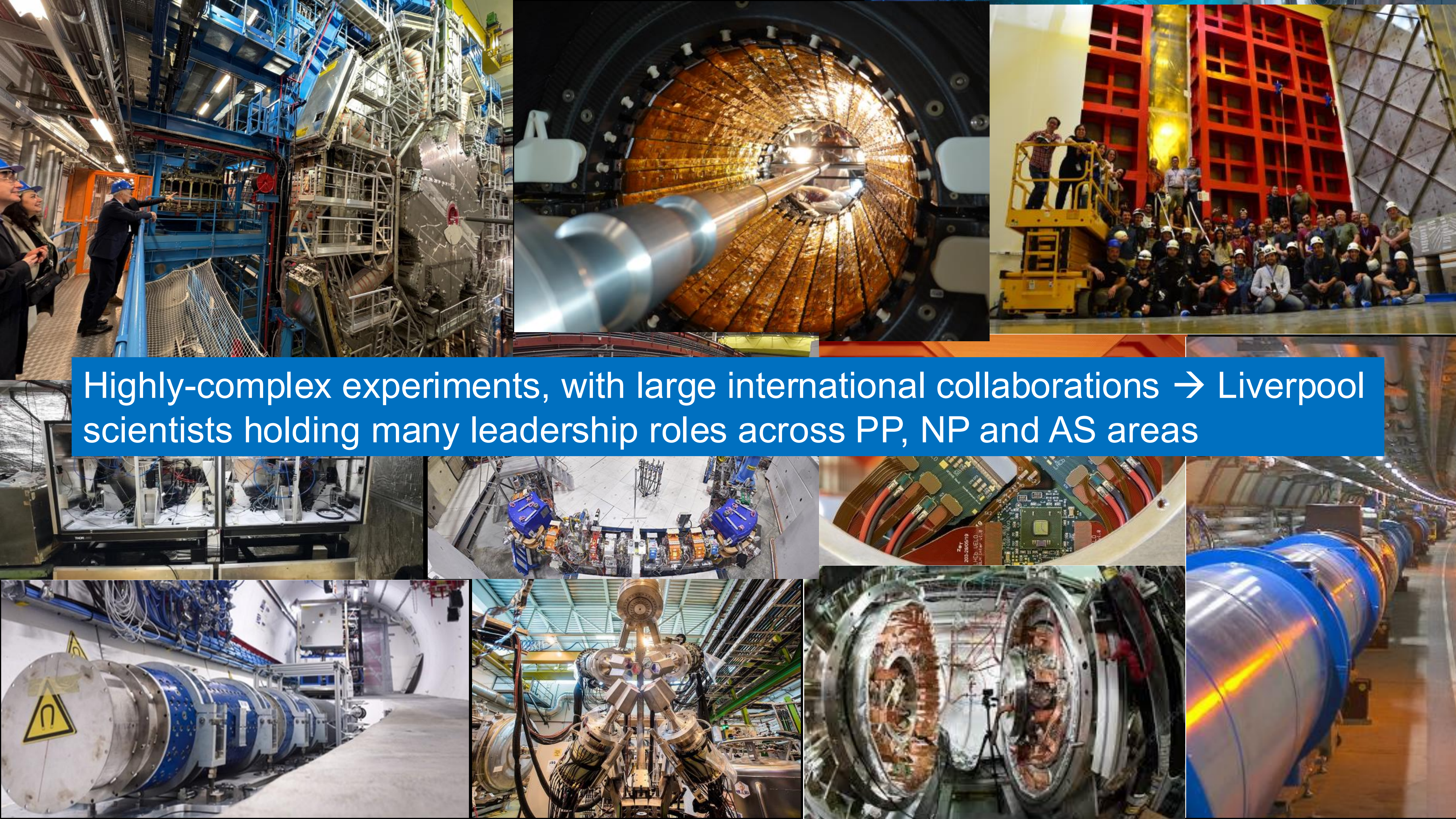




The Department of Physics is in the **top-25** list of CERN key collaborators.

- Build, upgrade, maintain, operate and exploit facilities and experiments in particle physics (**ATLAS, FASER, LHCb, neutrino platform DUNE/Ariadne, MUoNE**), nuclear physics (**ALICE, ISOLDE**) and accelerator physics (**AWAKE, AEGiS, ELENA, HL-LHC, FCC**)
- **~75%** of academic staff, researchers, engineers and technicians are engaged in CERN-related activities (and **more than 60 PhD students)**

We are engaged in several activities with CERN in **R&D** of new detectors, green technologies, large-scale data and AI, future facilities and more → **develop impact as an integral outcome of our research programme**

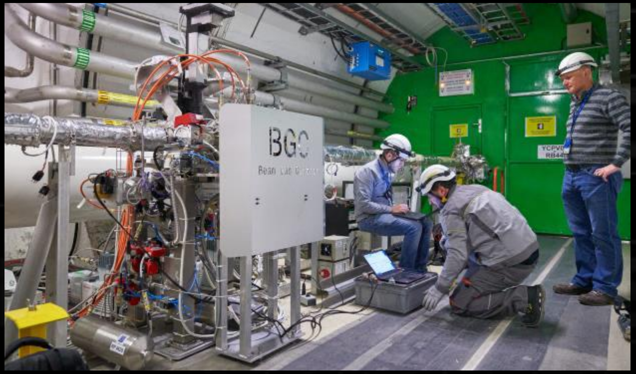


Highly-complex experiments, with large international collaborations → Liverpool scientists holding many leadership roles across PP, NP and AS areas

Beyond CERN: strategic partnerships

Liverpool, and CERN itself, is also a global partner of international and national labs

- Notable **international examples** are DESY and PSI in Europe, Fermilab, Brookhaven and Argonne in US, TRIUMF in Canada, RIKEN and J-PARC in Japan (we are also member of URA)
- National facilities include strong links and common activities with **Daresbury (silicon detectors, accelerator science)** as well as Boulby, NNL, NDA and Sellafield

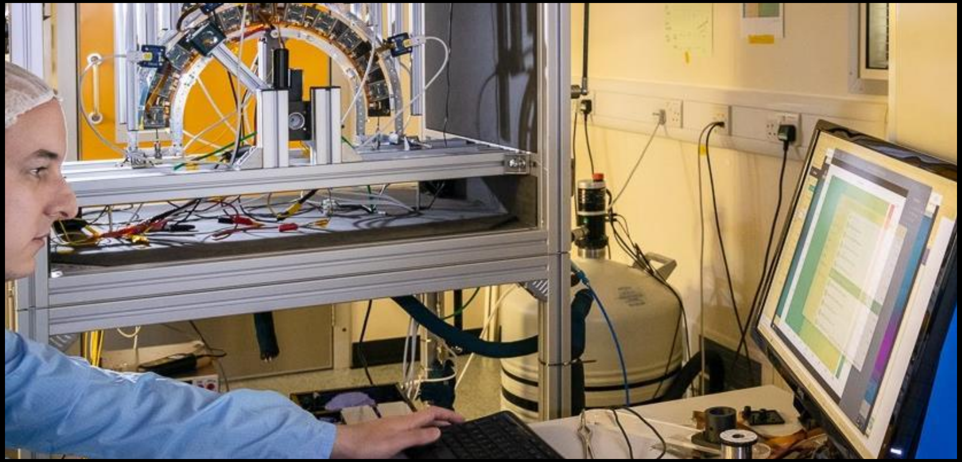


- **Detector Research & Development**: i.e. gamma-ray and neutron sensors → waste storage monitoring, security, environmental gamma-ray imaging

Local Laboratories and facilities

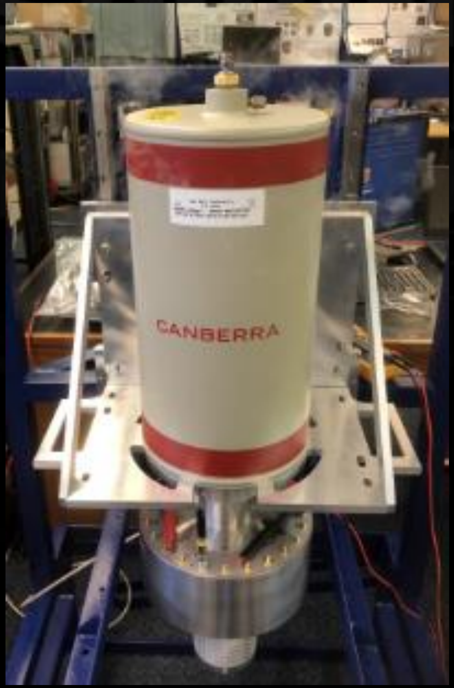
Longstanding and world-leading track record for the **development of detector technologies** and the construction of complex detector systems (silicon, liquid argon and germanium detectors, quantum sensors).

→ excellent local facilities



Liverpool Semiconductor Detector Centre

Detector Development Manufacturing Facility and Advanced Material lab



Nuclear Lab Detector Characterization Centre

Across-area activities

Four research themes of common interest:

- **Quantum**
- **Data science and AI**
- **Medical physics**
- **Sustainability**

Underpinning all our research – something you could engage with too!

Themes mapped within "research cluster" you will see later on. Some examples:

- Quantum --> Particle, Condensed Matter
- Data science and AI -> Particle, Accelerator
- Medical physics --> Nuclear, Condensed Matter, Accelerator Science
- Sustainability --> Condensed Matter, Nuclear, Particle

SPIRITED
CHALLENGING
INSPIRING
AMBITIOUS
SPIRITED
INSPIRING
CHALLENGING
AMBITIOUS
SPIRITED

Across-area activities

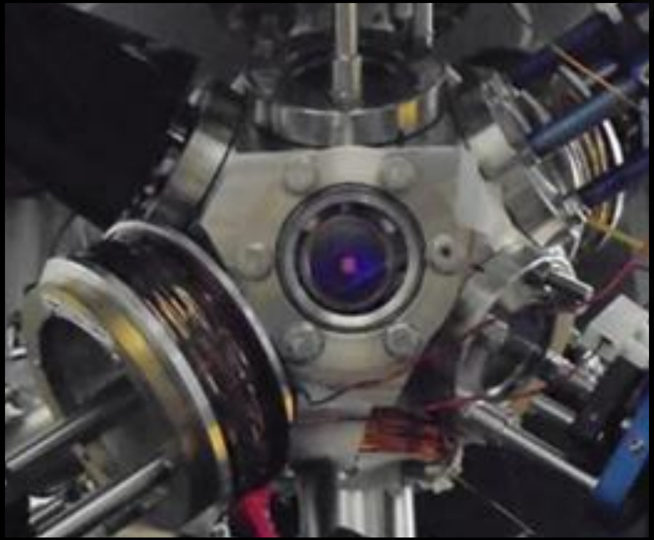
Four research themes of common interest:

- **Quantum**
- Data science and AI
- Medical physics
- Sustainability

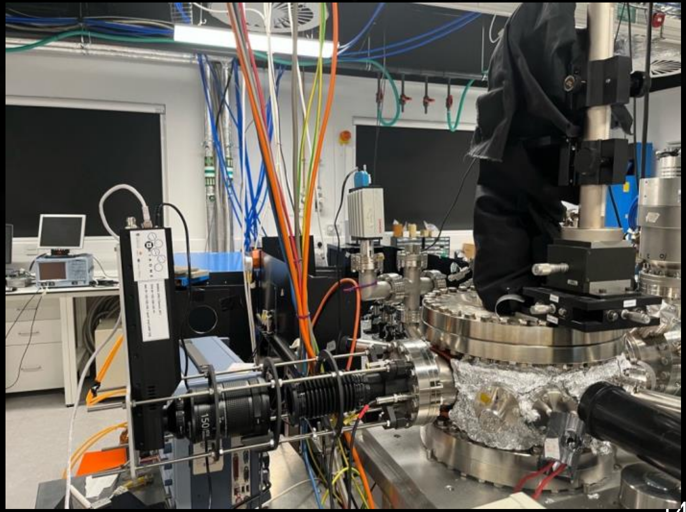
Underpinning all our research – something you could engage with too!

- **Quantum science** is an integral part of our research programme since more than a decade, with a strong focus on enabling novel fundamental physics experiments

Liverpool PP Laser laboratory, one of the few existing UK lab with in-house capability to develop **atom interferometry** devices



Cold chemical physics lab: study complex ion-neutral reaction systems at low temperature (cryogenic ion-trap)



Across-area activities

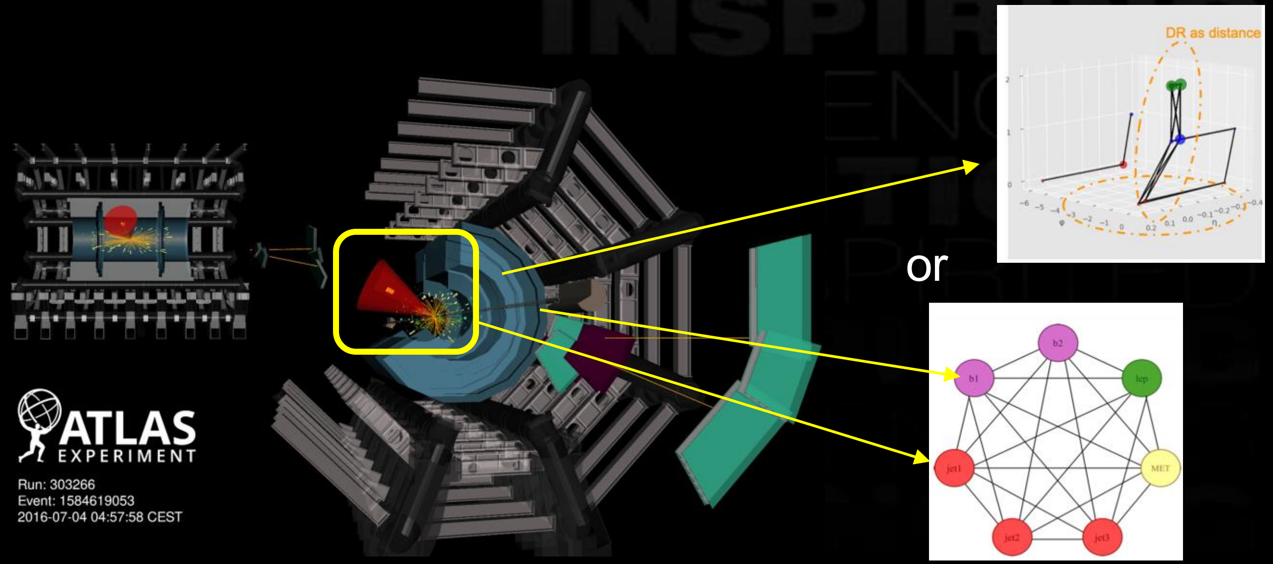
Large-scale data and AI underpins a lot of our research!

Four research themes of common interest:

- Quantum
- **Data science and AI**
- Medical physics
- Sustainability

Underpinning all our research – something you could engage with too!

Example in PP - ATLAS offline data analyses: → **event classification** and **process discrimination** in large and diverse datasets for discovery



LHCb data reconstruction: problem to be addressed → fast and efficient reconstruction of tracks in busy environment. ***How-to:*** ML-tracking on FPGAs algorithms, performing all the data organisation steps prior to a track fit being performed.

Across-area activities

Four research themes of common interest:

- Quantum
- Data science and AI
- **Medical physics**
- Sustainability

Underpinning all our research – something you could engage with too!

Lot of what we do can be relevant for healthcare

E.g. Cancer research: a decade of research on cancer by a dedicated research group within our department has resulted in the ability to predict the *prognosis* of oral cancer lesions by analysing infrared spectral images using machine learning.

How the device works…

A collaboration between the Head and Neck Centre and the department.

