# LIV.DATA NEWS

Issue 02 | July 2024

## Data is everywhere

Data is the cornerstone of modern society, driving improvements in healthcare, education, and urban development. The latest policies on AI and innovation highlight the importance of leveraging data for societal good.

LIV.INNO's mission is to use data for impactful research and real-world solutions. Our aim is to help ensure that technological advancements benefit everyone, fostering a future where innovation and well-being go hand in hand. This newsletter describes how we train the next generation of experts through focused schools and presents some of our latest research results.

Prof Carsten P. Welsch
LIV.INNO Director

## Using data science to understand rare Higgs boson decays

Several LIV.DAT students have worked as part of the ATLAS collaboration while undertaking their PhDs. The ATLAS detector in the LHC at CERN collects large amounts of data and processing this data presents many data science challenges. Some of these challenges have been overcome by students working in the LIV.DAT CDT using techniques which they have learned as part of their PhD training.

LIV.DAT student Adam Ruby's PhD presented a search for the decay of the Higgs boson into a Z boson and a light, pseudoscalar known as an axion-like particle (ALP). ALPs are particles that, if they exist, may play a role in explaining some unknown phenomena of the Standard Model, such as the strong CP-problem. ALPs are also a good dark matter candidate as they are thought to interact less frequently with matter. Work in this area has recently been published in the journal Physics Letters B as part of a paper by the ATLAS collaboration Data recorded by the ATLAS experiment at the LHC corresponding to an integrated luminosity of 139 $fb^{-1}$ from proton–proton collisions at a centre-of-mass energy of 13 TeV, was used to search for a rare decay of the Higgs boson to a $Z$

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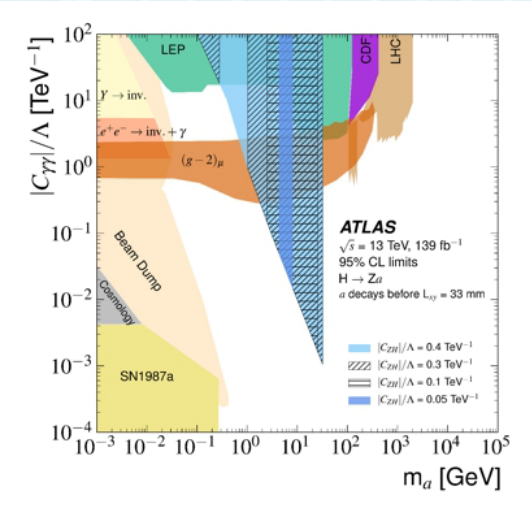
boson and an axion particle $a$, with a mass between 0.1 GeV and 33 GeV. This was one of the first searches for this specific decay mode of the Higgs boson, and it probes unexplored parameter space in models with axion-like particles (ALPs) and extended scalar sectors.

The $Z$ boson was reconstructed using an electron or muon pair, while the particle $a$ candidate was reconstructed from a pair of photons. The analysis accounts for the cases in which both photons are close enough to be reconstructed as a single photon in the detector, or topologies where they are reconstructed as two separate photons. No significant deviations with respect to the Standard Model predictions were observed and upper limits are set on the branching ratio of the Higgs boson decay to $Za$ times the branching ratio $a \to \gamma\gamma$, ranging from from 0.08% to 2% depending on the mass of the $a$ particle.

The published paper can be found here.




ATLAS observed 95% CL exclusion contours limits in terms of the ALP mass and its effective coupling to photons, |Cγγ|/Λ, for different values of the Higgs coupling to Za, |CZH|/Λ. The overlaid contour limits from other direct experimental searches are shown as well. The collider bounds (LHC, LEP, CDF) are displayed at 95% CL, while the remaining bounds (SN1987a, Cosmology and Beam Dump) are presented at 90% CL. The red band shows the preferred parameter space where the (g − 2)μ anomaly can be explained at 95% CL. (Image credit: the ATLAS collaboration.)

**More information:**

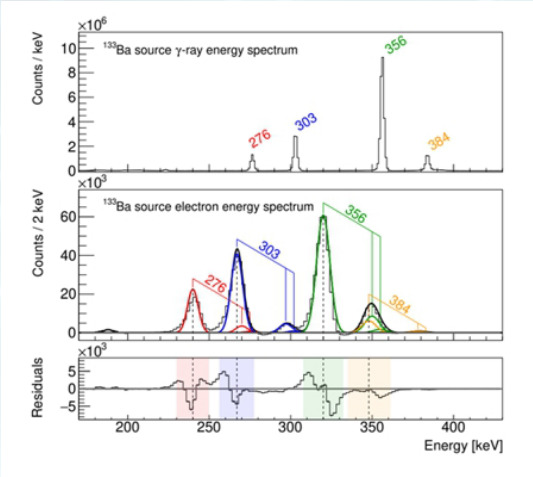
'Search for the decay of the Higgs boson to a Z boson and a light pseudoscalar particle decaying to two photons', The ATLAS Collaboration, Physics Letters B, Volume **850**, March 2024, 138536

https://doi.org/10.1016/j.physletb.2024.138536

# PRINCEPS: Towards the automation of simultaneous gamma ray and internal conversion electron analysis

LIV.DAT student Adrian Montes Plaza has recently had a paper published about the code he has developed to facilitate the analysis of conversion electron spectra. Results obtained for $^{190}$Pb using this code were presented in the Mazurian Lakes Conference on Physics which was held last year in Piaski, Poland.

