



# PHYSICS

# AT THE UNIVERSITY OF LIVERPOOL

Prof Tim Veal Head of Department





### **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:



AstrophysicsMedicalNuclearRenewable EnergyBiophysicsParticleMaterialsAccelerators



### EQUITY, DIVERSITY AND INCLUSIVITY

• We hold a Juno Practioner 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





# LIVERSITY OF

### 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

Department of Physics



liverpool.ac.uk/physics



### **PHYSICS DEPARTMENT RESEARCH**

Monica D'Onofrio

Head of Research & Impact, DHoD, Physics

28/11/2024, Postgraduate Open Day





# LIVERPOOL

### **Research in the Department at a glance**



 Research clusters: Particle Physics, Nuclear Physics, Accelerator Science, Condensed Matter.

- Physics Education overarching (research and enhancement)
- Research in Al/data science, quantum, sustainable technologies, medical physics underpinned by all clusters

• More than **120** PhD students enrolled in our programmes (STFC CDT <u>Big Data Science (LIV.DAT)</u>, <u>Innovation in Data Intensive Science</u> (<u>LIV.INNO</u>), EPSRC CDT's on <u>New and Sustainable Photovoltaics</u> and <u>Risk & Uncertainty</u>, EU ITN <u>Medical Accelerators</u> and <u>Antimatter Physics</u>).







tor 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.

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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/



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:

V.INNC

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).

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

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#### **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/physicseducation-research/

liverpool.ac.uk/physics

#### 🔆 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 longstanding 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/particlephysics/



#### From our current PhD students

IV.INNO 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 upported during my PhD. We have a strong community feeling here where everyone is welcoming and happy to have a chat. There have been co 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."

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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  $\rightarrow$  develop impact as an integral outcome of our research programme

Highly-complex experiments, with large international collaborations  $\rightarrow$  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).

#### $\rightarrow$ excellent local facilities



Liverpool Semiconductor Detector Centre





Detector Development Manufacturing Facility and Advanced Material lab

Nuclear Lab Detector Characterization Centre



Four research themes of common interest:

- Quantum
- Data science and Al
- Medical physics
- Sustainability

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





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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)





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

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

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



LHCb data reconstruction: problem to be addressed  $\rightarrow$  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.



Four research themes of common interest:

- Quantum
- Data science and AI
- Medical physics
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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.



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:



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

#### Solar cell Devices research





### PhD programmes

- Several other activities in close collaboration with STFC/Daresbury/Liverpool and with engagement of local industries in development
- Overarching importance of training 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**.



# 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)



# **2025 PhD studentship positions**

- When they start: 1<sup>st</sup> October 2025
- Topics cover 4 basic areas: Accelerator Physics (AP), Condensed Matter Physics (CM), Nuclear Physics (NP), Particle Physics (PP)
- Funding information:
  - Research Council Scholarships:
    - EPSRC (CM)
    - STFC (AP, NP, PP), including LIV.INNO: Liverpool Centre for Doctoral Training for Innovation and Data Intensive Science
  - 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 (but details may be different on occasion, e.g. Livinno has 4 years, including a 6-month placement)



# **Scholarship information**

- Research Council Studentships usually cover:
  - UK tuition fees
  - Stipend of ~£19k 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/



# 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



# **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 more than 120 PhD students
- Most accelerator physics students are based at the Cockcroft institute
- Condensed matter students are based on SIRE, Surface Science and Oliver Lodge Laboratory
- Nuclear and Particle physics students are in Oliver Lodge Laboratory
- We have together with us a few PhD students in this event, feel free to ask them questions!



# 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 Physics: Dr Hao Zhang, <u>Hao.Zhang3@liverpool.ac.uk</u>
  - Condensed Matter: Dr Frank Jaeckel, <u>Frank.Jaeckel@liverpool.ac.uk</u>
  - Nuclear Physics: Prof Robert Page, <u>R.D.Page@liverpool.ac.uk</u>
  - Particle Physics: Prof Neil McCauley, <u>N.McCauley@liverpool.ac.uk</u>



# What funded PhDs I can apply for?

#### **Accelerator Physics**



**Nuclear Physics** 



**Condensed Matter** 



#### **Particle Physics**







# **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. Current recipients from our department: Conor McPartland (final year Particle Physics):

https://www.iop.org/about/support-grants/bell-burnell-fund/2024-awardees/conor-mcpartland Elen Oldershaw (first year Education):

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





# **Bell Burnell Graduate Scholarship Fund**

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

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 has to be external.