Also: exploring AI/ML applied to healthcare problems (offering of a PhD position will depend on further funding)

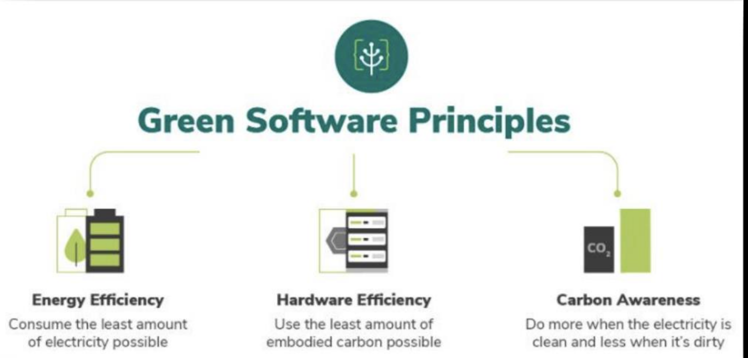
Across-area activities

Four research themes of common interest:

- Quantum
- Data science and AI
- Medical physics
- **Sustainability**

Underpinning all our research – something you could engage with too!

e.g. computing:



Green Software Principles

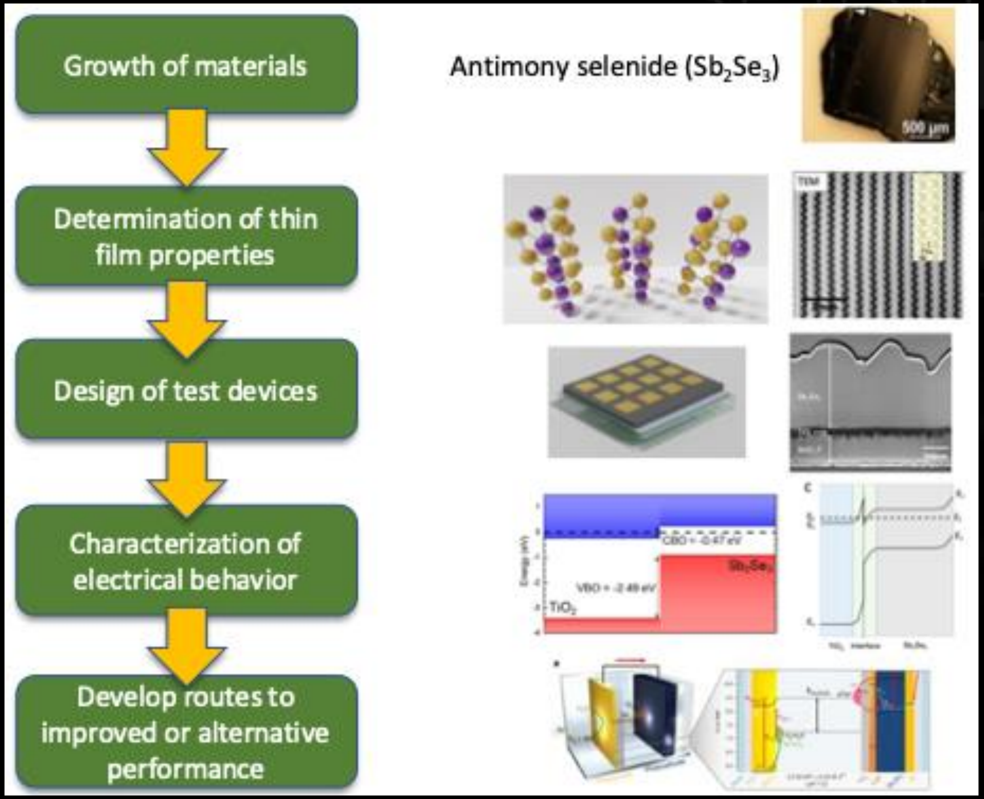
Energy Efficiency
Consume the least amount of electricity possible

Hardware Efficiency
Use the least amount of embodied carbon possible

Carbon Awareness
Do more when the electricity is clean and less when it's dirty

Sustainable technologies are at the core of several of our research – e.g. energy

Solar cell Devices research



Growth of materials

Determination of thin film properties

Design of test devices

Characterization of electrical behavior

Develop routes to improved or alternative performance

Antimony selenide (Sb_2Se_3)

PhD programmes

- Several other activities in close collaboration with STFC/Daresbury/Liverpool and with engagement of local industries in development
- Overarching importance of <u>training</u> skilled personnel for development of cutting-edge technologies
- Excellent programme in place for UG and PhD, underpinning all our research / impact activities

Major centre for doctoral training (up to 80 PhD students) in data intensive science, encompassing accelerator, particle and nuclear physics

Medical Physics and Clinical Scientific Computing MSc programmes where NHS staff are trained as clinical scientists. Collaboration Clatterbridge Cancer Centre, funded from the **PGT programmes**.

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Funded PhD Opportunities in the Physics Department at Liverpool

Dr Nikolaos Rompotis (Director of Postgraduate studies)

Dr Hao Zhang (Accelerator Physics)
Dr Frank Jaeckel (Condensed Matter)
Prof Robert Page (Nuclear Physics)
Prof Neil McCauley (Particle Physics)

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2026 PhD studentship positions

- When they start: 1st October 2026
- Topics cover 4 basic areas: Accelerator Science (AS), Condensed Matter Physics (CM), Nuclear Physics (NP) and Particle Physics (PP)

- Funding information:
  - Research Council Scholarships:
    - EPSRC (CM)
    - STFC (AP, NP, PP)
  - Project-specific funding or other sources
  - Eligibility: any student, but scholarships usually cover UK fees + quota for international students
  - Duration: usually fees + stipend for 3.5 years

Scholarship information

- Research Council Studentships usually cover:
  - UK tuition fees
  - Stipend of ~£20k pa (tax free)
  - Research support £3.5k over the PhD *(but more can be awarded)*
  - Depending on the project possibility for a long-term attachment funding to work at experiments abroad may be available
  - They are the same across the UK
- Other scholarships or bursaries are available, see link:

https://www.liverpool.ac.uk/study/postgraduate-research/fees-and-funding/scholarships-and-awards/

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What the University offers to PhD students

- Office/lab space
- Computing access
  - Laptop loan & access to research group computing facilities
- Access to expertise: supervisory team of at least 2 staff members
- Skills training
  - Subject specific and general training; chance to demonstrate (paid) and earn teaching qualification

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Structure of the PhD

- Year 1
  - PhD specific training (usually up to Christmas, but depends on the project/research group)
  - Start of the project; First-year report, including presentation and viva
- Year 2
  - Research; general skills training; thesis plan; long term attachment to experiments (where appropriate)
- Years 3+4
  - Main thesis work, publication(s), thesis writing; viva and graduation

According to the university regulations you need to submit your thesis within 4 years from your initial registration

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PhD students at Liverpool now

- Currently we have in Physics about 120 PhD students
- Most accelerator science students are based at the Cockcroft institute
- Condensed matter students are based on SIRE, Surface Science or in Oliver Lodge Laboratory (depending on project and team)
- Nuclear and Particle physics students are in Oliver Lodge Laboratory
  - Depending on project/experiments, they might be based at international labs for some time
- We have together with us a few PhD students in this event, feel free to ask them questions

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How to apply for a funded PhD

- Apply following the instructions appearing here:

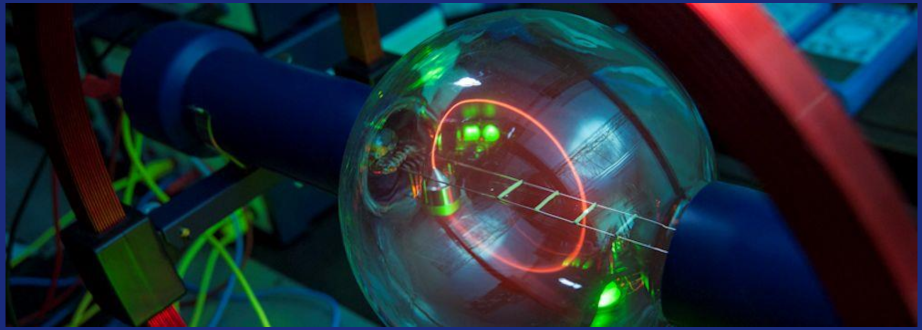
  https://www.liverpool.ac.uk/study/postgraduate-research/how-to-apply/
- In the application there is an entry to write the project/field you are interested in: you don't need to write a research proposal
- As supervisor include the contact for the particular research cluster the PhD is in

  - Accelerator Science: Dr Hao Zhang, Hao.Zhang3@liverpool.ac.uk
  - Condensed Matter: Dr Frank Jaeckel, Frank.Jaeckel@liverpool.ac.uk
  - Nuclear Physics: Prof Robert Page, R.D.Page@liverpool.ac.uk
  - Particle Physics: Prof Neil McCauley, N.McCauley@liverpool.ac.uk

What funded PhDs I can apply for?

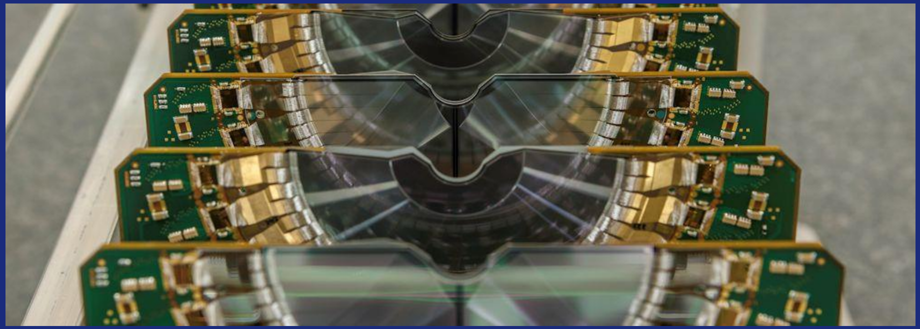
Accelerator Physics

Condensed Matter



Nuclear Physics

Particle Physics



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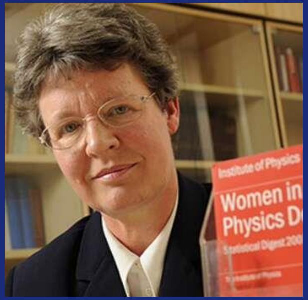

Bell Burnell Graduate Scholarship Fund

https://www.iop.org/about/support-grants/bell-burnell-fund

"An innovative fund instigated by leading physicist Professor Dame Jocelyn Bell Burnell and the Institute of Physics to encourage greater diversity in physics by assisting PhD physics students from underrepresented groups."

We have been very successful in the past with students who applied and got funding from this scheme. Recent recipients from our department:

Conor McPartland (final year Particle Physics):
https://www.iop.org/about/support-grants/bell-burnell-fund/2024-awardees/conor-mcpartland

Ellen Oldershaw (second year Education):

https://www.iop.org/about/support-grants/bell-burnell-fund/2024-awardees/ellen-oldershaw

Robyn Maxwell (first year Education):
https://www.iop.org/about/support-grants/bell-burnell-fund/2025-awardees/lewis-maxwell

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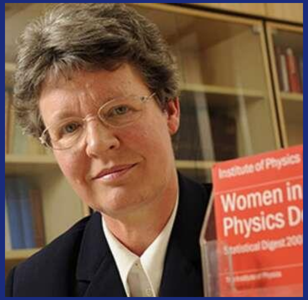

Bell Burnell Graduate Scholarship Fund

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Bell Burnell scheme does not restrict you what you study. If you are from an underepresented group or study something related to the scope of scholarship let us know.

There are institute quota: only up to 2 students per institute from which one must be external. It covers **less than 50%** of the cost of the scholarship and **we do not have any more a standard mechanism to fund the rest**. Before you formally express interest talk to your potential supervisor to ensure they can provide funding from other sources.

Send me (rompotis@liverpool.ac.uk) a proposal by December 12th and we will get back to you as soon as possible with enough time to prepare the application that has deadline January 19

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Visit our webpage for more information

Including our Postgraduate Research Flier with more information about our research and our PhD students

UNIVERSITY OF LIVERPOOL

Access this online here:

Department of Physics

Postgraduate Research Special : Open Day 27/11/2025, 17:00

Department of Physics Newsletter

"Welcome to our Postgraduate Opportunities Event! Our department is committed to providing all our students the opportunity to realise their maximum potential as physicists. I hope that you enjoy both the event and reading this special Newsletter. For more information about our Department please visit our website or get in touch with me at any time!" Prof Tim Veal, *Head of Department*

World-leading Research

Our research is carried out across research clusters, **Accelerator Science**, **Condensed Matter**, **Nuclear Physics**, **Particle Physics,** underpinned by continuous enhancements in **Physics Education** and transversal activities and work on cutting edge technologies in fields such as **artificial intelligence**, renewable energy and **sustainable technologies**, innovative materials, semiconductor and **quantum** sensors, and **medical physics**. Through a programme of **exploration** and **discovery**, we are addressing the most fundamental questions in physics. Our staff contribute to – and often lead – experiments in Liverpool and at international laboratories like CERN, Fermilab, and ESRF. As a PhD student, you will be a crucial part in this work.

The most recent Research Excellence Framework assessment (in 2021) placed us amongst the **UK's top 10 physics departments** for our research outputs and the quality of our research environment.

Prof Monica D'Onofrio, *Head of Research*

What it's like being a PhD student

Apply for one *of* **our fully funded PhD positions** to join a research community of more than 100 PhD students!

As a PhD student you will learn how to perform research both independently and as a part of a research group. You may work for large or small international collaborations, and you may have opportunities to take long-term attachments in overseas laboratories like CERN. During year 1, you will attend both subject specific and wider skill training. You will have the chance to attend seminars, go to schools and conferences and participate in undergraduate teaching. Within 4 years, you will have to submit a thesis for examination .

For general inquiries about out PhD programme please contact our Postgraduate Research Director, Dr Nikos Rompotis

Join our Postgraduate Open Day to learn more!

Thursday 27 November 2025, 17:00, Leo Carrol Suite and online

liverpool.ac.uk/physics
@livuniphysics
physics@liverpool.ac.uk

THE ORIGINAL REDBRICK

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Department of Physics

Images courtesy of: Liverpool Semiconductor Detector Centre | ALICE at CERN | XMaS based at ESRF | Department of Physics

PhD applications and funding

To apply for a PhD, it is usually expected that you have a MPhys with a 1st or 2:1 or an MSC.

We have **several fully funded PhD positions**, covering both fees and stipend for usually 3.5 years. Our main funders are STFC and EPSRC.

Our research Clusters

Accelerator Physics

Accelerator physics at Liverpool carries out world-class research with particle accelerators and drives innovation in technologies that help boost the performance of accelerator-based research infrastructures. Our research is realized in close collaboration with our national and international partners, enhanced by the unique facilities at Daresbury Laboratory and the Cockcroft Institute, as well as our collaboration partners from around the world.

Our research activities include:
Antimatter research: investigating fundamental symmetries and interactions.
Frontier accelerators: collaborating with global research groups to design, build, and optimize world-class research infrastructures such as the LHC at CERN and its upgrade programmes, contributing expertise in beam instrumentation, accelerator design, and optimisation.
Novel accelerators: including plasma wakefield accelerators and ultra-compact accelerators-on-a-chip.
Accelerator applications: R&D into healthcare technologies and applies Data Science techniques to real-world challenges.

For more information, contact Dr Hao Zhang or visit liverpool.ac.uk/quasar/ liverpool.ac.uk/physics/research/accelerator-physics/

Condensed Matter Physics

CMP at Liverpool embraces a wide range of physics that is aimed at making a positive impact on life, technology and innovation by developing both fundamental and applied understanding relevant to modern issues. 17 academics, 15 professional research staff and research associates, and 20 PhD students work in our five research themes:
Advanced Characterisation utilises X-rays (both at the XMas beamline at Grenoble and in house) for X-ray diffraction, resonant X-ray scattering, grazing incidence measurements, spectroscopy and small angle scattering.
Advanced Materials includes research on Bio - and soft matter-printing, magnetic materials and structures, and quasicrystals and quasiperiodic media.
Chemical and Electrochemical Physics studies chemical physics of reaction dynamics as well as electrochemical interfaces.
Imaging and Medical Diagnostics use IR imaging in near and far-field to study biological specimens (particularly cancer biopsies).
Solar Energy Conversion research prepares and investigates new materials for both solar hydrogen and electricity production (solar cells).