Transitions from excited states in atomic nuclei predominantly proceed via gamma ray or conversion electron emission, depending on their electromagnetic character and multipolarity. One of the best fingerprints for shape coexistence in nuclei is the measurement of conversion electrons. In order to extract electron intensities or internal conversion coefficients (ICCs), the measured electron spectra needs to be deconvoluted into the different components.




Acta Phys. Pol. B Proc. Suppl. 17, 3-A11 (2024) CC-BY 4.0. (Colour on-line) γ-ray and electron energy spectrum measured with a $^{133}$Ba source employing the SAGE spectrometer. The calculated spectrum obtained with PRINCEPS is overlaid with the measured one. The most prominent transitions are colour-coded, while the calculated total energy spectrum is in black. Transition energies in $^{133}$Cs are labelled, whereas K-, L-, and M-components have been marked with lines. In the residuals, K-component 3σ energy widths are colour-shaded. A 3σ grey band is also shown according to the residuals uncertainty average.

PRINCEPS (PRogram for INternal Conversion Electron and Photon Spectroscopy) has been developed in order to analyse and deconvolute internal conversion electron energy spectra measured simultaneously with gamma rays. The code calculates the expected conversion electron spectrum based on the gamma ray information, i.e. energy, multipolarity and intensity for every transition. It also accounts for user-defined resolution and efficiency parameters. The determination of the ICCs is performed by employing the well-known BrIcc conversion coefficient calculator. However, PRINCEPS allows the user to include measured conversion coefficients via mixed multipolarities. In particular, it can handle E0 transitions based on the provided electron intensity.

The performance of PRINCEPS is demonstrated with a standard $^{133}$Ba calibration source and with experimental in-beam data from the isotope $^{190}$-Tl, for which three conversion coefficients have been reported above the 9- isomeric state.

**More information:**

'PRINCEPS: Towards the automation of simultaneous γ-ray and internal conversion electron analysis', A.M. Plaza, et al., Acta Physica Polonica B Proceedings XXXVII Mazurian Lakes Conference on Physics Probing Fundamental Properties of Matter with Rare Isotopes, Vol. **17** (2024), article 3-A11

https://www.actaphys.uj.edu.pl/fulltext?series=Sup&vol=17&aid=3-A11

# Machine Learning Sheds Light on the Milky Way's History

LIV.INNO student Andrea Sante has recently had a paper, 'Applying machine learning to Galactic Archaeology: how well can we recover the origin of stars in Milky Way-like galaxies?' published in the Monthly Notices of the Royal Astronomical Society. This paper discusses a new technique using machine learning to find stars that live in our galaxy but were born in other, smaller, galaxies which got cannibalised by the Milky Way.

This research has the potential to contribute significantly to our understanding of the formation of our galaxy and others alike.

Traditionally, astronomers have relied on simple distinctions in stellar motions, chemical makeup, and position to determine if a star formed within the Milky Way (in-situ) or originated in a smaller galaxy that was later devoured by our own (accreted). However, this method is not always effective, especially when looking at densely populated areas like the galactic disc.

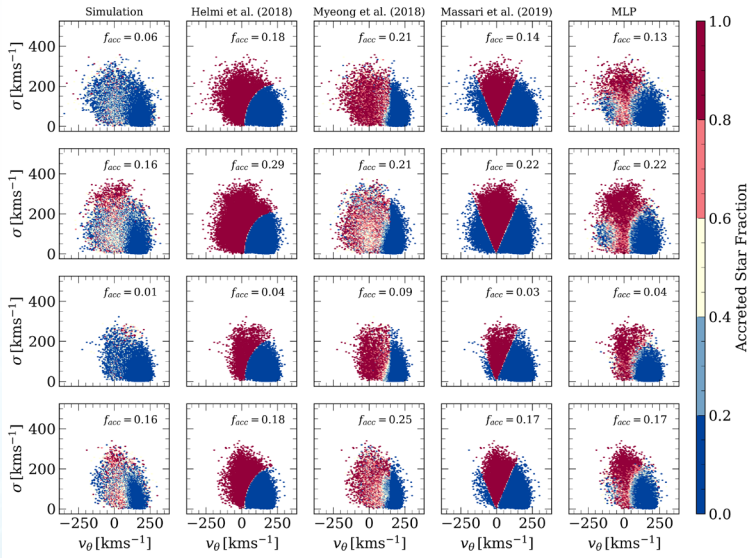
The new approach utilizes machine learning algorithms trained on data from complex computer simulations of galaxy formation. These algorithms can combine in complex ways all the available information on a star to determine its birthplace with greater accuracy.

