UCL DEPARTMENT OF PHYSICS AND ASTRONOMY

UCL

ANNUAL REVIEW 2023

Cover image:
The Eagle Nebula (aka M16) holds at its heart the ‘Pillars of Creation’, familiar as a favourite target for the Hubble Space Telescope. This is a site of active star formation.
Credit: Ian Howarth/Telescope Live

Image Page 5:
NGC 2997 is a ‘grand design’ spiral galaxy, some 10 Mpc distant from Earth. The range of colours of the foreground stars in our own Galaxy reflect the spread in their temperatures, from cool (red) to hot (blue).
Credit: Ian Howarth/Telescope Live

Image Page 32:
The Eagle Nebula (aka M16) holds at its heart the ‘Pillars of Creation’, familiar as a favourite target for the Hubble Space Telescope. This is a site of active star formation.
Credit: Ian Howarth/Telescope Live

Image Page 40:
The Tarantula Nebula lies in the Large Magellanic Cloud, one of the nearest galaxies to our own at only 50 kpc distance (around 160 thousand light-years). It is a ‘mini-starburst’ region, on its own forming new stars at a rate around one-tenth of our entire Milky Way galaxy. It also hosts some of the most massive stars known, in excess of 100x the mass of the Sun.
Credit: Ian Howarth/Telescope Live

Image Page 56:
The ‘Pencil Nebula’ (NGC 2736) is the brightest fragment of the much larger Vela Supernova Remnant, its shocked gas created by a supernova explosion around 11,000 years ago.
Credit: Ian Howarth/Telescope Live

Image Page 61:
Caption: Sh2-308 is a ‘bubble’ of gas swept up by the strong stellar wind of the Wolf-Rayet star near its centre; the same star also ionizes the bubble, causing it to shine in the blue light of oxygen.
Credit: Ian Howarth/Telescope Live

Review edited by Lucy Keepking **lucy.keepking@ucl.ac.uk**

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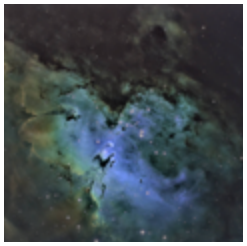
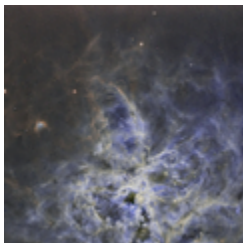
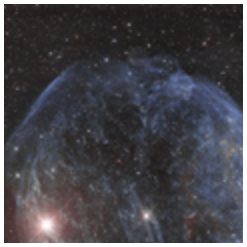




Welcome

I would like to begin this introduction to our 2023 Annual Review by deeply thanking all staff and students in the Physics and Astronomy department, for their continued dedication, hard work and collegiality. Inside this Review you will find outstanding examples of the breadth of our activities over the past year in research, education, campus experience and public engagement.

Founded on the excellence of our 5 major research groups, plus the growing activity in exciting cross-disciplinary themes and a sustained very healthy grants portfolio, there have been very exciting new lectureship appointments during the year: I would like to take the opportunity to welcome Luke Caldwell (atomic, molecular, optical and positron physics), Johanes Noller (astrophysics), Amy Cottle (high-energy physics), Kabir Hussain and Jaime Agudo-Canalejo (biological physics), and Venkat Kapil (condensed matter and materials physics). The Department also continues to attract outstanding early career researchers on long-term Fellowships (Royal Society, STFC and EPSRC) and our research successes have once more been reflected by the awards of prestigious prizes which are featured in this Review. This year, I was very pleased to have overseen the instalment of a new research strategy committee in the department, and I am grateful to Nikos Konstantinidis for agreeing to act as the Chair. The committee's early work has very successfully focussed in the areas of REF2021 review and REF2028 impact strategy, department's quantum physics strategy, and engagement with the grand challenge of climate crisis.

Prof. Raman Prinja featuring on Channel 4's Sunday Brunch, speaking about astronomy, and his range of children's books.

The quality of the undergraduate and postgraduate student experience remains central to our strategic goals in the department. Though we are largely beyond dealing with the aftermath of challenges to education posed by the Covid pandemic, the circa 800 current undergraduate population of the department has placed serious demands on staff workloads and the local estate. Going forward, listening to and engaging with the student voice is crucial and dependent on the closer communication between professional services, technical and academic staff, and the students. The quality and timeliness of feedback and assessment remains a priority in the department's education plan, and we certainly recognise the improvements we need to achieve. Along with providing greater clarity on the forms and weighting of assessments, there is more to do regarding their uniformity across our modules, along with greater engagement with digital assessment platforms.