Send me (<u>rompotis@liverpool.ac.uk</u>) a proposal by December 13th and we will get back to you as soon as possible with enough time to prepare the application that has deadline January 20





# Visit our webpage for more information

Department

of Physics

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



#### 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 blease visit our website or get in touch with me at any time!" Prof Tim Veal, Head of Department



#### World-leading Research

student, you will be a crucial part in this work

The most recent Research Excellence

us amongst the UK's top 10 physics

and the quality of our research

🥑 👩 @livuniphysics

environment.

Instagram

departments for our research outputs

Prof Monica D'Onofrio, Head of Research

liverpool.ac.uk/physics

physics@liverpool.ac.uk

Framework assessment (in 2021) placed

Our research is carried out across research clusters.

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!

Accelerator Science, Condensed Matter, Nuclear Physics, Particle Physics, underpinned by continuous As a PhD student you will learn how to perform researc enhancements in Physics Education and transversal both independently and as a part of a research group. activities and work on cutting edge technologies in fields. You may work for large or small international such as artificial intelligence, renewable energy and collaborations, and you may have opportunities to take sustainable technologies, innovative materials, long-term attachments in overseas laboratories like semiconductor and quantum sensors, and medical CERN. During year 1, you will attend both subject physics. Through a programme of exploration and discovery, we are addressing the most fundamental specific and wider skill training. You will have the chance to attend seminars, go to schools and conferences questions in physics. Our staff contribute to - and often and participate in undergraduate teaching. Within 4 lead - experiments in Liverpool and at international years, you will have to submit a thesis for examination laboratories like CERN, Fermilab, and ESRF. As a PhD

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



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#### Our research Clusters



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liverpool.ac.uk/physics

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#### rom our current PhD students

Sinead Eley (Particle Physics, LIV.INNO) ve just completed my first year of my PhD rking on dark sector searches with the FASER ctor. Having completed my undergraduat gree at Liverpool. I felt comfortable here and ew it was somewhere that I would be oported during my PhD. We have a strong munity feeling here where everyone is coming and happy to have a chat. There have b portunities during my first year, one that stands out is NDRS, a conference specifically for gender minorities in FEM, this really helped to address the imposter syndrome m f us face as researcher



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ore than happy to be working at. The department is very

verse and there is always something exciting to discuss with

Equality, Diversity and Inclusion

Ve 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** 

eers. Collaborations across the university enable to do

search in ways we have never expected!

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Dr. Julia Tena Vidal 💷 🗶 úlia did her PhD in the particle physics roup and the LIV.DAT CDT. She receiv e best PhD Award in 2023 for her utstanding work modelling neutrino nteractions with matter. She is now working as a post-doctoral research assistant at the Tel Aviv University's

Department

of Physics

Particle Physics Group Dr. Amir Salehilashkajani Amir did his thesis in our Accelerato roup working on beam monitoring. His evice was installed at CERN's Large Hadr Collider in 2022. He is now a research

scientist at CoMind, developing non-inv brain imaging methods for patients with raumatic brain injuries Dr. Jaimie Platt Jaimie graduated from her Nuclear Physics

Ph.D. investigating the feasibility of a nov gamma-ray imaging system for characterising radioactive waste in 2021. She now works as a Decommissioning Characterisation Consultant at Amentur

#### Dr. Wai Yuen (Alan) Chan 📩 lan did his PhD in the ATLAS eriment at CERN searching for heav ggs bosons. After his graduation in 021, he worked in quantum computi

at the University of Tokyo. urrently he is a researcher working at Brookhaven's Electron-Ion Collider Project, which is

EDI in our department is led by staff and student champions lecent activities include pursuing the IOP inclusion award and rrently under construction. sting the Conference for Undergraduate Women and Non-A warm welcome from our Postgraduate Binary Physicists. Postgraduate students play a crucial role in EDI as members of the EDI champions and in 2024 developed Research team! and delivered the first annual Woman and Non-binary earchers in STEM. WONDERS, confere



Athena IOP Institute of Physics



liverpool.ac.uk/physics





Condensed Matter Physic

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

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physics of reaction dynamics as well as electrochemical Imaging and Medical Diagnostics use IR imaging in near

and far-field to study biological specimens (particularly Solar Energy Conversion research prepares and investigates new materials for both solar hydrogen and

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Our fundamental science aims to understand how



For more information contact Prof Robert Page or visit



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# **Tom Wonderley – My Background**