"The models can identify accreted stars even in regions heavily dominated by in-situ stars," said lead author Andrea Sante.

This is a significant improvement, as it allows scientists to peer into the crowded disc and identify stars that may hold clues to the Milky Way's past mergers.

The technique was tested on additional simulations, demonstrating its effectiveness on unseen data. This bodes well for applying the method to real-world observations, potentially revealing previously hidden stellar streams and substructures within the Milky Way.

By deciphering the origin stories of our galaxy's stellar inhabitants, astronomers can piece together a more complete picture of galactic formation and evolution. This new machine learning technique offers a powerful tool to unlock the secrets written in the stars.




Comparison of the distribution of accreted (red) and in-situ (blue) stars colour-coded in the simulated Solar neighbourhoods. The rows corresponds to four different simulated galaxies. In the columns, the accreted stars are defined by: 1) the simulation label; 2-4) the observational selection criteria; 5) the label predicted by the MLP model, developed in this study. (Image credit: A. Sante, et al. Monthly Notices of the Royal Astronomical Society, Volume 531, Issue 4, CC-BY)

**More information:**

‘Applying machine learning to Galactic Archaeology: how well can we recover the origin of stars in Milky Way-like galaxies?’, Andrea Sante, Andreea S Font, Sandra Ortega-Martorell, Ivan Olier, Ian G McCarthy, Monthly Notices of the Royal Astronomical Society, Volume 531, Issue 4, July 2024, Pages 4363–4382

https://doi.org/10.1093/mnras/stae1398

# LIV.DAT student Magda Satrazani passes her PhD


Magda Satrazani (left) celebrating her success.

LIV.DAT student Magda Satrazani has successfully defended her PhD thesis on 'Gamma-ray spectroscopy of neutron-rich cerium isotopes following beta-decay of mass-separated caesium ions'. Her examiners were Dan Doherty (University of Surrey) and Helen Boston. Her supervisors were Liam Gaffney and Robert Page.

In her thesis, Magda studied the properties of excited states in $^{150}$Ce (proton number 58, neutron number 92), with a focus on identifying low-lying negative parity states which are important for understanding octupole deformation in nuclei. Using the technique of gamma-ray spectroscopy following beta decay at TRIUMF laboratory in Vancouver, Canada, Magda was able to identify these new states for the very first time, extending our knowledge of pear-shaped nuclei in this region of the nuclear chart. The results show that key states of interest increase slightly in energy compared to the less exotic neighbouring isotopes, implying that the maximum of the octupole correlations has already been reached at neutron number 88 or 90, in line with expectations from nuclear models.

Magda will start a post-doc position at KU Leuven, Belgium next month and we wish her all the best.