Our department must at all times be an inclusive and welcoming place of study and work, and one that respects and celebrates diverse cultures. During the year we have consulted, discussed and thought harder as to how we can move forward in ensuring everyone feels safe, supported and valued in the department. Improvements in our workplace culture must remain a priority as in the need to investigate deeper the current climate and act firmly upon any conclusions drawn. Meanwhile, under the stewardship of Benjamin Joachimi, we are currently preparing submissions for the renewals of our IOP Juno Champion status (under the new IOP EDI charter model) and the Athena Swan silver award

The 2023 Review also highlights the wonderful work members of the department having been doing in engaging the public (young and not so young) in physics, astronomy and broader sciences. The activities span public lectures, school visits, lively new books, media appearances, blogs, social media and much more. Effective public engagement is certainly also a route to impact and demonstrating the change to society or the economy that comes from our research.

There are, no doubt, continued challenges ahead for the UK HE sector, but thanks to the dedication and remarkable talents of our staff and students we can be confident in moving the department into a stronger position than ever.

Professor Raman Prinja
Head of Department

Community Focus

Teaching Lowdown

After what has felt like many years of covid disruption, we are finally able to get back to something that feels like a vague semblance of normal, or at least a new normal, for departmental teaching.

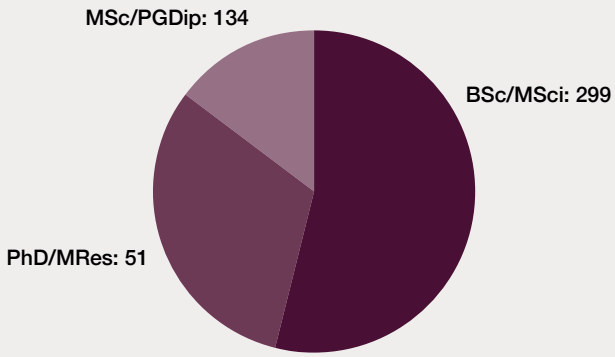
This year has seen a full return to unrestricted face-to-face teaching, to the certain relief of everyone. We've kept the best bits of our online provision though, and now use the valued asynchronous material that so many staff put so many hours into producing to supplement and complement rather than replace our in-person lectures. We've also returned to traditional in-person exams in 2023. While there was, understandably, a certain level of apprehension from some students who had also missed out on in-person A-level exams, this return went well and the overall feedback from students was that they welcomed this return to a familiar format.

Moreover, after several years of having a new UCL education operating model every single year, we now have the stability we need to continue making positive improvements to our departmental education provision - for example, we've introduced academic drop-in sessions for first year students, to complement our existing social coffee-morning student sessions.

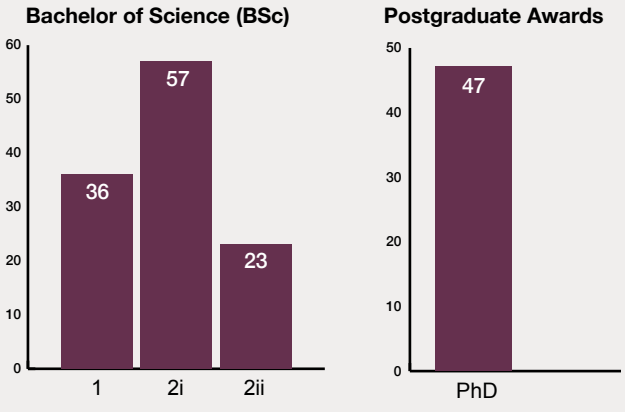
All-in-all, the huge effort and contribution of academic and professional services staff combined to return to our new normal has led to a very successful year for education in the department, and we are all hoping that 2023-24 will follow this trend.