For more information contact Dr Frank Jaeckel or visit liverpool.ac.uk/physics/research/condensed-matter-physics/

liverpool.ac.uk/physics

THE ORIGINAL REDBRICK

UNIVERSITY OF LIVERPOOL

Department of Physics

Nuclear Physics

Nuclear Physics at Liverpool encompasses many areas of research that range from enhancing fundamental understanding of the laws of physics by driving it to the extremes, to creating a positive impact on present issues such as medical treatment and preservation of the environment.

Our fundamental science aims to understand how nuclei can support the highest values of angular momentum; how single-particle and collective structure of nuclei evolve near the drip lines; the phenomenon of reflection asymmetry and shape coexistence in nuclei; the behaviour of the heaviest nuclei; and the phase equilibria of hadronic matter at extreme energy densities.

We perform our research at accelerator laboratories around the world, including those in Canada, Finland, Germany, Italy, Switzerland (CERN) and the USA. In many cases it exploits instrumentation that we have developed, such as AGATA, ALICE and the ISOLDE Solenoidal Spectrometer. This expertise in developing novel instrumentation underpins our applied research through projects like SIGMA and GRI+.

For more information contact Prof Robert Page or visit liverpool.ac.uk/nuclear-physics

Physics Education

The Physics Education cluster studies how students learn physics and how teaching practices affect outcomes. Comprising 2 academic staff and 2 PhD students, current research focuses on using machine learning to analyse socio-demographic disparities in degree outcomes, exploring AI's role in education, examining how institutional culture and psychology shape student identity and belonging, and developing inclusive public engagement experiences.

For more information contact Dr Chris Edmonds or visit liverpool.ac.uk/physics/research/physics-education-research/

Particle Physics

Our particle physics cluster is one of the largest in the UK and we conduct research into a wide range of phenomena at facilities across the globe, including CERN, Fermilab, JPARC, Sandford, Kamioka and PSI. We specialise in physics analysis and the development and delivery of detectors. Our 23 academics, 64 research staff, and 37 PhD students work across areas including: The **ATLAS** experiment at the LHC played a leading role in the discover of the Higgs boson. We now deepen our understanding of the Higgs, search for new physics and develop detectors for the HL-LHC. This is complemented by the **FASER** experiment. **LHCb** studies the behaviour of B mesons and develops future trackers. We study **Neutrino** oscillations at **T2K, Hyper-Kamiokande, SBND** and **DUNE**, and search for neutrinoless double beta decay with **LEGEND**. Our direct **Dark Matter** searches include **LZ** and **Darkside**, and applications of quantum technologies at **Magis** and **AION**. We make precision measurements of **Muon** properties like **g-2** and search for rare decays at **Mu2e** and **Mu3e**. Our research is underpinned by our long-standing expertise in development of new detectors including next generation silicon detectors and liquid argon time projection chambers.

For more information contact Prof Neil McCauley or visit liverpool.ac.uk/physics/research/particle-physics/

From our current PhD students

Sinead Eley (Particle Physics, LIV.INNO)

"I've just completed my second year of my PhD working on dark sector searches with the FASER detector. Having completed my undergraduate degree at Liverpool, I felt comfortable here and knew it was somewhere that I would be supported during my PhD. We have a strong community feeling here where everyone is welcoming and happy to have a chat. There have been countless opportunities; one that stands out is WONDRS, a conference specifically for gender minorities in STEM, this really helped to address the imposter syndrome many of us face as researchers."

liverpool.ac.uk/physics

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Department of Physics

More from our current PhD students

Qiyuan Xu (Accelerator Science)

"I am from China, previously a XJTLU student and currently a third-year PhD student in Accelerator Science. My research focuses on applying machine learning in beam diagnostics specifically develop a radiation-tolerant, remote beam imaging system. The department offers a very friendly and diverse environment with strong research support. I have had the opportunity to work at CERN and participate in international conferences and events with students and researchers from around the world. Overall, it has been a fantastic and truly enjoyable journey."

Baltazar Guedes (Condensed Matter)

"I am a third-year condensed matter physics PhD student, working with in-situ x-ray and electrochemical characterisation of materials, to obtain information on the structure changes of electrodes and electrolytes in electrochemical environments. Having spent my under-graduate years at the university and continuing with my PhD, both the university and city have been a friendly and welcoming place that I am more than happy to be working at. The department is very diverse and there is always something exciting to discuss with peers. Collaborations across the university enable to do research in ways we have never expected!"

Equality, Diversity and Inclusion

We are committed to equality, diversity, and inclusion (EDI). Our department is a JUNO practitioner (the IOP's flagship gender equality award) and we hold an Athena Swan silver award. The university has a Race Equality Charter bronze award and is part of Disability Confident and Stonewall Diversity Champions.

EDI in our department is led by staff and student champions. Recent activities include pursuing the IOP inclusion award and hosting the Conference for Undergraduate Women and Non-Binary Physicists. Postgraduate students play a crucial role in EDI as members of the EDI champions and in 2024 developed and delivered the first annual Woman and Non-binary Doctoral Researchers in STEM, WONDERS, conference.

We strive to help all students reach their potential, regardless of any disabilities or health conditions. Our inclusive programmes offer personalised support plans. If you have any questions, email the disability support team: disteam@liverpool.ac.uk

IOP Institute of Physics Juno Practitioner

Athena SWAN

Race Equality Charter

Meet some of our alumni

Dr Julia Tena Vidal

Júlia did her PhD in the Particle Physics group and the LIV.DAT CDT. She received the best PhD Award in 2023 for her outstanding work modelling neutrino interactions with matter. She is now working as a post-doctoral research assistant at the Tel Aviv University's Particle Physics Group.

Dr Amir Salehilashkajani

Amir did his thesis in our Accelerator Physics group working on beam monitoring. His device was installed at CERN's Large Hadron Collider in 2022. He is now a research scientist at CoMind, developing non-invasive brain imaging methods for patients with traumatic brain injuries.

Dr Jaimie Platt

Jaimie graduated from her Nuclear Physics Ph.D. investigating the feasibility of a novel gamma-ray imaging system for characterising radioactive waste in 2021. She now works as a Decommissioning Characterisation Consultant at Amentum.

Dr Jake Diprose

Jake's did his PhD in the Condensed Matter group, working in chemical dynamics. His research centred on investigating the chemical physics of ion molecule reactions under cold and controlled conditions. He is currently continuing his research at the University of Liverpool as a postdoctoral research associate.

A warm welcome from our Postgraduate Research team!

liverpool.ac.uk/physics

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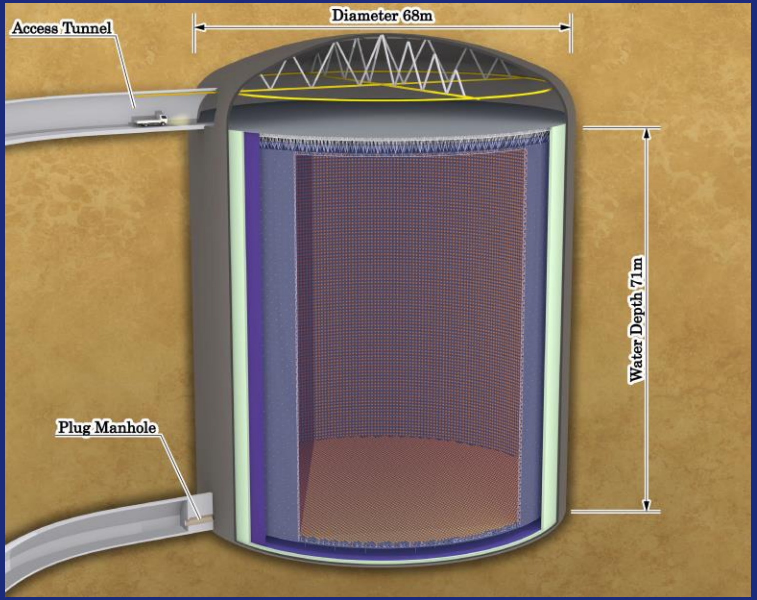
Naomi Foster

- 2nd year PhD student – Particle Physics Group
- MPhys University of Liverpool 2020-2024
- Supervised by Prof. Neil McCauley and Dr. Sam Jenkins
- I work on the neutrino experiment Hyper-Kamiokande, which is the successor to Super-Kamiokande and T2K located in Japan

My Work

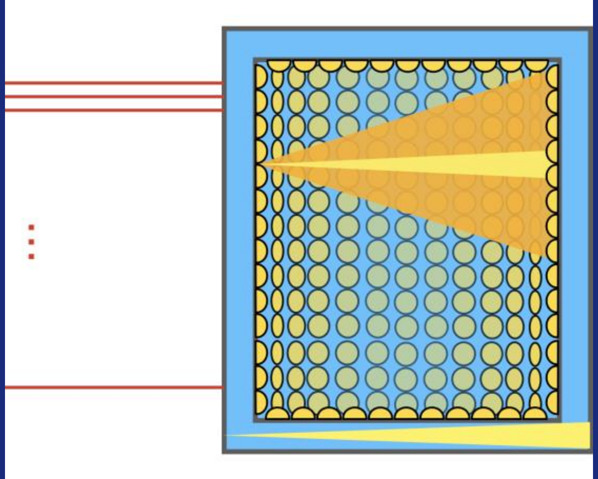


What it will look like when built - 2028

What it looks like now - July 2025 (I am in this picture!)

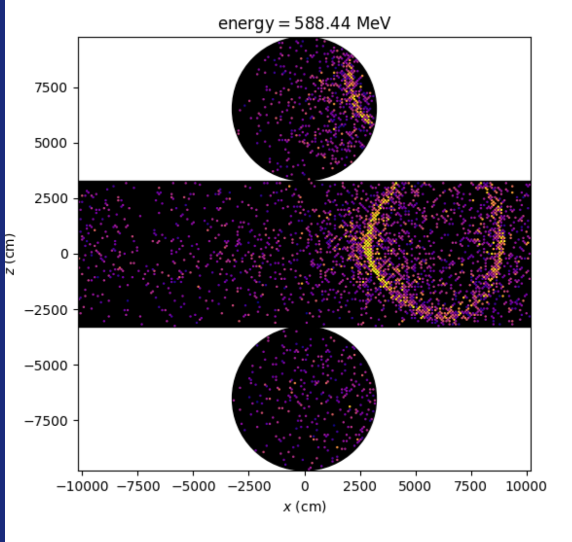
UK Light Injection System

I'm working on a PMT calibration with our test lights sources.



GNN Event Reconstruction

I'm also improving particle reconstruction, particle type and kinematics, using machine learning tools.



New Experiences

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Nuclear Physics

Contact: Prof Robert Page

R.D.Page@liverpool.ac.uk

“”

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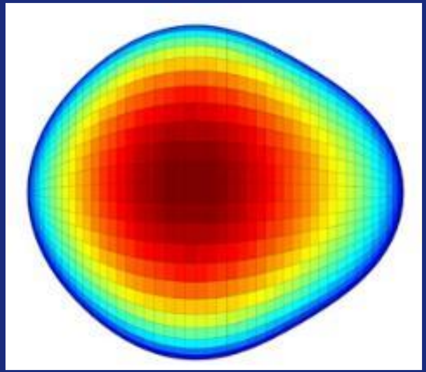
Nuclear physics group

http://www.liv.ac.uk/physics/research/nuclear-physics/

- ~30 PhD students, ~10 PhD supervisors
- Projects ranging from study of exotic nuclei to applied nuclear physics
- Research usually in collaboration with other Universities from the UK & overseas
- Sometimes with industry too.
- Many experiments at the University of Jyvaskyla (Finland), GSI (Germany), CERN (Switzerland), RIKEN (Japan), INFN (Italy), Argonne (USA) and TRIUMF (Canada)
- Admissions contact: Prof. Robert Page, R.D.Page@liverpool.ac.uk

GSI
UNIVERSITY OF JYVÄSKYLÄ
TRIUMF
Argonne NATIONAL LABORATORY
CERN
INFN
RIKEN



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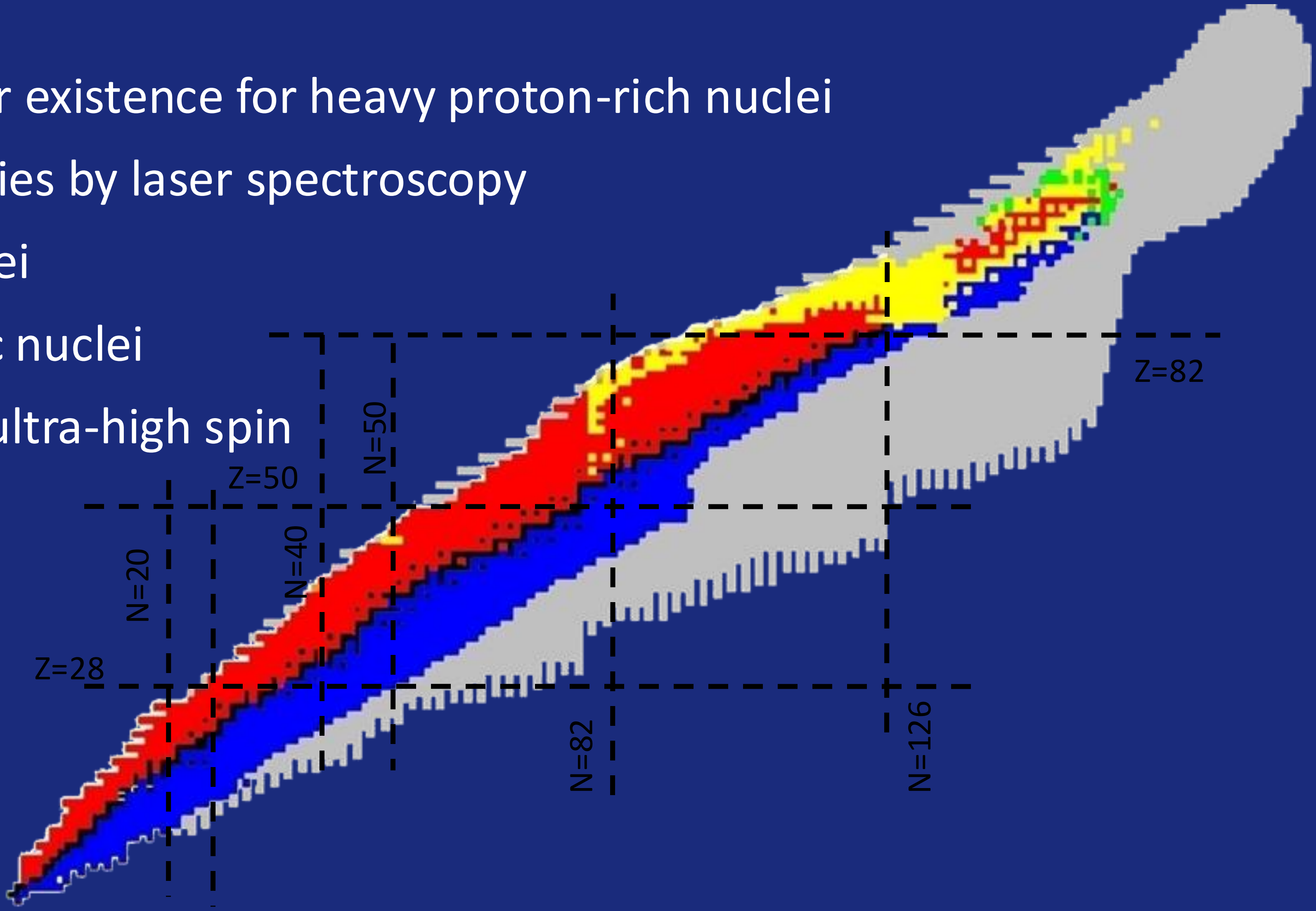
Our Research
(nuclei under extreme conditions)

- Exploring the limits of nuclear existence for heavy proton-rich nuclei
- Ground and isomeric properties by laser spectroscopy
- Structure of superheavy nuclei
- Collective behaviour of exotic nuclei
- Gamma-ray spectroscopy at ultra-high spin
- Heavy ion collisions (ALICE)
- Applied nuclear physics