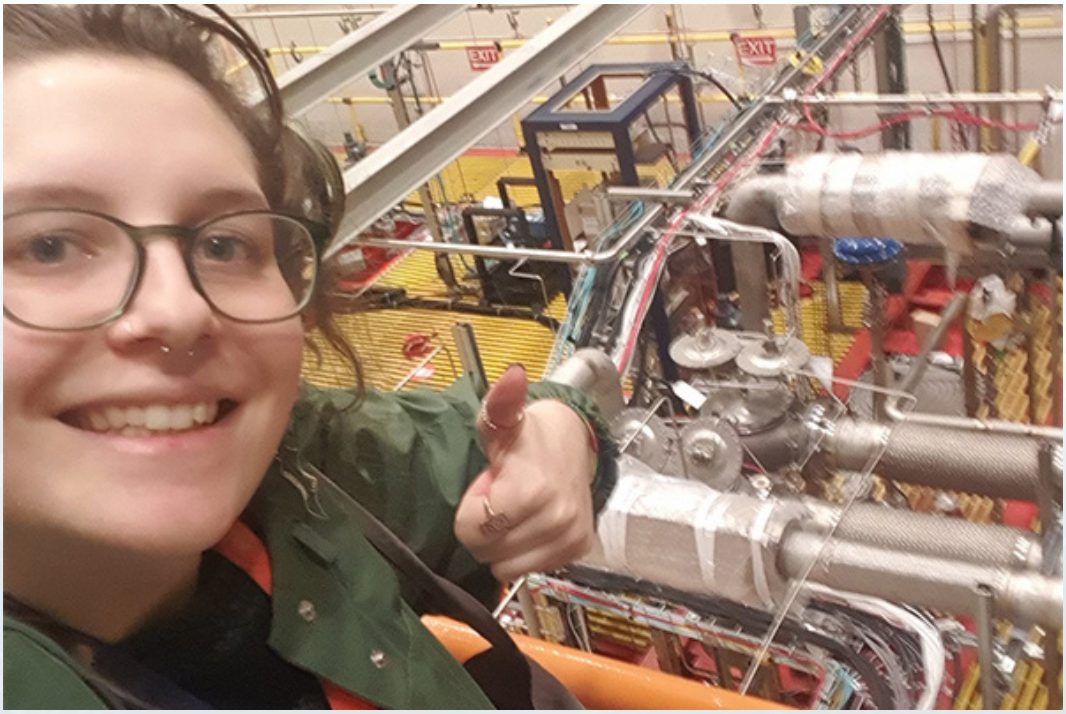
**Congratulations!**

# Searching for neutrinos using the Short Baseline Neutrino Detector at Fermilab

Like many particle physics PhD students, LIV.DAT student Beth Slater had the opportunity to spend time seeing the detector she was working on in action. For her this meant a transatlantic trip to Illinois, home to the Short Baseline Neutrino Detector (SBND) at Fermilab. Once she had arrived, Beth found herself surrounded by people who were all working on similar projects. It was unlike anywhere she had worked before; the sense of kinship and collaboration felt really special and helped to welcome her as she began her onsite research.

Neutrinos are notoriously difficult to detect so the community is always working to develop and improve the technologies they use. SBND is on the brink of collecting physics-quality data, meaning the whole collaboration is incredibly busy working hard to ensure readiness for the task ahead. With that in mind Beth wanted to maximise her time there, both to expand her experience and prepare the detector. Until now all her research work had been software based so she was excited, and a little scared, at the prospect of getting some hands-on hardware experience.

Once she had arrived, Beth joined the trigger group to work on testing all the subsystems to ensure they could efficiently record high-quality neutrino-rich data. SBND is special in that it will detect around two million neutrino events in a year, meaning it will quickly have one of the largest neutrino datasets in the world, resulting in exceptional statistics. Due to storage space limitations, it is impossible to record everything that happens in the detector so the trigger system is essential to set the conditions to record data when there is a potential to see a neutrino.




LIV.DAT student Beth Slater at Fermilab.

Beth's first task was to become familiar with each of the different subsystems at SBND and understand the intricacies of how they connect to record neutrino interaction data. The key areas she worked in were the light detection and cosmic ray tagger (CRT) subsystems. The light detection subsystem captures scintillation light to construct 3-dimensional tracks of particles passing through the detector and the CRT subsystem is to record cosmic ray events, the highest background in SBND. The CRT data has further applications for the commissioning and calibration of the detector. Detecting light is exceptionally important for the trigger as it is the fastest way to detect that something interesting is occurring.

Once Beth's understanding fully developed, she worked within the trigger team to test that each of the trigger types, which the collaboration desired was possible and produced the correct data. Timing is essential to reconstructing the events, so Beth spent a lot of time focusing on comparing the timestamps of various signals and ensuring the correct information was saved for each event.

A minor inconvenience of working through the summer at Fermilab is that the neutrino beam, which sends bursts of the particles to the detector, is not running. The trigger system relies on input signals from the beam to ensure the equipment is ready to record data every time there are neutrinos in the building so a simulated beam setup had to be devised to test the trigger system fully. Working collaboratively with the Beam and Timing Group, Beth helped to set up a series of function generators, fan out devices, and delay generators to simulate all relevant beam signals which are sent to a variety of components. Rigorous testing to ensure all systems ran as expected followed this. The simulated beam setup had the advantage of being adjustable to various frequencies, allowing a wider variety of tests of different trigger rates and beam frequencies to be possible.

Beth thoroughly enjoyed her time at Fermilab. She said: "Working with the trigger group was a completely different experience, and it felt amazing to be there in person, actively collaborating with people."

## Professor Welsch contributes to APS March meeting

LIV.DAT and LIV.INNO Director Professor Carsten P Welsch gave an invited talk on the Physics of Star Wars at the American Physical Society's (APS) March Meeting 2024. This is one of the largest physics conferences. It brought together more than 13,000 physicists from around the world in Minneapolis between 3-8 March 2024. Participants showcased their work, connected with others, and discovered groundbreaking physics research. It was a very special meeting this year as attendees joined to celebrate the 125th anniversary of APS.

Professor Welsch's talk was part of a session on Science Communication and International Public Impact on Thursday 7 March, chaired by CMS Spokesperson Patricia McBride from Fermilab. The talk showcased how the iconic films were used to explain the application of particle accelerators to science, society and commerce. The session also included presentations on CERN's 70th anniversary communication activities, the social media activities of the ATLAS experiment, the highly successful APS Physics Matters colloquia, and the non-

profit organization Investing In People in the Democratic Republic of Congo and the broader Central African region as examples of best practice.


Industry exhibition at the APS March meeting, (Image credit: APS)

In his talk, Professor Welsch described how each of his events reached hundreds of people on the day, and Millions around the world through media coverage. He gave an insight into the structure of his highly successful outreach events, presented the impact they have had and how this was assessed, and showed how the events have helped improve public awareness and understanding of accelerator technology.

By tapping into the universal appeal of Star Wars, Professor Welsch made complex physics concepts more relatable and inspired attendees to view the world around them through a lens of scientific inquiry. Over the years, the Physics of Star Wars events have had a significant impact on promoting public engagement with science. Through events, hands-on activities, material for science teachers and public lectures, Professor Welsch and his QUASAR Group have reached a diverse audience, from young students and aspiring scientists to lifelong fans of science fiction.