- 3<sup>rd</sup> Year PhD Student Nuclear Instrumentation
- Funded through LIV.INNO CDT
- 7<sup>th</sup> Year at UoL (Undergraduate + PhD)
- Masters work focused on Nuclear Structure of Cerium-132





Experimental Work





 Computational Data Analysis (Machine Learning)







### LIVERSITY OF LIVERPOOL **Travel**











# Stephenson Institute for Renewable Energy – PGR Event

Baltazar Guedes



#### About me:

- Born in Portugal.
- Did my undergraduate at the University of Liverpool.
- Second year Condensed Matter Physics PhD student working with Fundamental Electrochemistry.
- Supervised by Prof. Chris Lucas and Dr. Yvonne Gründer.







#### The SIRE:





The Stephenson Institute for Renewable Energy is dedicated to the research of energy generation, storage, materials manufacturing and characterisation.



#### My research:



Electrochemistry is the study of the interactions and structure changes at the interface of an electrode and electrolyte.

### Au(001)




### Travelling for experiments:





### Always something to do:







### Different things to enjoy:

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### UNIVERSITY OF LIVERPOOL Events and Seminars

## After work activities





### Travel



## UNIVERSITY OF LIVERPOOL

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# **Nuclear Physics**

**Contact: Prof Robert Page** 

R.D.Page@liverpool.ac.uk



# **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







## **Our Research** (nuclei under extreme conditions)

**WITH** 

Z=82

WWWW

• Exploring the limits of nuclear existence for heavy proton-rich nuclei

Z=28

- 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



### UNIVERSITY OF LIVERPOOL

## **Experiments at international facilities**







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### Prof Dave Joss, Dr Liam Gaffney, Prof Robert Page





### Prof Dave Joss, Dr Liam Gaffney, Prof Robert Page







### Prof Andy Boston

Mirion (1 studentship)

SATURN CDT (2 studentships)

# **Applied Nuclear Physics**



https://www.saturn-nuclear-cdt.manchester.ac.uk/

To be confirmed!

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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,
- Cluster leader: Prof. Rodi Herzberg,

R.D.Page@liverpool.ac.uk

rdh@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



# **Accelerator Science at Liverpool**

Visit our **websites** for more information <u>http://www.liverpool.ac.uk/physics/research/accelerator-physics</u> <u>http://www.quasar-group.org</u>

- Cluster leader: Prof Carsten P Welsch
- Academics: Prof Andy Wolski, Dr Andrea Santamaria Garcia (starting Feb 2025) + Prof James Bradley (EEE), Dr Laura Corner and Prof Geoff Dearden (Engineering)
- Deputy PGR Director: Dr Hao Zhang



# **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 four universities and national labs;
- world leading in accelerator research, education and training;
- the largest UK provider of accelerator science training.
- Learn more: <u>https://youtu.be/e6COn4bp-AQ</u>





## 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.





## What does the Cl research?

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





# **Study with University of Liverpool at The Cl**

- 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: <u>https://youtu.be/6tPYg1fTny0</u>





### 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

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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



### Realization of a Cherenkov-Diffraction Radiation based Outcoupling Scheme for Beam Diagnostic Applications

- The emission of Cherenkov radiation (ChDR) by charged particles traveling in the vicinity of a dielectric material is comparably high light yield and large emission angle could be used as a non-invasive beam diagnostics.
- This project will investigate the ChDR in view of light extraction out of the accelerator vacuum system in the visible and infrared spectral region with possible applications for bunch length diagnostics and timing applications in the ~10 fs range.
- Collaboration with DESY in Hamburg, Germany in the DESY LINAC & PETRA III beam line, where you would be based for 2 years. Project is part of LIV.INNO = comprehensive training in data science and industry placement!



### Contact: Dr Hao Zhang, Dr Joe Wolfenden and Prof Carsten Welsch



### Instrumentation studies for AWAKE Run 2c

- AWAKE is the world's first proton-driven plasma wakefield acceleration experiment.
- Run 2c requires novel instrumentation to measure and monitor the three beams, (proton, electron, and laser) throughout the acceleration process. Longitudinal pulse profile with fs resolution in this project is one of many.
- Collaboration with U Manchester and CERN, opportunities to visit and be based at CERN for up to one year and support the success of Run 2c.