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Experiments at international facilities

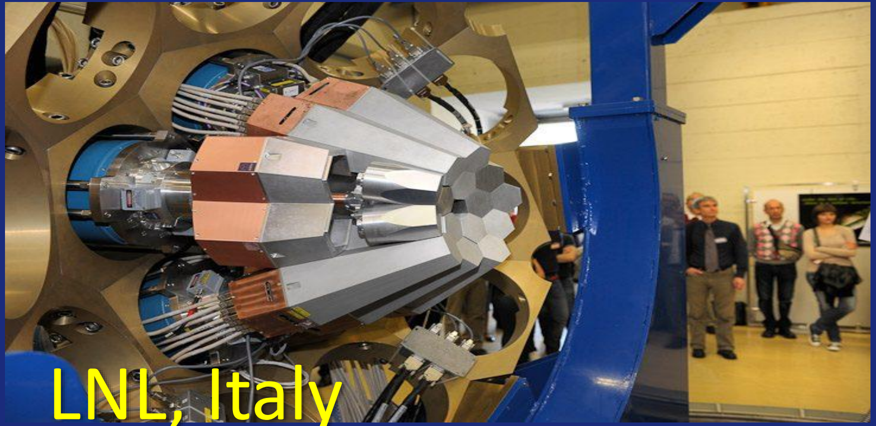

TRIUMF,


University of Jyvaskyla, Finland


GANIL, France


CERN, Switzerland


GSI, Germany

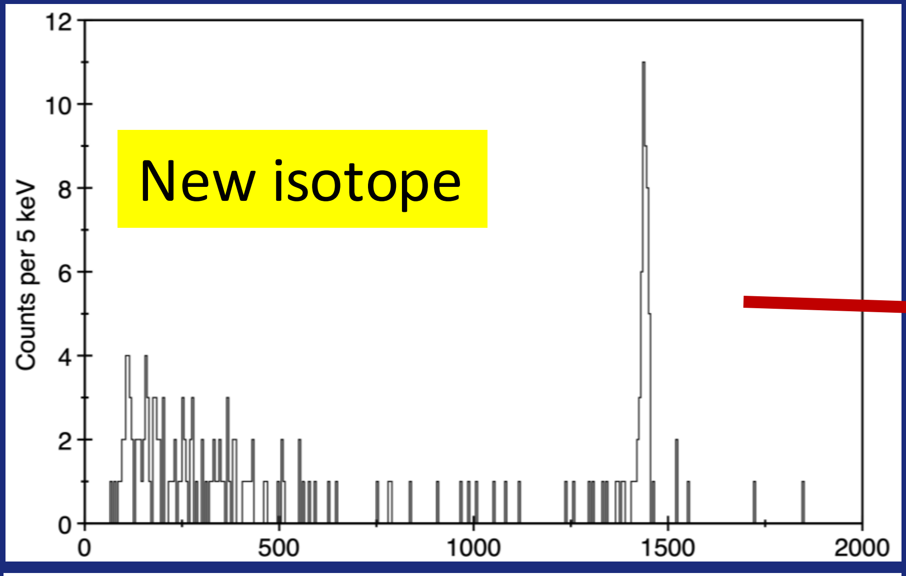

LNL, Italy

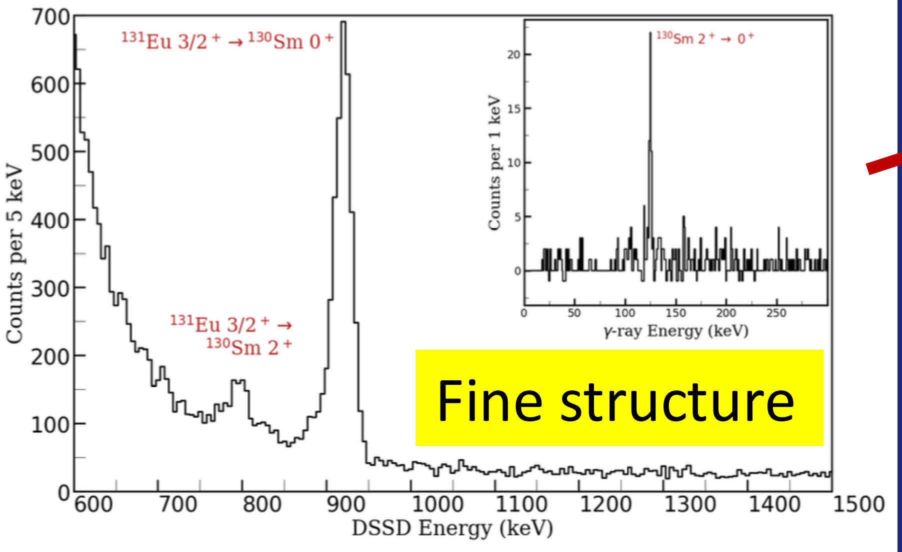

RIKEN, Japan

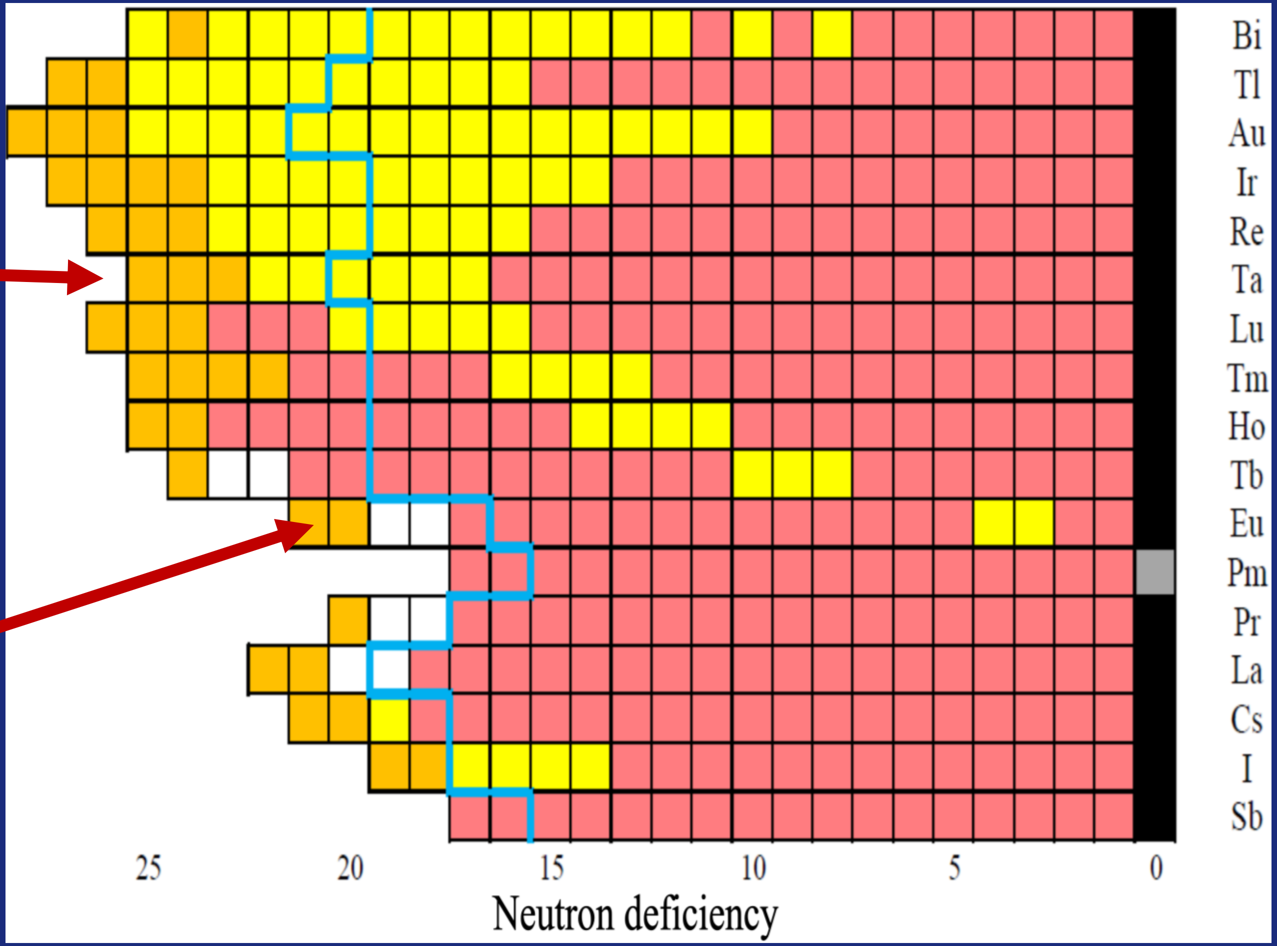

Argonne, USA

Prof Robert Page, Prof Dave Joss

MARA, Jyväskylä







Proton emission = limits of existence

Applied Nuclear Physics

Prof Andy Boston

SATURN CDT studentships

RAPTOR studentships?

To be confirmed!

Radiation Detection & Measurement for Nuclear Applications (Radiometrics) M.Sc. also an option

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Nuclear physics Ph.D. opportunities

If you think you might be interested, discuss the research directly with potential supervisors

Also talk to current Ph.D. students to find out what it's really like

Long Term Attachments at international laboratories available

Most Nuclear Physics Ph.D. students go to more than 1 laboratory

Robert Page	(R.D.Page@liverpool.ac.uk)
Dave Joss	(David.Joss@liverpool.ac.uk)
Andy Boston	(Andrew.Boston@liverpool.ac.uk)

Admissions contact:	Prof. Robert Page,	R.D.Page@liverpool.ac.uk
Cluster leader:	Prof. Dave Joss,	David.Joss@liverpool.ac.uk

M.Sc. possibilities include Radiometrics – contact Prof. Robert Page

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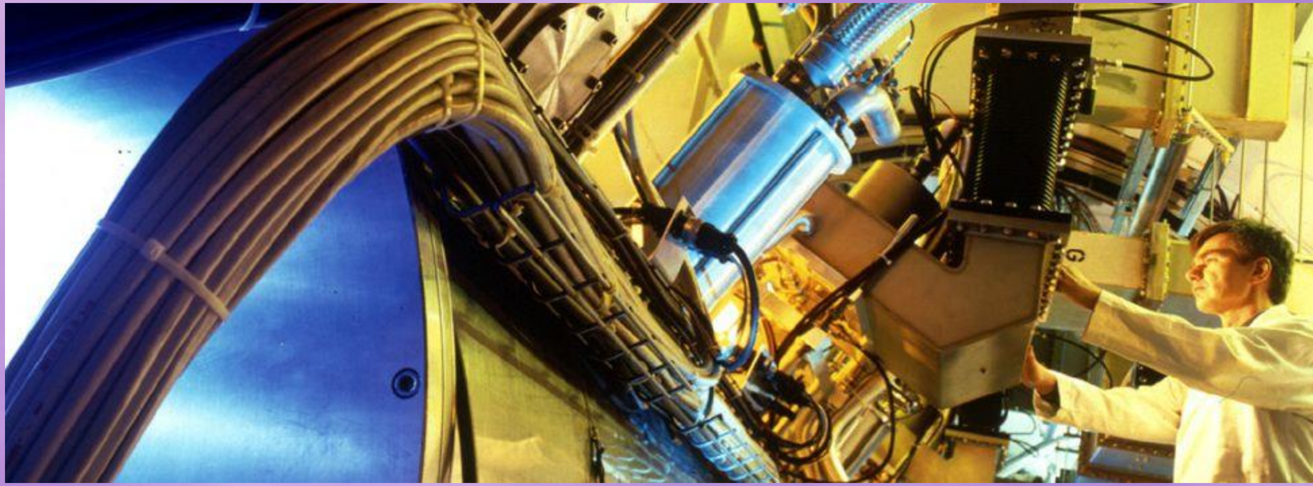

Accelerator Physics

Contact: Dr Hao Zhang

haozhang@liverpool.ac.uk

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Accelerator Science at Liverpool

Visit our **websites** for more information

http://www.liverpool.ac.uk/physics/research/accelerator-physics
http://www.quasar-group.org

- **Cluster leader:** Prof Carsten P Welsch
- **Academics:** Prof Andy Wolski, Dr Andrea Santamaria Garcia (Physics) and Dr Laura Corner (Engineering)
- **Deputy PGR Director:** Dr Hao Zhang

UNIVERSITY OF LIVERPOOL

Join A Diverse Community of Scientists

The Cockcroft Institute – home to University of Liverpool's Accelerator Science cluster.

The Cockcroft Institute is:

- a partnership between 4 universities + a national lab;
- world leading in accelerator research, education and training;
- the largest UK provider of accelerator science training.

Learn more: https://youtu.be/e6COn4bp-AQ

QUASAR Group: https://youtu.be/ezp9lAFdRdU

Where is the Cockcroft Institute?

The Cockcroft Institute is based at Sci-Tech Daresbury

- One of STFC’s two national labs that research accelerator science;
- Wide range of research groups and SMEs
- Just outside of Warrington, many students choose to live in Runcorn, Warrington, Liverpool or Manchester.

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What does the CI research?

- **Frontier accelerators**
  - e.g. LHC upgrades and FCC, antimatter R&D
- **Applications of accelerators**
  - e.g. medical and imaging technologies, security and sustainability applications
- **Novel accelerator techniques**
  - e.g. AWAKE, EuPRAXIA, ultra-compact micro accelerators-on-a-chip

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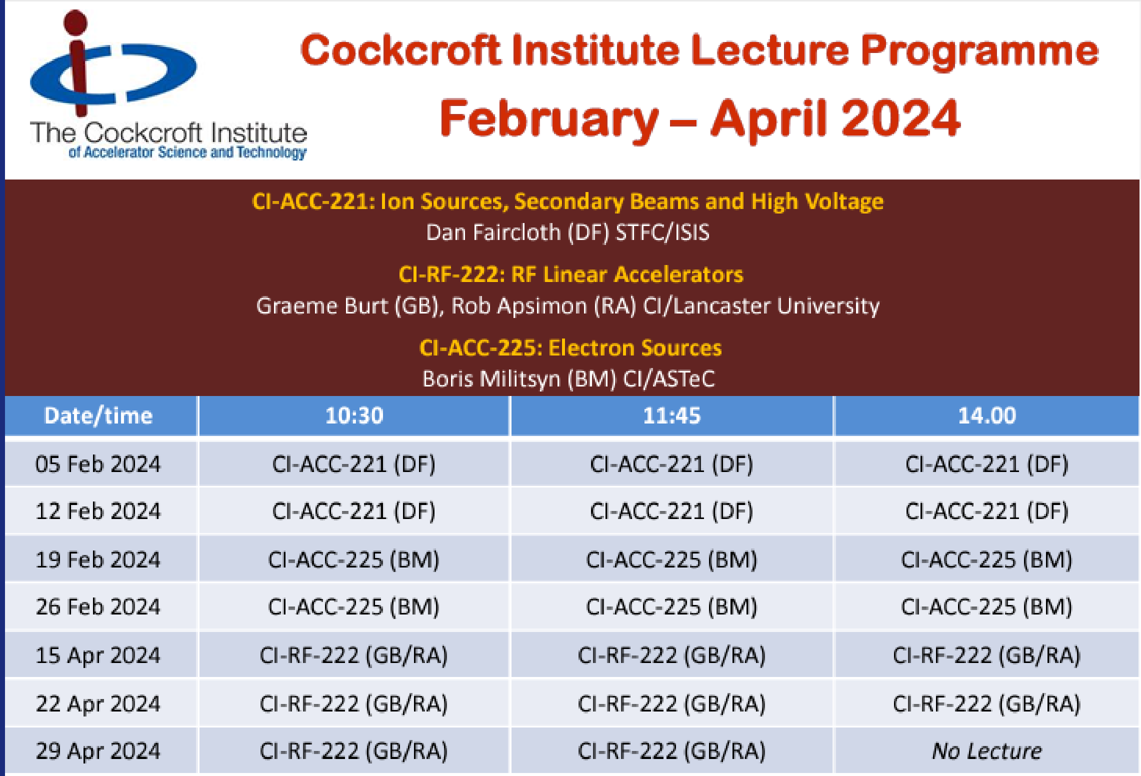
Study with University of Liverpool at The CI