The talk was very well received by the international audience and Professor Welsch already received follow-on invitations to speak at the African School of Physics, the WOMAD Festival in the UK, and the Swiss National Centre of Competence in Research on Spin Qubits in Silicon.

More information about Physics of Star Wars can be found here.


Professor Welsch giving his talk. (Image credit: Christine Darve, ESS)

# LIV.INNO students access wide range of data science training

LIV.INNO students receive extensive formal training as part of their PhD and this is expected to benefit their research, and boost their employability. For example, during their first year they receive training from courses run by the University of Liverpool and Liverpool John Moores University in both data science and research areas which are more specific to the focus of their PhD. They also receive training organised by LIV.INNO in wider career skills, including project management, presentation techniques and science communication. Finally, structured seminars and specialised summer schools complement their training.

In addition, the centre's students are also encouraged to take part in other trainings that are relevant to their studies, and LIV.INNO helps them do this by promoting specific opportunities. One of these opportunities is run by the Doctoral Network in Artificial Intelligence for Future Digital Health at the University of Liverpool.

This training has been running since 2019, initially for PhD students in this Doctoral Network and more recently extended to students from other departments and universities. It was designed by Professor Vitaliy Kurlin, LIV.INNO Training Coordinator, who leads the Data Science Theory and Applications group at the University of Liverpool.

This training is currently being updated for the first cohort starting in the new Centre for Doctoral Training in Digital and Automated Materials Chemistry in October 2024. Based on the positive feedback from previous students, who learned to use rigorous methods of Data Science and understand the inevitable pitfalls of artificial tool, it will cover for example the Foundations of Data Science and Geometric Data Science.

Details will be posted in September 2024 on this website. Anyone interest is welcome to email vitaliy.kurlin@liverpool.ac.uk to express their interest.


Professor Vitaliy Kurlin

# Data Science Fellow Interview

In each edition of this newsletter, we will interview one of our Data Science Fellows from the LIV.DAT CDT, which recruited students from 2017 to 2020. In this edition, we speak to Adam Lowe who has been studying 'Development of Liquid Argon TPC read-out technology for neutrino physics within the ARIADNE project' during his time at the University of Liverpool.

### Can you explain in a few words what your project was about and what you have achieved?

During my masters I found a passion for both hardware and software and was looking for a PhD that combined the two. A PhD on the ARIADNE project was ideal, joining the team that runs the 1 tonne ARIADNE liquid argon particle detector in the Physics Department and working on improving the novel optical readout technology. During my PhD, I spent a year at CERN, Geneva, where we built ARIADNE+, a large scale demonstration of optical readout for LArTPCs. On returning, we published a paper on the results with myself as lead author.

### What has the CDT provided you professionally?

The CDT has offered me opportunities to network with academics and industry which have proved very useful. The career development plans have allowed me to reflect on my work completed so far and always be looking forward to after my PhD career wise. The CDT has also given me chance to highlight my work to a larger audience through it's news stories.

### Can you say something about your next career move?

After I have submitted my thesis I plan to begin looking for a Post-Doc position in Particle Physics within the UK. I find it very exciting to be working on experiments hoping to expand the bounds of human knowledge but also opportunity to teach the next generation of physicists.

### What is your favourite memory from your time as part of the CDT?

LIV.DAT students were invited to present their work at the LIV.INNO 'kick-off' meeting. This was a great event to chat with industry and academics and finished with a formal dinner in the Liver Building; somewhere I've wanted to visit since coming to Liverpool in 2015!

Presentations during the LIV.INNO kick-off meeting.

# LIV.INNO hosts STFC Data Science Summer School in Liverpool


Participants at the STFC School on Data Intensive Science.

The LIV.INNO Centre for Doctoral Training (CDT) has hosted the 2024 STFC Data Science Summer School in Liverpool between 15th – 19th July. Almost 100 PhD students and speakers from across the UK joined the school, jointly hosted by Liverpool John Moores University (LJMU) and the University of Liverpool, to deepen their understanding of data science during the week-long school.

The school started on the Monday with a talk from Prof Carsten P Welsch, Director of LIV.INNO, welcoming students to the school and giving an overview of the centres activities. This was followed by introductions from Prof Julie Seldon, Dean of the Doctoral School at LJMU and Naomi Smith, LIV.INNO Centre Manager.

The students then split into smaller groups to study in workshop sessions which were all led by the Hartree Centre before finishing the day with an Ice Breaker exercise lead by Dr Alex Hill, Data Science Fellow at the University of Liverpool.

Introductions from Prof Julie Seldon, Dean of the Doctoral School at LJMU.