Contact: Dr Joe Wolfenden, Dr Guoxing Xia (Manchester) and Prof Carsten Welsch



# Beam gas curtain monitor for the High Luminosity LHC

- The BGC has already demonstrated to work exceptionally well for both protons and heavy ions across the LHC energy range.
- Additional monitors will be installed in a test stand and for LHC beam 2 during LS3.
- To fully exploit the potential of this novel beam monitor, detailed simulation studies are required that further the understanding of the jet generation and formation process, jet-beam interaction, as well as image acquisition and analysis.
- Collaboration with CERN, will be based at CERN for 2 years for installation and measurements; part of LIV.INNO



Contact: Dr Hao Zhang, Dr Stefano Mazzoni (CERN) and Prof Carsten Welsch



### Carbon Nanotube-based Ultra-compact Particle Accelerators

- Plasma-based compact particle accelerators stand out as a leading candidate for future high-energy accelerators.
- An innovative approach: Carbon nanotube (CNT) based solid-state particle accelerators could achieve an even higher accelerating gradient.
- CNTs are graphene-based single- or multi-wall tubular structures.
- Wider collaboration between UoM, UoValencia, Spain, DESY, PSI and Federal University of Health Sciences of Porto Alegre, Brazil

**Contact: Dr Bifeng Lei and Prof Carsten Welsch** 





### Sustainable Beam Diagnostics for Particle Accelerators

- Beam diagnostics are essential for monitoring and controlling particle beams, but current technologies often consume significant resources and energy.
- The research will address these challenges by designing diagnostics with reduced environmental footprints through advanced material choices, optimized designs, and life cycle analysis (LCA).
- This project is ideal for candidates with a strong background in physics or engineering and an interest in computational modelling and applied physics.
- Collaboration with Daresbury Laboratory, STFC/ASTeC, CERN and DESY; Part of LIV.INNO.

Contact: Dr Hao Zhang, Dr Joe Wolfenden and Prof Carsten Welsch



### Novel laser plasma acceleration: making accelerators smaller, cheaper, better

Laser wakefield acceleration has demonstrated high rates of acceleration but shot-to-shot stability is poor. One reason for this is the poor quality of particle bunches that are injected into these accelerators. One possible solution is to inject very high-quality bunches from a conventional accelerator.

This project is experimental and numerical in nature, involving work with high power lasers and particle accelerators (specifically: CLARA at Daresbury).

You will be based primarily at the Cockcroft Institute, with some work in the laser lab at the University of Liverpool. Options for international work are available.

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





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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







Energy Technologies

#### SIRE

New materials for energy conversion Thermoelectric materials Spin transport

### Nanoscience

Surface Science Reseach Centre and SIRE Quasicrystals Hybrid nanomaterials Electrochemistry Electron microscopy



SIRE and ChemistryLiquid liquid interface electrochemistryNanoparticles for energy conversion3D printing and microfluidicsSustainable emulsion design

### SIRE and ESRF Functional materials for energy conversion and

storage

Microelectronics

#### Structure and Dynamics at solid liquid interfaces

### Low-Temperature Physics

Oliver Lodge Ultracold ion neutral reactions Radical surface interactions Atomic collision modelling

## **Biophysics**

Oliver Lodge and Chemistry IR and microscopic imaging Tissue structure and function Cancer diagnostics 3D printed tissue models



## **Studentships in Condensed Matter**

- ~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 2024 interviews in February

### For more information:

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



Atomic structure of a high entropy alloy

### **Surface Properties of High Entropy Alloys**

Supervisor: Dr Hem Raj Sharma, H.R.Sharma@liverpool.ac.uk

- □ High entropy alloys (HEAs) are a new type of solid material, formed by at least five elements randomly distributed on crystal lattice sites.
- HEAs exhibit unexpected properties, opening new areas of research in fundamental science and technological applications within the fields of materials science and physics.
- Many potential applications of HEAs, such as catalysts and coating materials for the transport and aerospace industries, are closely related to surface phenomena.
   However, there is currently very little research on the surface properties of HEAs.
- This project focuses on the characterisation of the surface atomic and electronic properties, as well as the oxidation behaviour of HEAs, using ultra-high vacuumbased experimental techniques. These include X-ray Photoemission Spectroscopy (XPS), Scanning Tunnelling Microscopy (STM), and Low Energy Electron Diffraction (LEED).
- The ultimate aim is to achieve an atomic-scale understanding of HEA surfaces and interfaces, which would be crucial for optimising their properties for industrial applications.

## Artificial Optical Synapses Based on Solar Cells for Neuromorphic Computing



Typical Sb<sub>2</sub>Se<sub>3</sub> solar cell structure



Example of a Se-based visual synapse being potentiated by 455nm illumination pulses and reset through a negative electrical bias or mechanical bending.