- Access to large scale accelerator facilities
- Work alongside leading researchers from academia, national labs and industry
- Education programme delivered by all Cockcroft partners
- Annual PGR conference
- Options for long-term attachment to world-class labs such as CERN

Learn more about the **PhD life** at the CI: https://youtu.be/6tPYg1fTny0



The Cockcroft Institute of Accelerator Science and Technology

Cockcroft Institute Lecture Programme February – April 2024

CI-ACC-221: Ion Sources, Secondary Beams and High Voltage
Dan Faircloth (DF) STFC/ISIS

CI-RF-222: RF Linear Accelerators
Graeme Burt (GB), Rob Apsimon (RA) CI/Lancaster University

CI-ACC-225: Electron Sources
Boris Militsyn (BM) CI/ASTeC

Date/time	10:30	11:45	14.00
05 Feb 2024	CI-ACC-221 (DF)	CI-ACC-221 (DF)	CI-ACC-221 (DF)
12 Feb 2024	CI-ACC-221 (DF)	CI-ACC-221 (DF)	CI-ACC-221 (DF)
19 Feb 2024	CI-ACC-225 (BM)	CI-ACC-225 (BM)	CI-ACC-225 (BM)
26 Feb 2024	CI-ACC-225 (BM)	CI-ACC-225 (BM)	CI-ACC-225 (BM)
15 Apr 2024	CI-RF-222 (GB/RA)	CI-RF-222 (GB/RA)	CI-RF-222 (GB/RA)
22 Apr 2024	CI-RF-222 (GB/RA)	CI-RF-222 (GB/RA)	CI-RF-222 (GB/RA)
29 Apr 2024	CI-RF-222 (GB/RA)	CI-RF-222 (GB/RA)	*No Lecture*

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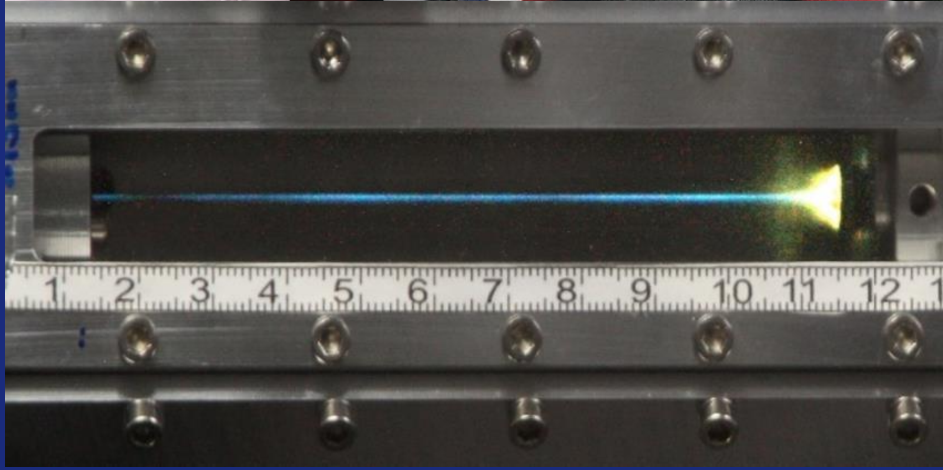
Lasers for Accelerators

- University of Liverpool Research Group

- We work on:
    - Laser-driven plasma acceleration
    - Development of high power fibre lasers
    - New gas targets for plasma accelerators
    - Strong field QED effects in electron/laser interactions

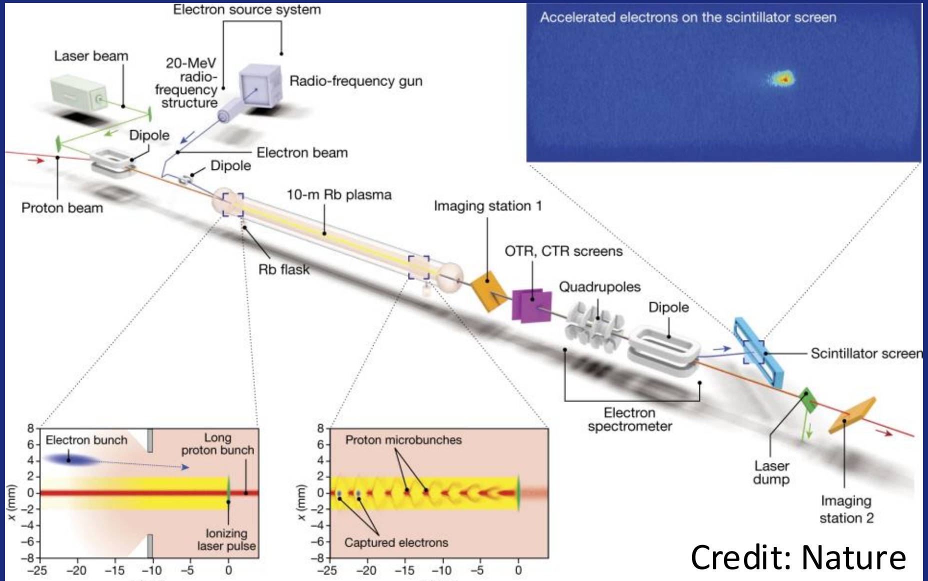
- PhD projects available in all research areas



Contact: Dr Laura Corner (laura.corner@liverpool.ac.uk)

Instrumentation development for AWAKE

- AWAKE is the world’s first proton-driven plasma wakefield acceleration experiment.
- You will develop novel instrumentation to measure and monitor three beams: protons, electrons and lasers (!) Longitudinal pulse profile with fs resolution is one of many challenges.
- Collaboration with U Manchester and CERN, with opportunity to visit and be based at CERN for up to one year.



Credit: Nature

Contact: Dr Joe Wolfenden and Prof Carsten P Welsch

Exploiting Laser Pulse Shaping and Phase Space Tomography to Optimise Longitudinal Beam Dynamics at the Interaction Point of CLARA

Motivation

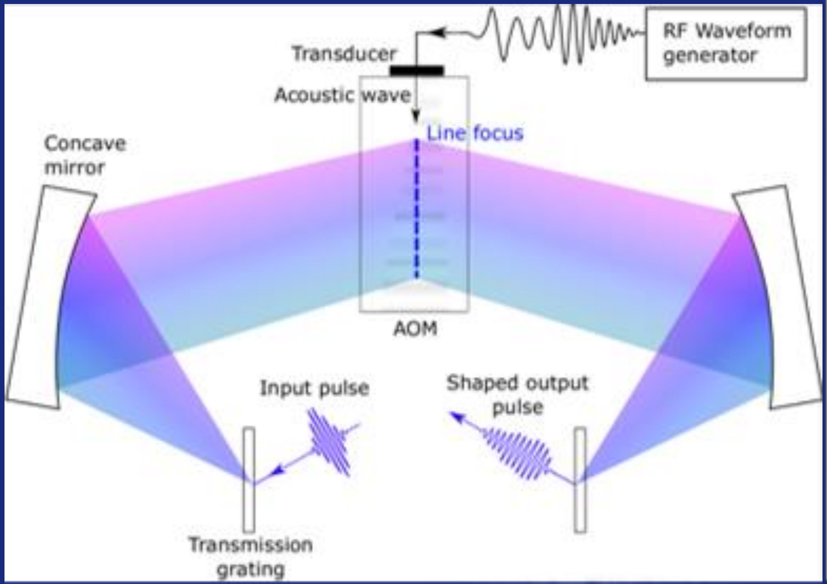
At the CLARA facility we aim to use machine learning to deliver an efficient, **automated accelerator** with **rapidly customisable beam properties** for a wide range of user experiments

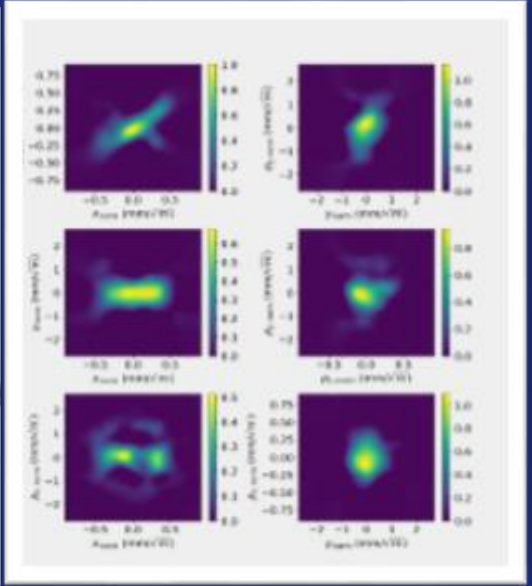
Goal of the Thesis

Combining advances in **machine learning based phase space tomography** and **laser pulse shaping**, develop a method to target longitudinal bunch profiles at the interaction point of CLARA for use in user experiments.

Contact

Prof. Andrzej Wolski (awolski@liverpool.ac.uk)
Dr. Andrea Santamaria Garcia (ansantam@liverpool.ac.uk)
Dr. Amelia Pollard (amelia.pollard@stfc.ac.uk)





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Goal-Conditioned Reinforcement Learning for Bunch-Shape Control in Linear Accelerators

CLARA is a linear accelerator in the Daresbury Laboratory, and its full energy beam exploitation (FEBE) hutch is being prepared to support diverse user programmes that require different electron-bunch characteristics at the experimental chamber.

What you will build

A goal-conditioned RL controller: you will need to define the problem in RL terms.

Model-based planning: you'll use Cheetah, a fast, tensorised, differentiable start-to-end model of CLARA, to plan short, data-efficient adjustment sequences. Part of the thesis will be to compare the usefulness of different RL methods for this problem and propose improvements.

Virtual diagnostics: surrogate model for beam parameter prediction with uncertainty quantification.

Application deadline: 31st Jan 2026
Confirmation: ~Spring 2026
Start: ~Oct 2026

Contact: ansantam@liverpool.ac.uk
Dr. Andrea Santamaria Garcia

Why this is exciting

Real impact: your controller helps users switch experiment modes faster and more reliably.

Cutting-edge methods: goal-conditioned policies, differentiable simulators, uncertainty-aware ML applied to a national facility.

Who should apply

Curious interdisciplinary scientists with a strong coding background and a passion for machine learning (Physicists/Computer Scientists).

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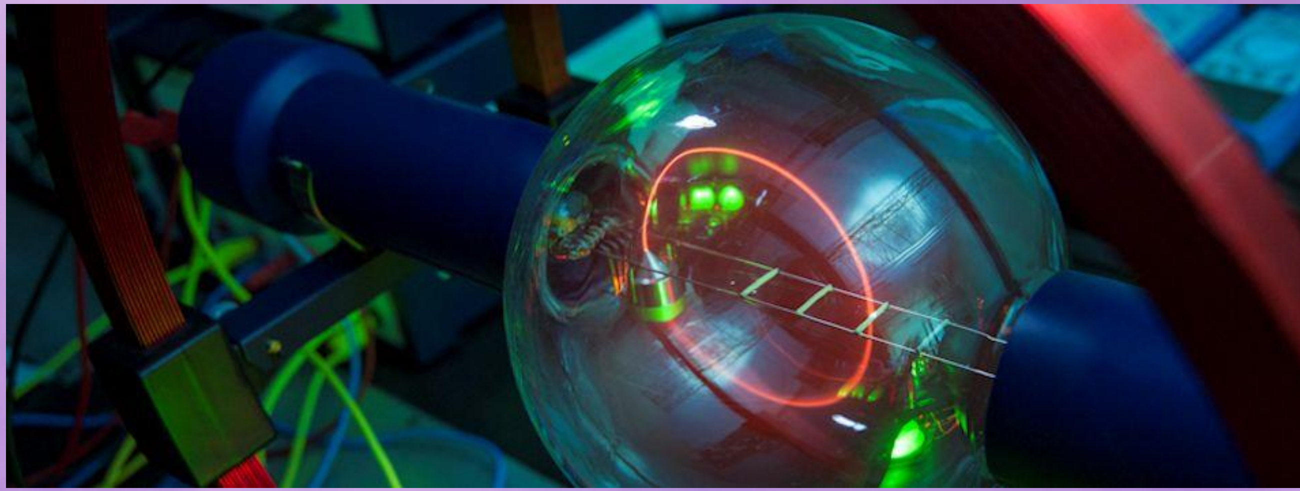

Condensed Matter

Contact: Dr Frank Jaeckel

fjaeckel@liverpool.ac.uk

Condensed Matter at Liverpool

Members from:

- **Stephenson Institute for Renewable Energy**
- **Surface Science Research Centre**
- **Materials Innovation Factory**
- **Oliver Lodge Laboratory**
- **Department of Chemistry**

~30 PhD Students
~15 Staff Members

Materials Innovation Factory
Opened 2017

Prof. Chris Lucas
Head of Group

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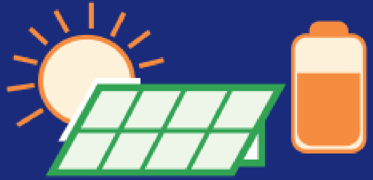
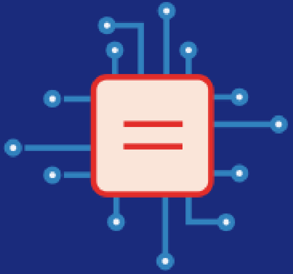
Energy
Storage



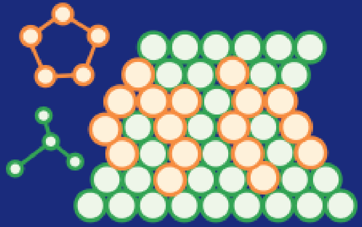
Quasicrystals



Solid-Liquid
Interfaces

Energy Technologies

Solar Energy
Conversion



Electronic Structure

Nanoscience

Artificial
Photosynthesis

Condensed Matter Physics

Green
Catalysis

Radical Surface
Interactions

Charge
Transport

Molecular
Condensates

Low-Temperature Physics

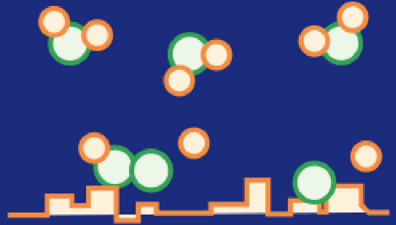
Soft Matter

3D Printing

Biophysics

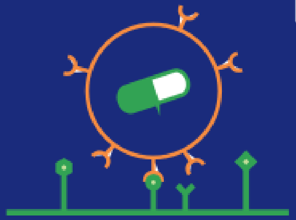
Sustainable
Materials

Image Analysis

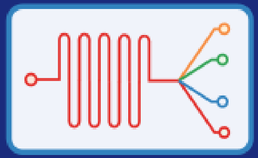


Collision
Modelling

Tissue Structure



Cancer Diagnosis



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DEPARTMENT
OF PHYSICS

Liverpool is one of the best places in the world for research in functional materials, for energy conversion and storage, catalysis and surface science, and biophysics.