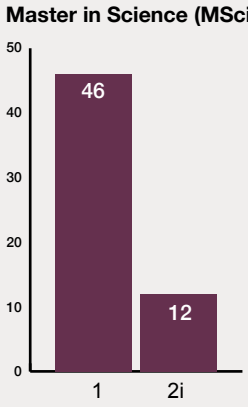
Dr Louise Dash
Director of Teaching

Intake



Awards





Student Accolades

UNDERGRADUATE PRIZES 2020/21

Oliver Lodge Prize
Best performance 1st year Physics
Siqi Xiang

Halley Prize
Best performance 1st year Astrophysics
Kirill Batrakov

C.A.R. Tayler Prize
Best performance in Communication Skills, 1st/2nd year
Sophie Newman

Wood Prize
Best performance 2nd year Physics
Luo Long

Huggins Prize
Best performance 2nd year Astrophysics
Leonor Negalho Lisboa Simoes

David Ponter Prize
Most improved performance in department, 1st to 2nd year
Phoebe Routh

Dr Sydney Corrigan Prize
Best performance in experimental 2nd year work
Preslav Asenov

Best Performance 3rd Year Physics Prize
Juan Juan Castella

Best Performance 3rd Year Astrophysics Prize
Hiba Noor

Sessional Prize for Merit
Best 4th year project achieving balance between theoretical and practical physics
Rebecca Daly

Burhop Prize
Best performance 4th year Physics
Samuel Fedida

Herschel Prize
Best performance 4th year Astrophysics
Zac Hale

Brian Duff Memorial Prize
Best 4th year project
Leonardo Corsaro

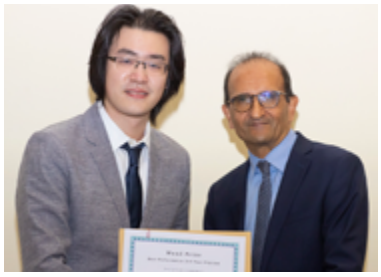
William Bragg Prize
Best overall undergraduate
Lorenzo Pica Ciamarra

Tessella Prize for Software (Tessella is now part of Capgemini Engineering and their team is changing its name to Hybrid Intelligence.)
Best use of software in a final year (Astro) physics project (Jointly awarded)
Dávid Puskás


Siqi Xiang


Kirill Batrakov


Sophie Newman


Luo Long


Leonor Negalho Lisboa Simoes


Juan Juan Castella


Hiba Noor


Samuel Fedida


Lorenzo Pica Ciamarra


Group photo, student and staff prize winners

POSTGRADUATE PRIZES

Harrie Massey Prize
Best Astrophysics and Planetary Science MSc Student
Julio Hernandez Camero

Harrie Massey Prize
Best Physics and Quantum Technologies MSc Student (Jointly awarded)
David Moody and Wenqing Xie

MSc in Scientific and Data Intensive Computing Prize
Best SDCI MSc Student (Jointly awarded)
Zheng Cong and Yuting Li

Spreadbury Prize
Outstanding postgraduate research in High Energy Physics
James Chappell

High Energy Physics Prize
Outstanding postgraduate physics research in High Energy Physics
Sebastian Jones

Biological Physics Prize
Outstanding postgraduate physics research in Biological Physics
Georgina Benn

Marshall Stoneham Prize
Outstanding postgraduate physics research in Condensed Matter and Materials Physics (Jointly awarded)
Denes Berta (theory) and Cameron Dashwood (experimental)

Carey Foster Prize
Outstanding postgraduate physics research in Atomic, Molecular, Optical and Positron Physics (Jointly awarded)
George Katsoulis

Christopher Skinner Prize (Astro)
Outstanding postgraduate physics research in Astrophysics
Benjamin Stolzner

Jon Darius Memorial Prize
Outstanding postgraduate physics research in Astrophysics
Mario Morvan


David Moody


Yuting Li


Sebastian Jones


Georgina Benn


Cameron Dashwood


George Katsoulis


Benjamin Stolzner


Mario Morvan

Alumni Matters

The Physics and Astronomy Prize Giving Ceremony 2022-23 was held in the Jeremy Bentham Room on 22 December 2022. This was preceded by the annual colloquium, where Dr. Emily Nurse spoke on 'The UK's journey to Net Zero and my journey into climate policy.'

Professor Raman Prinja, Head of Department, opened the award ceremony and welcomed all the staff, students and guests at the event, including UCL's Chief Financial Officer, Charu Gorasia.

We are incredibly proud of our remarkable community of over 7000 alumni, living in over 60 countries worldwide and always enjoy hearing from you. Please do reach out to share your news and connect with us at UCL.