The Tuesday started with a lecture on Agentic AI for Data Analysis by Boris Bolliet of the University of Cambridge, followed again by three smaller workshops on Neural Network Emulators, GIT and Algorithms for Astrophysics. After lunch more lectures about Machine Learning and self-supervised learning followed before a poster session where the students got to present their work to each other. The day concluded with an evening lecture which was open to the public by Professor Anna Scaife (University of Manchester) who spoke about AI and Aliens.


Prof Anna Scaife presented a public talk on 'Artificial Intelligence and Aliens'

On Wednesday the day started with a lecture on Open source science before three parallel workshops on PyAutofit, Big Data Python Ecosystems and Publishing Code took place.

The Thursday was a day dedicated to industry with a wide range of speakers from industries who use data science. It started with a talk from Zhe Wang of Google Deepmind before students split into smaller workshops led by Naimuri, NHS England and Ed Bennett (Swansea University) who ran a workshop on Numpy. The afternoon saw short talks from the Dogs Trust, The Guardian, Multiverse and KPMG before the students were given the opportunity to quiz all of the speakers in some panel sessions.

Workshop during the STFC summer school.

On the final day the students were set a challenge in a Kaggle competition run by Dr David Hutchcroft, University of Liverpool. This challenge allowed the students to use the data science skills which they had acquired during the week to solve the challenge which was set while working in teams with new colleagues.

The students were working in small teams on the Kaggle competition challenge.

The school was considered as very successful by participants. The students commented on the very positive learning environment provided, the opportunities for networking with others, and that they felt they learned a lot of useful new things.

More details about the school and all presentations can be found at https://indico.ph.liv.ac.uk/event/1639/ .

# Sports Data Experts from Twenty First Group Share Insights with Liverpool Physics Students

Data Science Forum by Twenty First Group.

This May, the Department of Physics welcomed representatives of sports intelligence company Twenty First Group (TFG) to Liverpool.

LIV.INNO is a Centre for Doctoral Training that provides extra training opportunities beyond that of a conventional PhD to ensure that its students are fully prepared for their future careers, be that in academia or industry.

Working with industry is a key focus for LIV.INNO. Bridging the gap between academic research and industry applications will be highly significant for the UK economy in the coming decades, therefore it is important that students are aware of current industry challenges, career opportunities, and areas for collaboration.

Head of TFG Labs Andy Shora and Senior Data Scientists Alex Fassone and Jordan Lambis participated in the LIV.INNO Data Forum Series, where PhD students are introduced to businesses at the forefront of their sectors employing data science to drive innovation.

TFG operates in the world of sports. With diverse clients from Premier League clubs to the PGA Tour, they operate to optimise sporting performance, identify talent, and construct competitions that maximise fan engagement.

Andy, Alex and Jordan discussed their career paths and the history of TFG and their main activities. The company started by asking the question of what they would do differently if they were the 21st team in the Premier League. Using data science to make intelligent decisions is a guiding principle, which has served them well as they have diversified into golf, F1 and other sports.

The presentation touched on the use of Markov Chain Monte Carlo techniques to simulate games, as well as the challenges in accurately assessing the contribution of players in team sports where different roles and formations have different measures of success.

Andy discussed his role as the lead of TFG Labs, an initiative that prioritises novel research within a results-oriented organisation. A key focus for TFG Labs is Academic Partnerships, ensuring that the company stays at the forefront of research and can attract top talent.

The representatives of TFG highlighted placement opportunities for the LIV.INNO students, and discussed with senior leadership within the Department of Physics the possibility of further collaboration.

PhD students and other staff attending were highly interested in the research methodologies being used and their applications to sport. Following the well-attended seminar, the guests and attendees went to a nearby pub for continued animated discussion on the academia, industry, and collaboration routes and the cross-pollination of ideas.

Are you part of a business interested in working with academia? To get involved with LIV.INNO, please contact Business Development Manager Constantinos Astreos c.astreos@liverpool.ac.uk or Data Science Fellow Dr Alex Hill at a.d.hill@liverpool.ac.uk.

## LIV.INNO reaches out as part of British Science Week

British Science Week ran from the 8th to 17th March this year and as ever many science outreach events were arranged to coincide with this. The Victoria Gallery and Museum, which is part of the University of Liverpool, organised an event on Saturday 16th of March aimed at the visitors who would normally visit at a weekend who are mainly family groups. Researchers from across the university were invited to display an activity about their research at this event.

Qiyuan Xu, who is a first year LIV.INNO student and Andres Levia Genre, who is a Fellow as part of the EuPRAXIA-DN project attended this event to talk to the visitors about the ‘Physics of Particle Accelerators’. They took lots of hands on demonstrations with them including the Surfatron, which shows how sub-atomic particles can be accelerated using electromagnetic waves, and the Gauss rifle which uses magnetic fields to accelerate a particle. Electromagnetic fields are used in real particle accelerators to both accelerate and steer the beam. Qiyuan’s PhD project involves developing diagnostics on the LHC at CERN. He also showed how the LHC circulates and collides beams of particles using a train set.