Materials Innovation Factory (MIF) (opened 2017)

Stephenson Institute for
Renewable Energy
(opened 2013)

Stephenson Institute
for Renewable Energy

THE ORIGINAL
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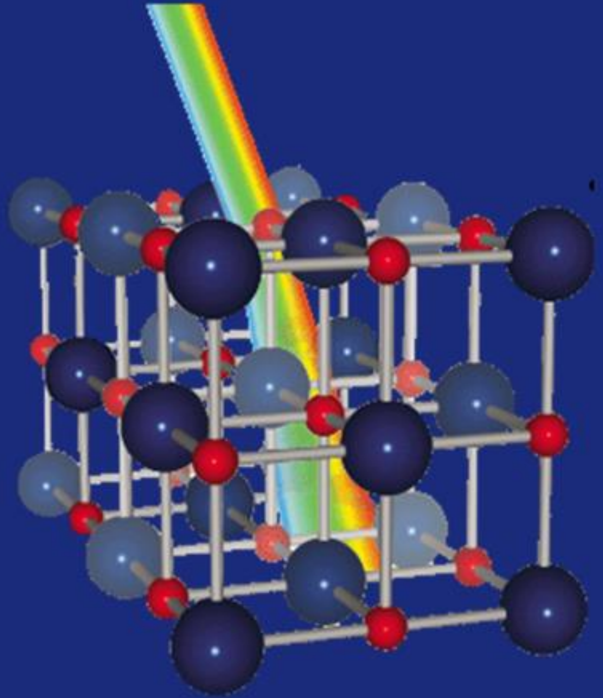


Energy Technologies

Stephenson Institute for Renewable Energy

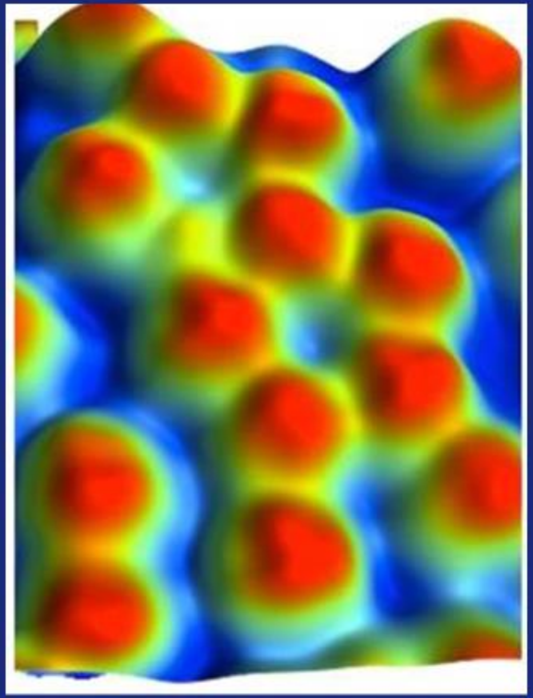
- Novel semiconductor materials
- Solar energy materials and solar cells
- Photocatalysis and sustainable fuels
- Thermoelectric materials
- Spin transport in magnetic materials

People
Dr Elisabetta Arca, Dr Jonathan Alaria, Prof Ken Durose, Dr Yvonne Grunder, Dr Frank Jaeckel, Dr Chris Lucas, Dr Jon Major, Prof Tim Veal

Nanoscience

Surface Science Research Centre and **Stephenson Institute for Renewable Energy**

- Quasicrystals
- Electrochemical characterisation of solid-liquid interfaces
- Hybrid nanomaterials
- Electron microscopy



Quasicrystalline ordering of Pb and C60 on i-Ag-In-Yb – Dr Hem Raj Sharma

People

Dr Sam Coates, Dr Yvonne Grunder, Dr Frank Jaeckel, Prof Chris Lucas, Dr Hem Raj Sharma

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Electronic Structure

Stephenson Institute for Renewable Energy and **ESRF Grenoble**

- Functional materials for energy conversion and storage
- Microelectronics
- Structure and dynamics at the solid-liquid interface

People

Dr Yvonne Grunder, Prof Chris Lucas, Prof Tim Veal

CMP's XMaS Beamline in Grenoble!

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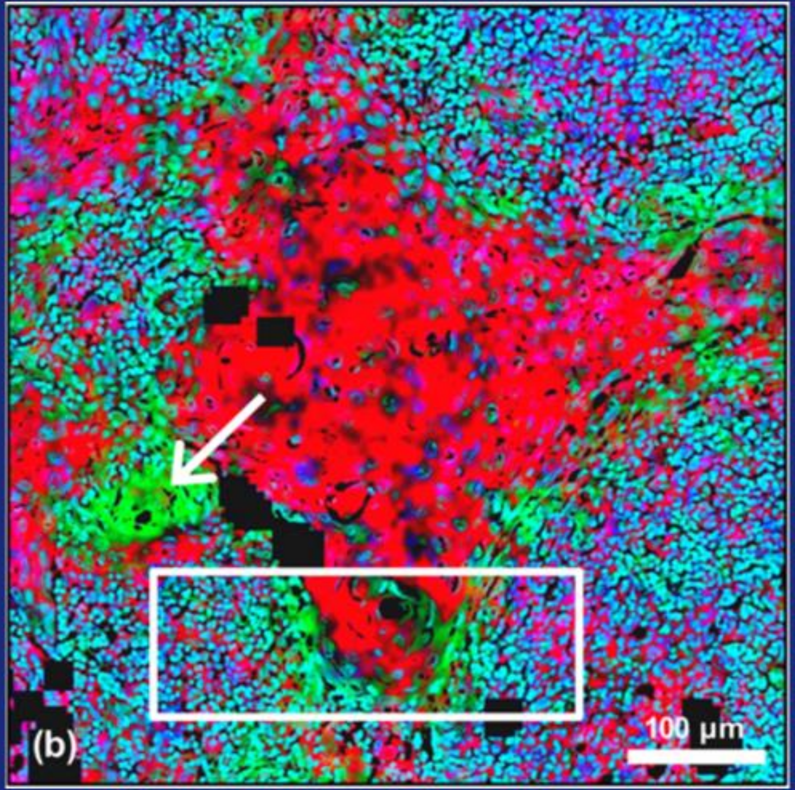
Biophysics

Oliver Lodge Laboratory and **Department of Chemistry**

- Infrared and microscopic imaging (SNOM, AFM)
- Tissue structure and function
- Biological growth fronts
- 3D-printed tissue models
- Cancer diagnosis



Using machine learning to diagnose cancer – Prof Weightman

People

Dr Joe Forth, Dr David Martin, Prof Peter Weightman

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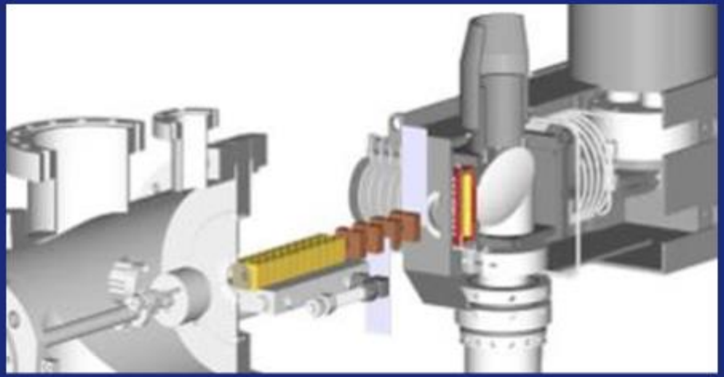
Cold Chemical Physics

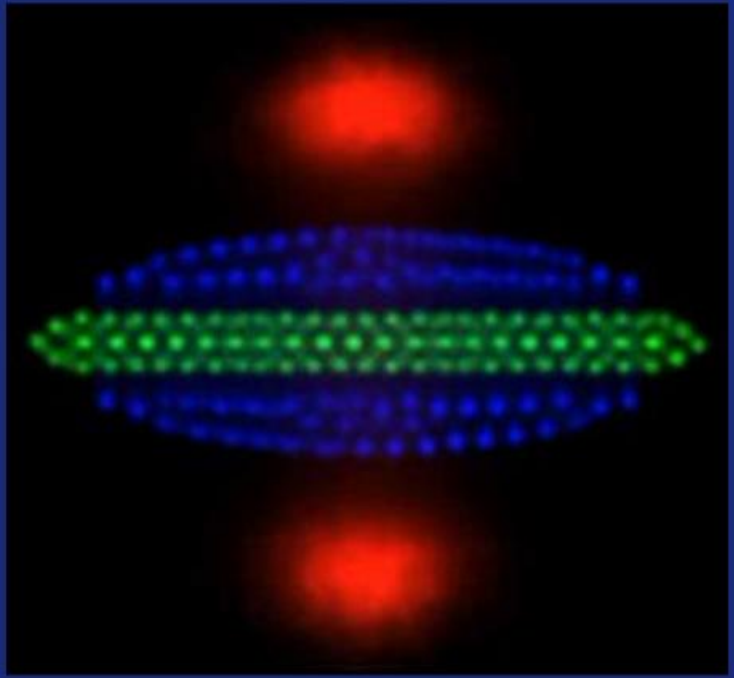
Oliver Lodge Laboratory

- Ultra cold ion-neutral reaction studies
- Radical surface interactions
- Atomic collision modelling

People

Prof Brianna Heazlewood





A Coulomb crystal formed in an ion trap – Prof Heazlewood

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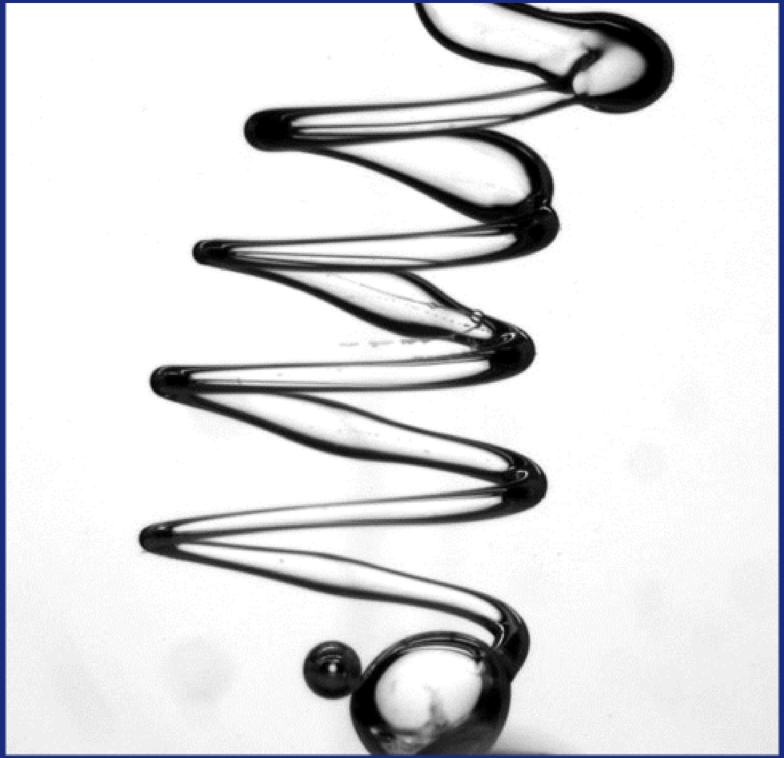
Soft Matter Physics

Stephenson Institute for Renewable Energy
and **Department of Chemistry**

- Liquid-Liquid Interface Electrochemistry
- Nanoparticles for Energy Conversion
- 3D Printing and Microfluidics
- Sustainable Emulsion Design



“Reconfigurable Printed Liquids”, Forth et al, Advanced Materials (**2018**)

People

Dr Joe Forth, Dr Yvonne Grunder, Dr Frank Jaeckel

Studentships in Condensed Matter

- Opportunities for projects in most areas of research, talk to the research leads
- ~1-2 funded positions this year
- Self-funded (or some form of personal fellowship) applicants **welcome!**
- If you are interested in working in a particular area talk directly to the potential supervisor
- Our applications are handled collectively - **mention the experiment(s) you are interested in and put "Frank Jaeckel" as suggested supervisor**
- Application deadline: late-January / early-February 2026 - interviews in February

For more information:

https://www.liverpool.ac.uk/physics/research/condensed-matter-physics/opportunities/

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Particle Physics

Contact: Prof Neil McCauley

n.mccauley@liverpool.ac.uk

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Particle Physics at Liverpool

One of the strongest Particle Physics Groups in the UK

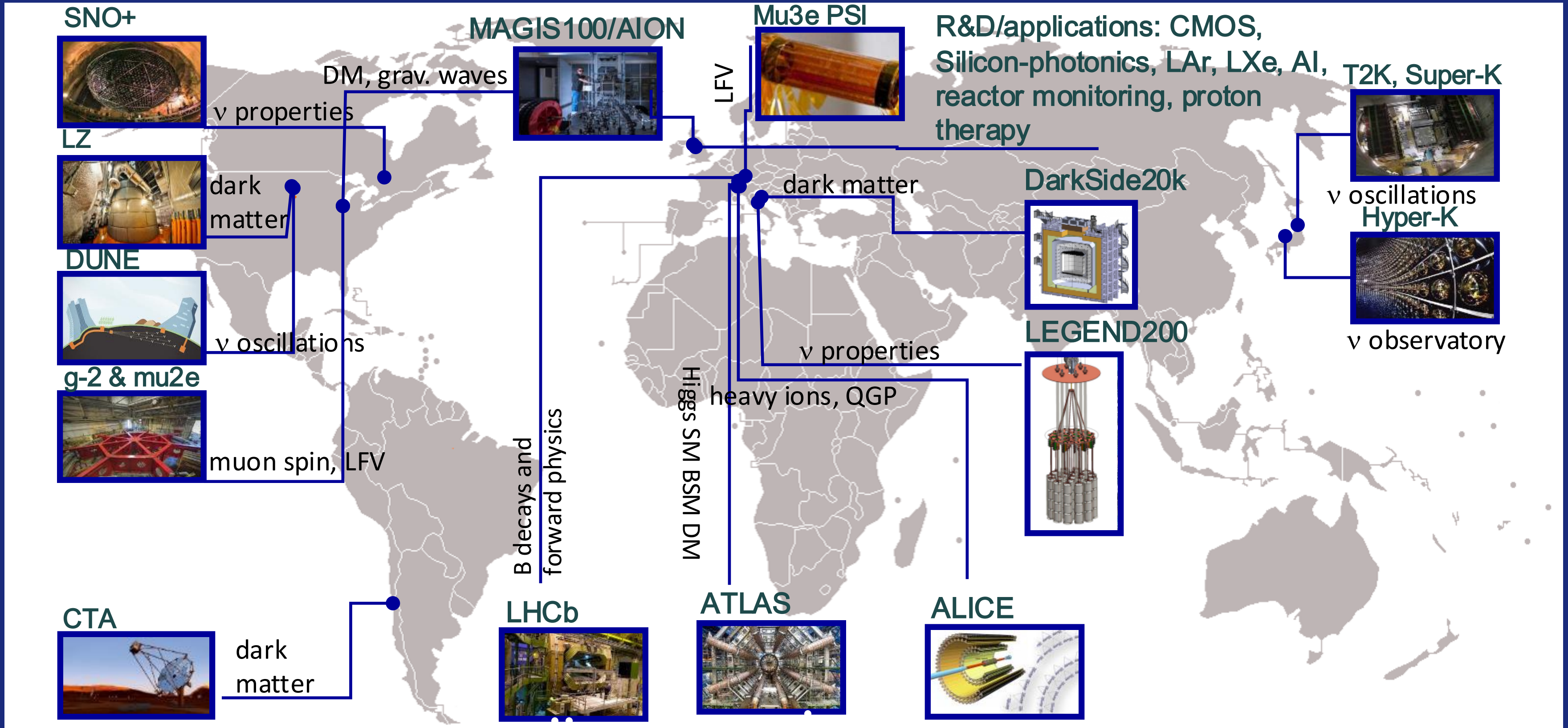
~60 PhD students,
~65 staff members

Strong track record on the development of future experiments and on the physics exploitation of current ones.