- To redeploy thin-film solar cells produced in the Stephenson Institute for artificial synapses.
- Allows light pulses to be converted to programable information for Neuromorphic computing.
- Student will learn to fabricate complete cell structures and undertake characterisation/analysis to assess synaptic properties of current signal.

#### Supervisors





Dr Jon Major Dr Laur

Dr Laurie Phillips





Part of **SOLIS** project collaborating with labs in Barcelona, Verona, Tallinn, Cape Town, Rabat, Manilla, Kyoto

Research placements at partner labs during PhD

### Cancer research: SciaScan group (Peter Weightman and colleagues)

**Development of the Liverpool Diagnostic Infrared Wand (LDIR Wand)** 1 Apply patented machine learning algorithm to Infrared

spectral images of cancer cancerous tissue

2 Determine key infrared wavelengths for cancer progression

3 Two variants of the LDIR Wand use the key wavelengths

a) Use in histopathology laboratory for analysis of biopsies
b) In-situ probe for operating theatre







Current research projects Oral cancer, Breast Cancer, Lung Cancer, Cervical Cancer, Uveal Melanoma Funding is being sought to support to a PhD student

## Combined Xray and Raman spectroscopy for battery materials

The aim of the project is to combine within a single measurement: *in situ* Raman and *in situ* x-ray spectroscopy and scattering methods for electrochemical and more specific battery related systems.

> You will work in a laboratory, learn about conducting xray experiments (in Grenoble) and Raman spectroscopy and the associated data analysis

The project will be based in the Stephenson Institute for Renewable Energy at UoL with placements to the XMaS beamline in Grenoble (France)







Operando XRD



Contact: grunder@liverpool.ac.uk







Supervisors: Yvonne Grunder (Physics), Laurence Hardwick (Chemistry), Chris Lucas (Physics)

### Ultrafast transient absorption spectroscopy of bacterial photosynthetic supercomplexes

### Dr Frank Jaeckel (CMP and SIRE), Prof Luning Liu (Biology), Dr Adrian Gardner (Chemistry, SIRE, and Laser Laboratory)





#### AIM

- Investigate a range of modified light harvesting reaction center complex with ultrafast transient absorption spectroscopy
- Gain understanding of energy and charge transfer dynamic on the ps time scale
- Elucidate structure function relationship in those complexes KEY POINTS
- Work in a highly interdisciplinary team
- Work with ultrafast lasers
- Opportunities to learn some biological techniques as well



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# **Particle Physics**

### **Contact: Prof Neil McCauley**

n.mccauley@liverpool.ac.uk



# **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)





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

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



Liverpool Semiconductor Detector Centre





Advanced Materials Laboratory



Detector Manufacturing Facility



## **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







# **Energy Frontier**

### ATLAS Experiments at CERN

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





### **Neutrinos & the Dark Matter**

- Neutrino physics group:
  - Neutrino oscillations, CP violation, neutrino properties
  - T2K, Hyper-Kamiokande, DUNE, SBND, JUNO
- Dark Matter
  - LZ experiment & Future Xenon Detectors
  - 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









### 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 ( $\mu \rightarrow e, \mu \rightarrow eee$ )
  - Experiments: g-2 (FNAL), Mu2e (FNAL), Mu3e (PSI), MuonE (CERN), MuEDM (PSI)
  - Low mass precision tracking detectors built at Liverpool





# 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/PSI/KEK 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 29th (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 Andrew Low** 

andrew.low@liverpool.ac.uk



# **Physics Education Research**

- Recently formed research cluster
- Currently 1 PhD student (awarded the Jocelyn-Bell Burnell Scholarship)
- Limited funding opportunities but if you wish to discuss further, please contact Andrew Low
- 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
  <u>nikolaos.rompotis@liverpool.ac.uk</u>
- Accelerator Physics: Dr Hao Zhang, <u>Hao.Zhang3@liverpool.ac.uk</u>
- Condensed Matter: Dr Frank Jaeckel, <u>Frank.Jaeckel@liverpool.ac.uk</u>
- Nuclear Physics: Prof Robert Page, <u>R.D.Page@liverpool.ac.uk</u>
- Particle Physics: Prof Neil McCauley, <u>N.McCauley@liverpool.ac.uk</u>
- Education: Dr Andrew Low, Andrew.Low@liverpool.ac.uk





### Visit our webpage for more information

Department

of Physics

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



### 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 blease visit our website or get in touch with me at any time!" Prof Tim Veal, Head of Department



### World-leading Research

student, you will be a crucial part in this work

The most recent Research Excellence

us amongst the UK's top 10 physics

and the quality of our research

🥑 👩 @livuniphysics

environment.