LIV.INNO student Qiyuan Xu explaining the 'Physics of Particle Accelerators' to the visitors. (Image: VG&M)

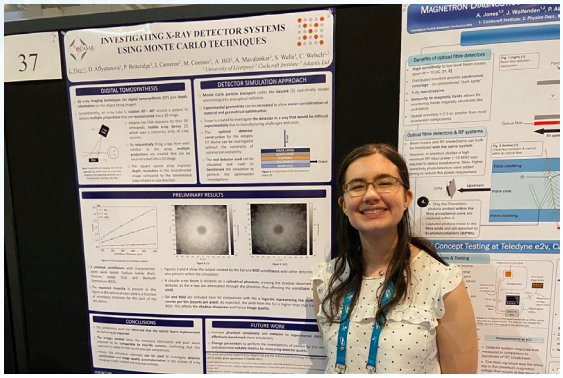
# LIV.INNO at IPAC

The University of Liverpool's STFC-funded Liverpool Centre for Doctoral Training for Innovation in Data Intensive Science (LIV.INNO), was showcased at this year's International Particle Accelerator Conference (IPAC'24). An international event that attracts more than 1,200 attendees, the conference is an opportunity to present and discuss advances in all areas of particle accelerator science with leading experts in the field. IPAC'24 was hosted in Nashville, Tennessee and ran from 19th – 24th May.

The LIV.INNO CDT saw multiple avenues of representation including a poster and paper about the CDT presented by Professor Carsten Welsch, a spotlight on the University of Liverpool exhibitor stand and the presentation of research by Lauryn Eley, a 2nd year PhD student on the CDT.

LIV.INNO highly featured at the University of Liverpool's exhibition stand as part of the industry exhibition. Constantinos Astreos and Minh Cao represented the university and distributed latest news on large-scales projects including LIV.INNO, the MSCA Doctoral Network EuPRAXIA-DN as well as the R&D carried out within the QUASAR Group.

Lauryn created a paper and poster for this conference focussed on her current research, both titled 'Investigating X-ray detector systems using Monte Carlo Techniques'. This contribution explored her use of Geant4, which uses Monte Carlo statistics to model particle interaction with matter, to simulate a detector system to investigate what the optimal detector would look like for X-ray imaging. The investigation is specifically concentrated on digital tomosynthesis: a 3D X-ray imaging modality used by Adaptix Ltd, the industry partner on this project, as outlined in greater detail within the associated proceeding.




LIV.INNO student Lauryn Eley in front of her poster at IPAC'24.

In general, there was a very strong focus on data science applied over a range of topics at IPAC'24. A large number of discussions taking place centred around machine learning, optimisation, AI and other related subjects. This provided a unique opportunity to discuss this work with experts using particle accelerator techniques and data analysis methods for similar medical physics applications, particularly within the poster session. With the range of techniques presented by the other attendees, the scope of discussion possible proved informative in creating new perspectives.

Lauryn's paper, as well as Prof. Welsch's and other data science relevant proceedings are available from the IPAC'24 pre-proceedings at https://www.jacow.org/ipac2024/ . The full official proceedings will follow these soon.

# Alan Turing Institute brings PhD researchers together in Liverpool

In an era where data science and artificial intelligence are rapidly evolving, collaboration among researchers and knowledge sharing of the latest advancements in different fields has become increasingly crucial. To facilitate this, the Alan Turing Institute hosts a regular series of PhD Student Presentation and Networking events, which showcase cutting-edge research in data intensive science and AI, and also foster connections that could shape the future of these fields.

In May, the University of Liverpool hosted an event in the series, welcoming PhD students in data intensive science and AI from universities from across the UK. The local organising committee saw significant cross-departmental collaboration between LIV.INNO and the Distributed Algorithms CDT, among others.

This event provided students with the opportunity to present their research via talks and posters, and to network with their peers, forging connections that will support them in their future careers.


Introduction by Denise Bianco (AIT) and Dr Alexander Hill (University of Liverpool).

Following an introduction from Turing representative Denise Bianco and lead local organiser Dr Alexander Hill, the Liverpool event had a packed itinerary, including group icebreaker and share-out activities, almost a dozen short talks on research, and a poster exhibition area.

Icebreaker session at the AIT event.

Among the day's speakers was LIV.INNO student Mehul Depala, who spoke on machine learning applications in High Energy Physics at the ATLAS experiment. Providing a welcome context for discussion on the ethical implications of AI, Shi Yun Ng of Manchester Metropolitan University discussed her contribution to the development of a fair framework for responsibility and accountability in data-driven and AI systems.

A keynote presentation from Professor Reecha Sofat and LIV.DAT student Andrew Mason reflected on the challenges in unifying multimodal healthcare data across trusts and patient lifetimes, and the differences and synergies that such research has with a data science-focussed PhD, in this case in the field of astrophysics.

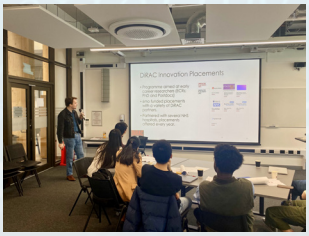
The presentation of physical posters was augmented by the creation of a bespoke virtual environment, which enabled attendees to promote their work and the event through social media channels.