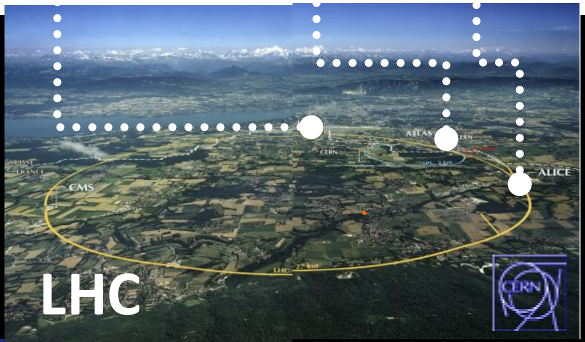
A worldwide programme:

Working on all frontiers of fundamental physics:

- Energy frontier collider physics
- Precision quark and lepton flavour physics
- Neutrino physics
- Dark matter searches
- *Heavy ion physics (in NP cluster)*



Experiments at a glance



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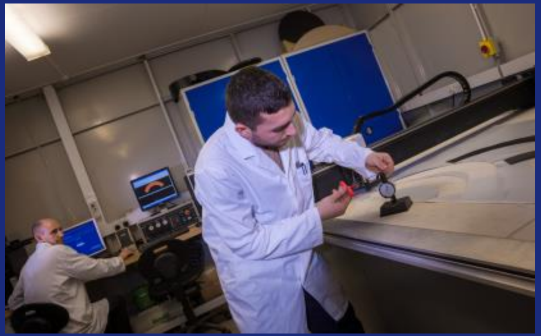
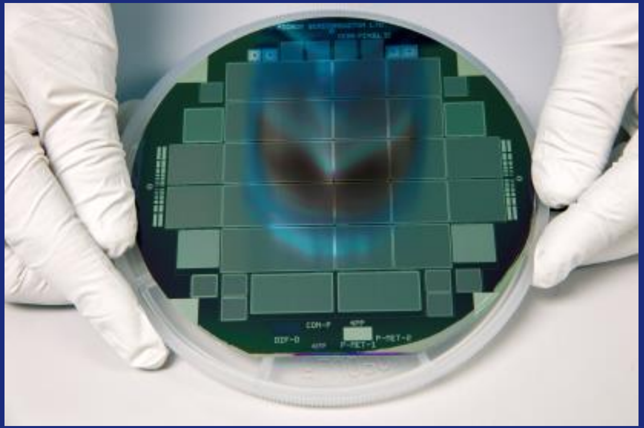
One of the best places in the world to build detectors:

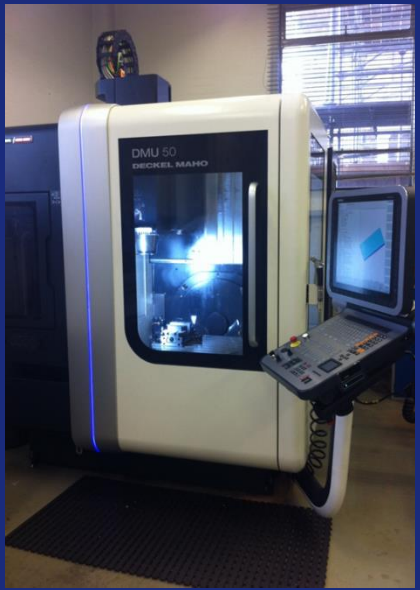
Liverpool devices operate at CERN, Fermilab, JPARC, and instrument medical physics equipment.



Advanced Materials Laboratory

Liverpool Semiconductor Detector Centre





Detector Manufacturing Facility

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Particle Physics Projects at Liverpool

- We expect to award several PhD positions across our programme
- Visit our website for more information on how to apply

  https://www.liverpool.ac.uk/particle-physics/experiments/

- **Head of the PP Group: Prof Joost Vossebeld**
- **Post-graduate coordinator for the PP group: Prof Neil McCauley**

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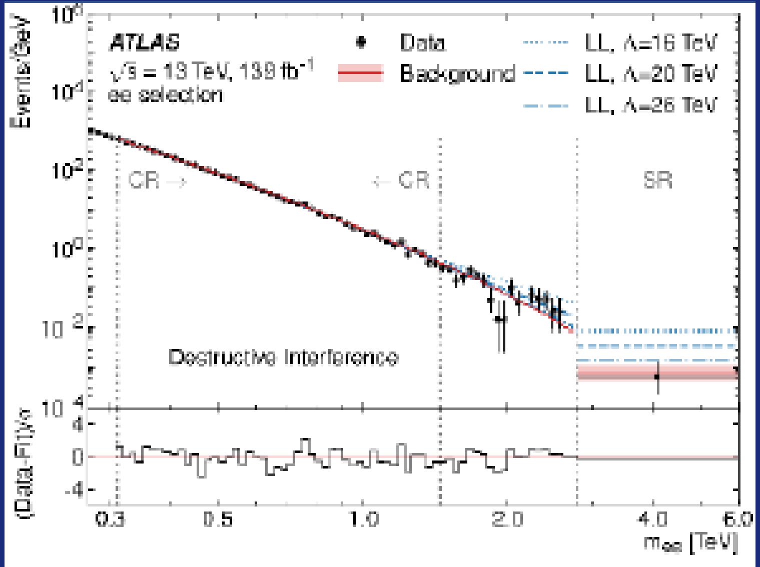
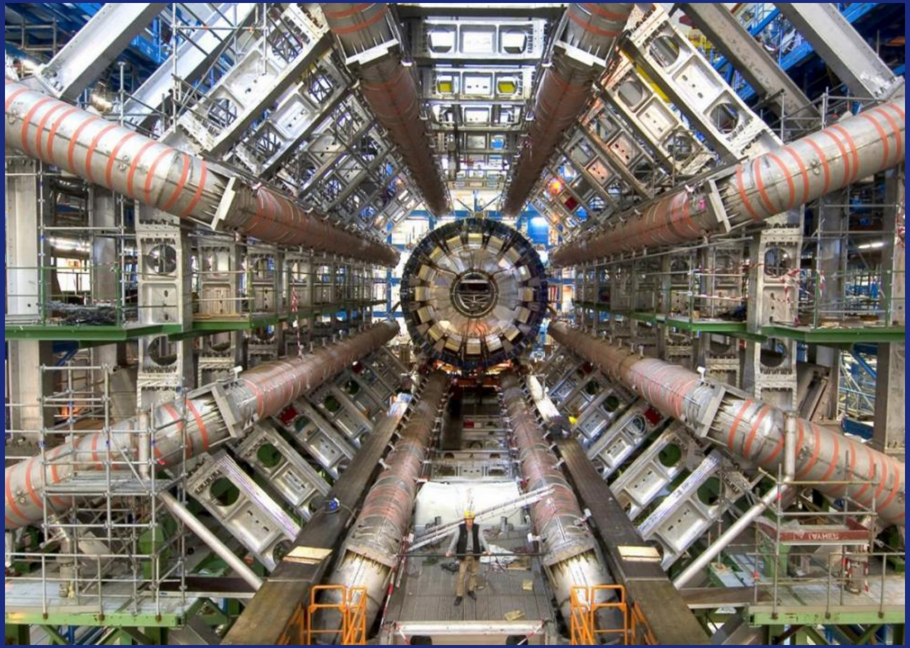
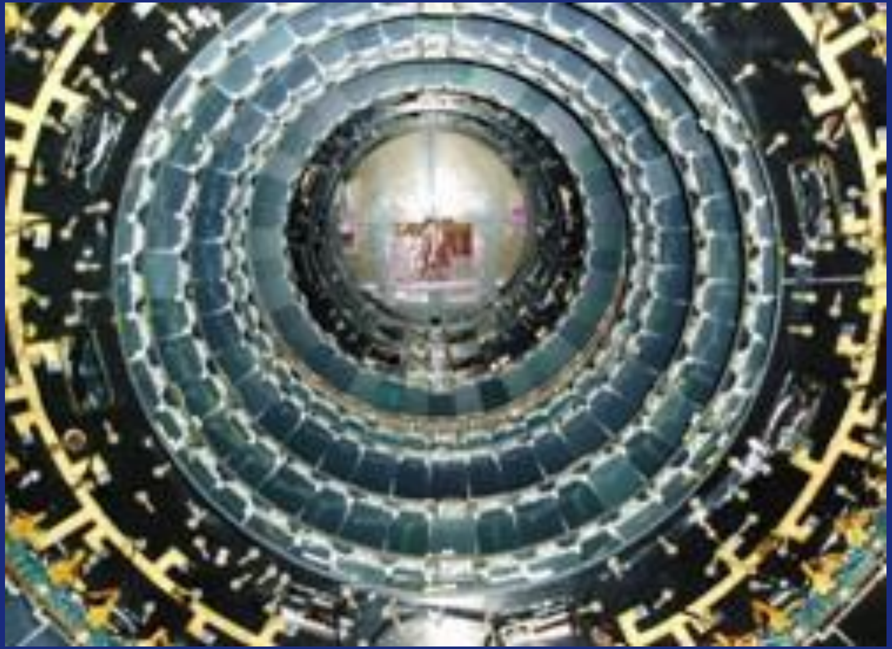




Energy Frontier

- **ATLAS Experiments at CERN**
  - Higgs properties, precision measurements, exotic particle searches, supersymmetry, dark matter
  - Silicon trackers for ATLAS upgrades



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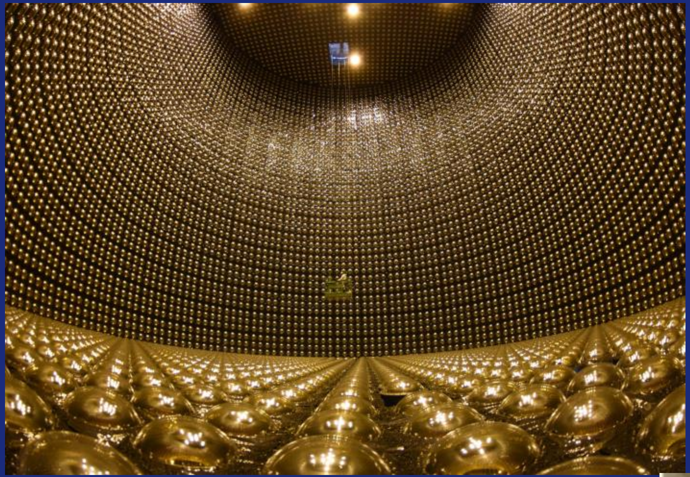
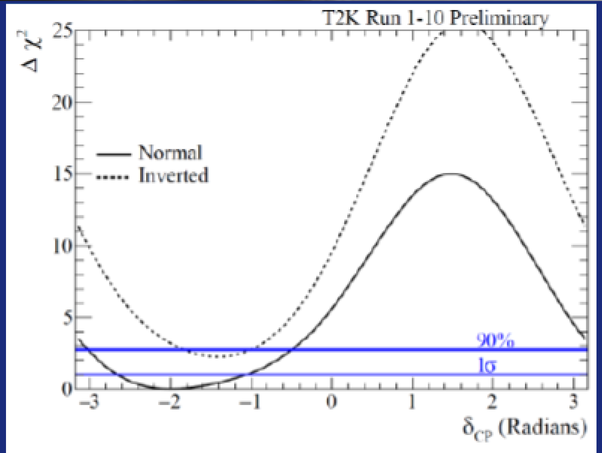
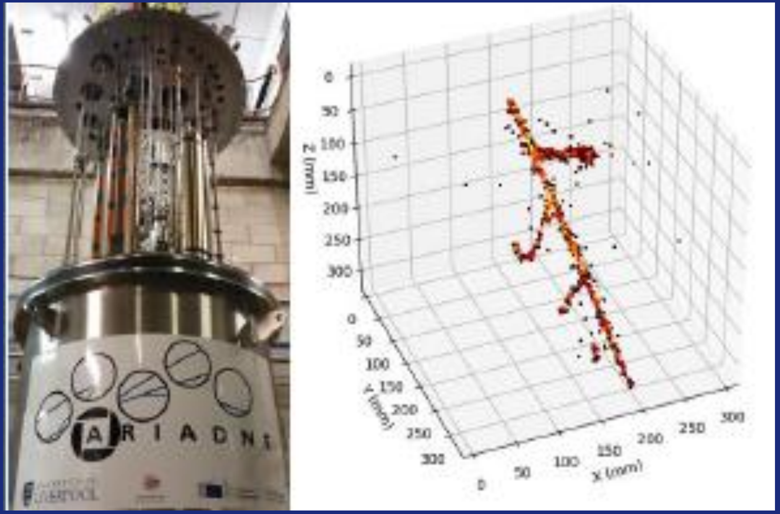


Neutrinos & the Dark Matter

- **Neutrino physics group:**
    - Neutrino oscillations, CP violation, neutrino properties
    - T2K, Hyper-Kamiokande, DUNE, SBND, JUNO
- **Dark Matter**
    - LZ experiment & XLZD
    - Darkside
    - Atom interferometry, MAGIS100/AION
    - FASER experiment at CERN





Flavour physics and R&D

- **Quark Physics: LHCb Experiment at CERN**
  - Precision SM, Rare Decays
- **Detector R&D**
  - Silicon detector development
  - Liquid Argon TPC readout technology

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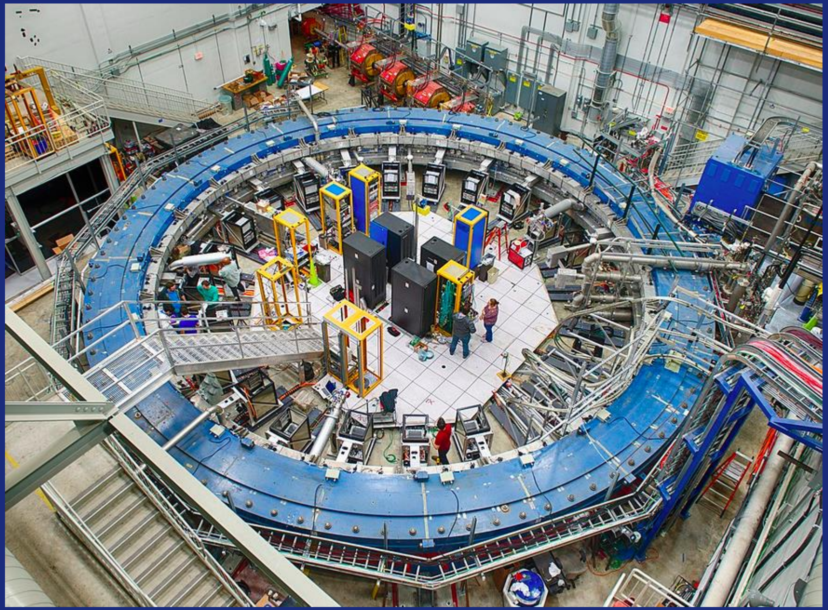
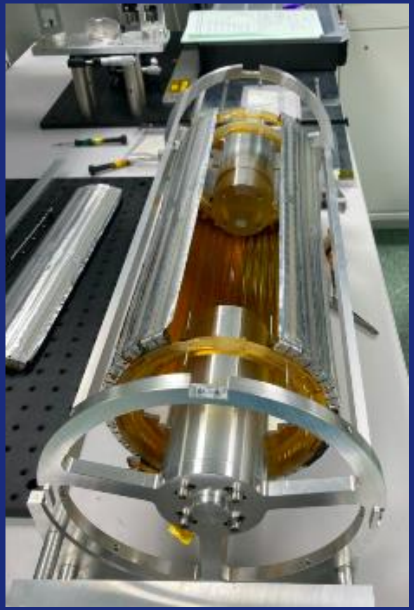
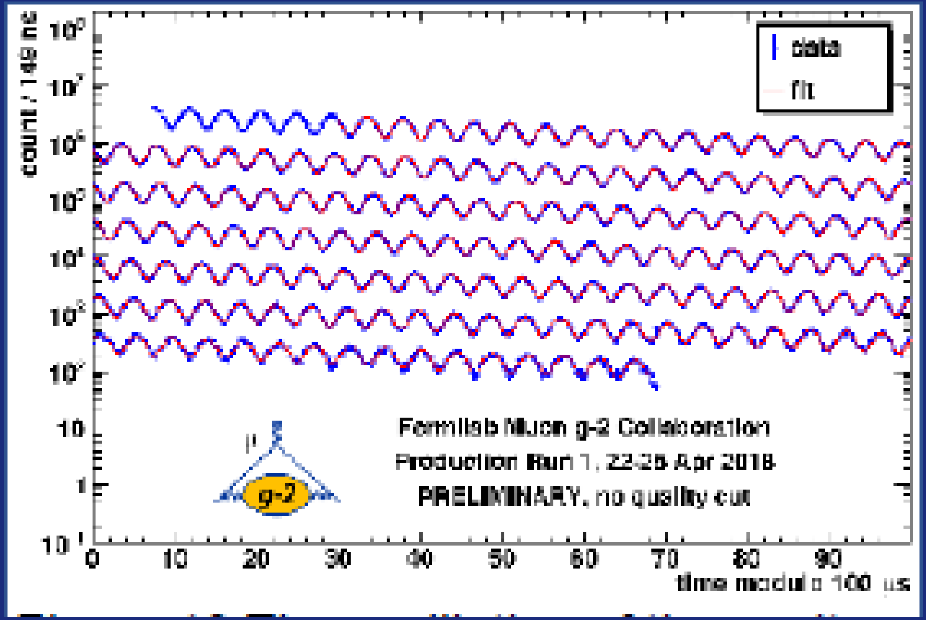
Muon Precision Frontier





- **Ultra-precise measurements of well predicted variables sensitive to New Physics in the muon sector**
  - Electric and Magnetic Dipole Moment, rare conversion rates (μ→e, μ→eee)
  - Experiments: g-2 (FNAL), Mu2e (FNAL), Mu3e (PSI), MuonE (CERN), MuEDM (PSI), g-2@JPARC
  - Low mass precision tracking detectors built at Liverpool



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What a Particle Physics PhD student does for research?