Instagram

departments for our research outputs

Prof Monica D'Onofrio, Head of Research

liverpool.ac.uk/physics

physics@liverpool.ac.uk

Framework assessment (in 2021) placed

Our research is carried out across research clusters.

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!

Accelerator Science, Condensed Matter, Nuclear Physics, Particle Physics, underpinned by continuous As a PhD student you will learn how to perform researc enhancements in Physics Education and transversal both independently and as a part of a research group. activities and work on cutting edge technologies in fields. You may work for large or small international such as artificial intelligence, renewable energy and collaborations, and you may have opportunities to take sustainable technologies, innovative materials, long-term attachments in overseas laboratories like semiconductor and quantum sensors, and medical CERN. During year 1, you will attend both subject physics. Through a programme of exploration and discovery, we are addressing the most fundamental specific and wider skill training. You will have the chance to attend seminars, go to schools and conferences questions in physics. Our staff contribute to - and often and participate in undergraduate teaching. Within 4 lead - experiments in Liverpool and at international years, you will have to submit a thesis for examination laboratories like CERN, Fermilab, and ESRF. As a PhD

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



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### 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 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.

liverpool.ac.uk/physics

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



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

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

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 evoloits 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+.

### Physics Education

liverpool.ac.uk/physics

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 or more information contact Dr Andrew Low or

isit liverpool.ac.uk/physics/research/physic education-research/



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

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properties like g-2 and search for rare decays at Mu2e and Mu3e. Our research is underpinned by our longstanding 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/particl

### rom our current PhD students

Sinead Eley (Particle Physics, LIV.INNO) ve just completed my first year of my PhD rking on dark sector searches with the FASER ctor. Having completed my undergraduat gree at Liverpool. I felt comfortable here and ew it was somewhere that I would be oported during my PhD. We have a strong munity feeling here where everyone is coming and happy to have a chat. There have b portunities during my first year, one that stands out is NDRS, a conference specifically for gender minorities in FEM, this really helped to address the imposter syndrome m f us face as researcher



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ore than happy to be working at. The department is very

verse and there is always something exciting to discuss with

Equality, Diversity and Inclusion

Ve 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** 

eers. Collaborations across the university enable to do

search in ways we have never expected!

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Dr. Julia Tena Vidal 💷 🗶 úlia did her PhD in the particle physics roup and the LIV.DAT CDT. She receiv e best PhD Award in 2023 for her utstanding work modelling neutrino nteractions with matter. She is now working as a post-doctoral research assistant at the Tel Aviv University's

Department

of Physics

Particle Physics Group Dr. Amir Salehilashkajani Amir did his thesis in our Accelerato roup working on beam monitoring. His evice was installed at CERN's Large Hadr Collider in 2022. He is now a research

scientist at CoMind, developing non-inv brain imaging methods for patients with raumatic brain injuries Dr. Jaimie Platt Jaimie graduated from her Nuclear Physics

Ph.D. investigating the feasibility of a nov gamma-ray imaging system for characterising radioactive waste in 2021. She now works as a Decommissioning Characterisation Consultant at Amentur

### Dr. Wai Yuen (Alan) Chan 📩 lan did his PhD in the ATLAS eriment at CERN searching for heav ggs bosons. After his graduation in 021, he worked in quantum computi

at the University of Tokyo. urrently he is a researcher working at Brookhaven's Electron-Ion Collider Project, which is

EDI in our department is led by staff and student champions lecent activities include pursuing the IOP inclusion award and rrently under construction. sting the Conference for Undergraduate Women and Non-A warm welcome from our Postgraduate Binary Physicists. Postgraduate students play a crucial role in EDI as members of the EDI champions and in 2024 developed Research team! and delivered the first annual Woman and Non-binary earchers in STEM. WONDERS, confere



Athena IOP Institute of Physics



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Condensed Matter Physic

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

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

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physics of reaction dynamics as well as electrochemical Imaging and Medical Diagnostics use IR imaging in near

and far-field to study biological specimens (particularly Solar Energy Conversion research prepares and investigates new materials for both solar hydrogen and

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Our fundamental science aims to understand how



For more information contact Prof Robert Page or visit



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