This platform, kindly created by 4wardFutures, may be accessed here: 4fvirtual.org.uk/alan-turing-Liverpool .

Feedback following the event was overwhelmingly positive. One attendee commented that the day was a “Very productive and purposeful event. It was refreshing for me to see a cohort of PhD around me, as you normally work lonely as a PhD student. The dedication of the organisers was amazing!”, while another said “This was a really fun event, and the diversity of research topics really made the day for me”.

The success of the Alan Turing Institute PhD Student Presentation and Networking Day at the University of Liverpool underscores the vital role such events play in the academic ecosystem. By bringing together diverse minds from across the UK, this event not only facilitated knowledge exchange but also laid the groundwork for future collaborations. As data science and AI continue to shape our world, these interdisciplinary connections among early-career researchers promise to drive innovation and tackle complex challenges. The overwhelmingly positive feedback from attendees reinforces the need for more such opportunities, ensuring that the next generation of data scientists and AI researchers are well-equipped to push the boundaries of their fields.





# LIV.INNO Showcase Event – Register now!

Registration is now open for the LIV.INNO Showcase Event. The showcase brings together PhD students, supervisors, and industry partners interested in data-intensive science. You will be able to find out about the center's cutting-edge projects and explore the impactful work of our talented PhD students.

## Why attend?

Open to industry, researchers, and potential partners, this event is your chance to forge partnerships and explore joint research opportunities, engage with leading experts, exchange ideas and discover new opportunities for collaboration. The LIV.INNO Showcase Event is the perfect venue to connect, collaborate and drive forward-thinking innovation in data science.

For industry and public organizations, the benefits of attendance also include the opportunity for:

*Collaborative Research:* Meet potential collaborators from the Department of Physics at the University of Liverpool to solve your data science challenges through collaborative research and development.

*Research Support:* Access specific research knowledge and support to address research problems in data science.

*Talent Recruitment:* Meet prospective data science talent for recruitment.

*Industry Internships:* Learn about the opportunities our students have for industry internships and placements, and present the opportunities you can offer.

Delegates will be have the opportunity to present their work through industry pitches, posters and exhibition stands.

# Meet the LIV.INNO students

In each edition of this newsletter, we will introduce some of the students who are studying as part of LIV.INNO CDT

## Rupeshkumar Ghagi (2nd Year PhD student)

**Project title:**

Optical transition radiation diagnostics for low energy ion beams

**Where are you from?**

Warora, Central India

**What degree did you study?**

I have done my Master of Science in the Department of Physics, University of Pune in 2008.

**What do you do in your free time?**

I like to explore design of various things including products, structures and even social constructs.

## Alexander Jury (2nd Year PhD student)

**Project title**

Longitudinal Density Monitor for the Large Hadron Collider

**Where are you from?**

Barnstaple, North Devon, UK

**What degree did you study?**

I graduated from the Open University in Physics and Mathematics, while working for the National Autistic Society to provide residential care for adults with autism.

**What do you do in your free time?**

In my free time I enjoy reading quizzes and tinkering with electronics projects.

## Ryan Roberts (2nd Year PhD student)

**Project title:**

Constraining the complex relationship between galaxies and their machine learning

**Where are you from?**

Prestatyn area, North Wales, UK

**What degree did you study?**

I graduated from an integrated Astrophysics MPhys course that was provided jointly between the University of Liverpool and LJMU.

**What do you do in your free time?**

In my free time I enjoy watching/playing sports (football, badminton), have a keen interest in Formula 1 and also enjoy going for hikes.

## Thomas Wonderley (2nd Year PhD student)

**Project title**

Artificial Intelligence to improve HPGe detector performance and reliability

**Where are you from?**

Liverpool, England, UK

**What degree did you study?**

I studied the Physics Integrated Masters (MPhys) course at the University of Liverpool.

**What do you do in your free time?**

In my free time I love being outdoors, especially climbing and hiking. I also enjoy singing and playing the guitar.

## Dates for your Diary

| | | | |
|---|---|---|---|
| 16 September 2024 | All day | LIV.INNO Showcase Event, Hilton Hotel, Liverpool, UK | |
| 8 October 2024 | 15:00 BST | Virtual Seminar Series: Data Science for Galaxy Zoo | Mike Walmsley (University of Toronto) |
| 12 November 2024 | 15:00 BST | Virtual Seminar Series: AI regulatory frameworks | Antonella Perini (Alan Turing Institute) |
| 10 December 2024 | 15:00 GMT | Virtual Seminar Series: Data Challenges for the SKA | Anna Scaife (University of Manchester) |

## Notice Board

### Liverpool Virtual Seminar Series on Data Intensive Science

The seminars in this series cover R&D outside of the LIV.INNO centre's core research areas and give an insight into cutting edge research data intensive science.

To register to attend these seminars please visit
https://indico.ph.liv.ac.uk/e/data_science_seminars

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