- The main tools of experimental particle physics research are:
  - Software: data analysis, machine learning, high-performance computing
  - Electronics: design and commissioning
  - Detector building: using our lab facilities
- We offer for the first half-year of the PhD dedicated Particle Physics courses and courses to prepare students with these tools
- PhD studentships may use on one of these tools or a combination, depending on the project
- Every year we have several projects that cover all these areas and combinations – scope for project personalization also exist

Particle Physics Studentships

- We expect several fully funded positions
- (Self-funded positions are also available)
- Some positions offer year at CERN/DESY/FNAL/RAL/Kamioka or elsewhere; others are Liverpool based
- **In your application mention the experiment(s) you are interested in and put as the suggested supervisor Prof Neil McCauley: all particle physics applications are handled collectively**
- Deadline: January 30th (for funded PhDs); interviews in February

More information about the deadlines will appear under:

https://www.liverpool.ac.uk/particle-physics/postgrad_places/

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Physics Education

Contact: Dr Chris Edmonds

cse@liverpool.ac.uk

“”

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Physics Education Research

- Recently formed research cluster

- Currently 2 PhD students (both awarded the Jocelyn-Bell Burnell Scholarship)

- Limited funding opportunities but if you wish to discuss further, please contact Chris Edmonds
- Current research focuses on:
    - Use of machine learning to quantify and track physics degree awarding gaps
    - Use of Artificial Intelligence in physics education
    - Advanced physics transposition – novel approaches to teaching advanced physics topics to undergraduates
    - The experiences and barriers faced by minority groups in physics

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Who to contact

- General Inquiries
  Dr Nikolaos Rompotis, Director of Postgraduate studies
  nikolaos.rompotis@liverpool.ac.uk

- Accelerator Physics: Dr Hao Zhang, Hao.Zhang3@liverpool.ac.uk
- Condensed Matter: Dr Frank Jaeckel, Frank.Jaeckel@liverpool.ac.uk
- Nuclear Physics: Prof Robert Page, R.D.Page@liverpool.ac.uk
- Particle Physics: Prof Neil McCauley, N.McCauley@liverpool.ac.uk
- Education: Dr Chris Edmonds, cse@liverpool.ac.uk

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Visit our webpage for more information

Including our Postgraduate Research Flier with more information about our research and our PhD students

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Access this online here:

Department of Physics

Postgraduate Research Special : Open Day 28/11/2024, 17:00

Department of Physics Newsletter

"Welcome to our Postgraduate Opportunities Event! Our department is committed to providing all our students the opportunity to realise their maximum potential as physicists. I hope that you enjoy both the event and reading this special Newsletter. For more information about our Department please visit our website or get in touch with me at any time!"

Prof Tim Veal, *Head of Department*

World-leading Research

Our research is carried out across research clusters, **Accelerator Science**, **Condensed Matter**, **Nuclear Physics**, **Particle Physics,** underpinned by continuous enhancements in **Physics Education** and transversal activities and work on cutting edge technologies in fields such as **artificial intelligence**, renewable energy and **sustainable technologies**, innovative materials, semiconductor and **quantum** sensors, and **medical physics.** Through a programme of **exploration** and **discovery**, we are addressing the most fundamental questions in physics. Our staff contribute to – and often lead – experiments in Liverpool and at international laboratories like CERN, Fermilab, and ESRF. As a PhD student, you will be a crucial part in this work.

The most recent Research Excellence Framework assessment (in 2021) placed us amongst the **UK's top 10 physics departments** for our research outputs and the quality of our research environment.

Prof Monica D'Onofrio, *Head of Research*

Keep up to date with our latest news via X or Instagram.

What it's like being a PhD student

Apply for one *of* **our fully funded PhD positions** to join a research community of more than 100 PhD students!

As a PhD student you will learn how to perform research both independently and as a part of a research group. You may work for large or small international collaborations, and you may have opportunities to take long-term attachments in overseas laboratories like CERN. During year 1, you will attend both subject specific and wider skill training. You will have the chance to attend seminars, go to schools and conferences and participate in undergraduate teaching. Within 4 years, you will have to submit a thesis for examination .

For general inquiries about out PhD programme please contact our Postgraduate Research Director, Dr Nikos Rompotis

Join our Postgraduate Open Day to learn more!

Thursday 28 November 2024,
17:00, Leo Carrol Suite and online

liverpool.ac.uk/physics
@livuniphysics
physics@liverpool.ac.uk

THE ORIGINAL REDBRICK

UNIVERSITY OF LIVERPOOL

Department of Physics

Images courtesy of: Liverpool Semiconductor Detector Centre| ALICE at CERN | XMaS based at ESRF | Department of Physics

PhD applications and funding

To apply for a PhD, it is usually expected that you have a MPhys with a 1st or 2:1 or an MSC.

We have **several fully funded PhD positions**, covering both fees and stipend for usually 3.5 years. Our main funders are STFC and EPSRC. Some of the positions are under specific programmes, like the **Liverpool Centre for Doctoral Training for Innovation for Data Intensive Science** (LIV.INNO). For LIV.INNO positions the funding is 4 years and they also include a 6-month industrial placement during the 4-year period.

Our research Clusters

Accelerator Physics

Accelerator physics at Liverpool carries out world-class research with particle accelerators and drives innovation in technologies that help boost the performance of accelerator-based research infrastructures. Our research is realized in close collaboration with our national and international partners, enhanced by the unique facilities at Daresbury Laboratory and the Cockcroft Institute, as well as our collaboration partners from around the world.

Our research activities include:
Antimatter research: investigating fundamental symmetries and interactions.
Frontier accelerators: collaborating with global research groups to design, build, and optimize world-class research infrastructures such as the LHC at CERN and its upgrade programmes, contributing expertise in beam instrumentation, accelerator design, and optimisation.
Novel accelerators: including plasma wakefield accelerators and ultra-compact accelerators-on-a-chip.
Accelerator applications: R&D into healthcare technologies and applies Data Science techniques to real-world challenges.

For more information, contact Dr Hao Zhang or visit liverpool.ac.uk/quasar/ liverpool.ac.uk/physics/research/accelerator-physics/

Condensed Matter Physics

CMP at Liverpool embraces a wide range of physics that is aimed at making a positive impact on life, technology and innovation by developing both fundamental and applied understanding relevant to modern issues. 17 academics, 15 professional research staff and research associates, and 20 PhD students work in our five research themes:
Advanced Characterisation utilises X-rays (both at the XMas beamline at Grenoble and in house) for X-ray diffraction, resonant X-ray scattering, grazing incidence measurements, spectroscopy and small angle scattering.
Advanced Materials includes research on Bio - and soft matter-printing, magnetic materials and structures, and quasicrystals and quasiperiodic media.
Chemical and Electrochemical Physics studies chemical physics of reaction dynamics as well as electrochemical interfaces.
Imaging and Medical Diagnostics use IR imaging in near and far-field to study biological specimens (particularly cancer biopsies).
Solar Energy Conversion research prepares and investigates new materials for both solar hydrogen and electricity production (solar cells).

For more information contact Dr Frank Jaeckel or visit liverpool.ac.uk/physics/research/condensed-matter-physics/

liverpool.ac.uk/physics

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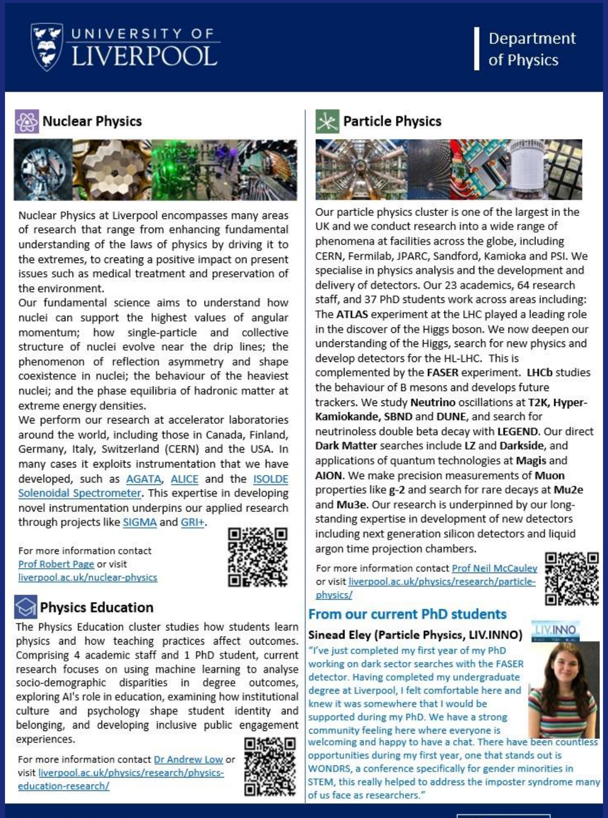

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Department of Physics

Nuclear Physics

Nuclear Physics at Liverpool encompasses many areas of research that range from enhancing fundamental understanding of the laws of physics by driving it to the extremes, to creating a positive impact on present issues such as medical treatment and preservation of the environment.
Our fundamental science aims to understand how nuclei can support the highest values of angular momentum; how single-particle and collective structure of nuclei evolve near the drip lines; the phenomenon of reflection asymmetry and shape coexistence in nuclei; the behaviour of the heaviest nuclei; and the phase equilibria of hadronic matter at extreme energy densities.
We perform our research at accelerator laboratories around the world, including those in Canada, Finland, Germany, Italy, Switzerland (CERN) and the USA. In many cases it exploits instrumentation that we have developed, such as AGATA, ALICE and the ISOLDE Solenoidal Spectrometer. This expertise in developing novel instrumentation underpins our applied research through projects like SIGMA and GRI+.

For more information contact Prof Robert Page or visit liverpool.ac.uk/nuclear-physics

Physics Education

The Physics Education cluster studies how students learn physics and how teaching practices affect outcomes. Comprising 4 academic staff and 1 PhD student, current research focuses on using machine learning to analyse socio-demographic disparities in degree outcomes, exploring AI's role in education, examining how institutional culture and psychology shape student identity and belonging, and developing inclusive public engagement experiences.

For more information contact Dr Andrew Low or visit liverpool.ac.uk/physics/research/physics-education-research/

Particle Physics

Our particle physics cluster is one of the largest in the UK and we conduct research into a wide range of phenomena at facilities across the globe, including CERN, Fermilab, JPARC, Sandford, Kamioka and PSI. We specialise in physics analysis and the development and delivery of detectors. Our 23 academics, 64 research staff, and 37 PhD students work across areas including: The **ATLAS** experiment at the LHC played a leading role in the discover of the Higgs boson. We now deepen our understanding of the Higgs, search for new physics and develop detectors for the HL-LHC. This is complemented by the **FASER** experiment. **LHCb** studies the behaviour of B mesons and develops future trackers. We study **Neutrino** oscillations at **T2K, Hyper-Kamiokande, SBND** and **DUNE**, and search for neutrinoless double beta decay with **LEGEND**. Our direct **Dark Matter** searches include **LZ** and **Darkside**, and applications of quantum technologies at **Magis** and **AION**. We make precision measurements of **Muon** properties like **g-2** and search for rare decays at **Mu2e** and **Mu3e**. Our research is underpinned by our long-standing expertise in development of new detectors including next generation silicon detectors and liquid argon time projection chambers.

For more information contact Prof Neil McCauley or visit liverpool.ac.uk/physics/research/particle-physics/

From our current PhD students

Sinead Eley (Particle Physics, LIV.INNO)

"I've just completed my first year of my PhD working on dark sector searches with the FASER detector. Having completed my undergraduate degree at Liverpool, I felt comfortable here and knew it was somewhere that I would be supported during my PhD. We have a strong community feeling here where everyone is welcoming and happy to have a chat. There have been countless opportunities during my first year, one that stands out is WONDRS, a conference specifically for gender minorities in STEM, this really helped to address the imposter syndrome many of us face as researchers."

liverpool.ac.uk/physics

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Department of Physics

More from our current PhD students

Adam McCarter (Nuclear Physics)

"I moved from Edinburgh to Liverpool to do a PhD in nuclear physics. Now in my final year, I have discovered a new isotope that decays by emitting protons. The experiment was conducted in Finland, where I spent a year on long term attachment. I have visited other labs in Italy and Poland, presented my work at international conferences and I have won beam time to look for another new proton emitter. These were unique opportunities, and I feel incredibly privileged to have worked with the fantastic group of people at Liverpool, who have made my PhD thoroughly enjoyable."

Baltazar Guedes (Condensed Matter)

"I am a second-year condensed matter physics PhD student, working with in-situ x-ray and electrochemical characterisation of materials, to obtain information on the structure changes of electrodes and electrolytes in electrochemical environments. Having spent my under-graduate years at the university and continuing with my PhD, both the university and city have been a friendly and welcoming place that I am more than happy to be working at. The department is very diverse and there is always something exciting to discuss with peers. Collaborations across the university enable to do research in ways we have never expected!"

Equality, Diversity and Inclusion

We are committed to equality, diversity, and inclusion (EDI). Our department is a JUNO practitioner (the IOP's flagship gender equality award) and we hold an Athena Swan silver award. The university has a Race Equality Charter bronze award and is part of Disability Confident and Stonewall Diversity Champions.

EDI in our department is led by staff and student champions. Recent activities include pursuing the IOP inclusion award and hosting the Conference for Undergraduate Women and Non-Binary Physicists. Postgraduate students play a crucial role in EDI as members of the EDI champions and in 2024 developed and delivered the first annual Woman and Non-binary Doctoral Researchers in STEM, WONDERS, conference.

We strive to help all students reach their potential, regardless of any disabilities or health conditions. Our inclusive programmes offer personalised support plans. If you have any questions, email the disability support team: disteam@liverpool.ac.uk

IOP Institute of Physics Juno Practitioner
Athena SWAN
Race Equality Charter

Meet some of our alumni

Dr. Julia Tena Vidal

Júlia did her PhD in the particle physics group and the LIV.DAT CDT. She received the best PhD Award in 2023 for her outstanding work modelling neutrino interactions with matter. She is now working as a post-doctoral research assistant at the Tel Aviv University's Particle Physics Group.

Dr. Amir Salehilashkajani

Amir did his thesis in our Accelerator Physics group working on beam monitoring. His device was installed at CERN's Large Hadron Collider in 2022. He is now a research scientist at CoMind, developing non-invasive brain imaging methods for patients with traumatic brain injuries.

Dr. Jaimie Platt

Jaimie graduated from her Nuclear Physics Ph.D. investigating the feasibility of a novel gamma-ray imaging system for characterising radioactive waste in 2021. She now works as a Decommissioning Characterisation Consultant at Amentum.

Dr. Wai Yuen (Alan) Chan

Alan did his PhD in the ATLAS experiment at CERN searching for heavy Higgs bosons. After his graduation in 2021, he worked in quantum computing at the University of Tokyo. Currently he is a researcher working at Brookhaven's Electron-Ion Collider Project, which is currently under construction.

A warm welcome from our Postgraduate Research team!

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