As UCL alumni, you are a crucial part of UCL's vibrant global network and there is a huge range of useful services and exclusive benefits available to you. Please visit the UCL Alumni website to view services available to you, lifelong learning opportunities and opportunities to volunteer and support UCL students: **www.ucl.ac.uk/alumni**

Charu Gorasia

Clubs and networks

To help you stay connected with your UCL peers, our volunteers run a range of alumni clubs and community networks especially designed for UCL alumni.

Reconnect digitally by joining the **UCL official alumni group on LinkedIn.**

Equality, Diversity and Inclusion

What's the point of EDI charters for Physics & Astronomy?

UCL Physics and Astronomy currently holds Juno Champion and Athena SWAN Silver awards. With the Gold-equivalent charter marks still a fairly rare occurrence, our awards demonstrate that we are working to a high standard, which independent evaluations of the schemes have shown to improve culture and practices in awardee departments. They boost Physics and Astronomy's reputation and attractiveness as an employer, and serve as increasingly relevant support for inclusion plans and EDI evidence in funding applications.

Both charters focus on gender equality and have been running for 15 years or more; Juno is sector-specific as a project by the Institute of Physics, while Athena SWAN is run by the charity AdvanceHE across academia nationally and internationally (e.g., UCL as an institution also holds a Silver award). Focussing on Juno, its principles cover organisational procedures, management commitment, the creation of a quantitative and qualitative evidence base, fair recruitment and career progression, measures towards an inclusive culture, flexible working practices, professional conduct and complaints procedures. A key ingredient of a successful Juno application is a stretching action plan covering four or more years with measurable actions directly derived from the evidence base.

Aren't these charters just a box-ticking exercise? To some extent yes, but ticking these boxes establishes proven, necessary conditions for a fair, diverse, and inclusive institution to thrive, and in doing so establishes comparable standards across the UK and Ireland. While the work mandated by the EDI charters and their action plans provides the framework for our EDI Committee's activities, it does not stop there and is equally driven by local and current challenges and opportunities. Examples include changing working practices as a result of the pandemic, the departmental response to the Black Lives Matter movement, or our unique position in the heart of diverse, and costly, Greater London.

The charters, much like our own EDI efforts, evolve to remain relevant and ambitious. The Juno Project has just been retired to be replaced with a new, broader inclusion model that will cover all protected characteristics. Physics and Astronomy will be among a dozen or so departments in the British Isles to engage in the pilot from the new Academic Year onwards. Success in this new scheme will require redoubled effort from the EDI leads and broad support from everyone in the Department, but we are convinced it is worthwhile: after all, the point is to make Physics and Astronomy a welcoming, supportive, and pleasant place for everyone.

Professor Benjamin Joachimi
on behalf of the Physics and Astronomy EDI committee

Students in Action

Women in Physics

The UCL Women in Physics group (WiP) has been championing and celebrating women and their achievements for many years now. This last year we have seen some big changes within the group itself, and we are excited to continue growing and supporting the departmental Equality, Diversity & Inclusion (EDI) efforts.

After over three years of dedicated service as the Academic Chair for the group, Prof. Carla Faria has stepped down from her role. We would like to thank Carla for her support and wish her the very best in the future.

The WiP group is for all members of UCL P&A, and we have made it our mission to increase undergraduate involvement in the coordination of the group. On International Women's Day 2023, we delivered a talk to 1st year physics undergraduates on EDI and the role of the WiP group in the department. We are delighted to have an expanding team of undergraduates now involved in the organisation of the group's activities and we welcome anyone else – including staff and postgraduates – to join the team.

This year, we are pleased to have increased our involvement with other London Women in Physics groups, notably Imperial College London, Queen Mary and Kings College London. The four university WiP groups hosted a successful and well-attended bar night for staff, postgraduates and undergraduates. We look forward to our future partnerships with the London groups.

We also continued our in-house collaborations, specifically with the PandA initiative. Both the WiP group and PandA were successful in the MAPS EDI funding call "Take bold action for Inclusion". WiP have filmed an interview on EDI and Women in Physics as part of the PandA spotlight series, which aims to highlight the work and life of historically underrepresented demographics within Physics and Astronomy.

Reflecting on this last year, we feel it is important to remind everyone that the Women in Physics group is here to listen and support those wanting to come forward and discuss matters of any kind. Undeniably, we've seen some difficult times in the department as of late. We must continue to challenge unacceptable behaviour and strive for a work environment where everyone feels safe and respected.

EDI efforts in research are often driven by minoritized researchers, but it's important that we recognise the need to take collective responsibility. We are constantly combating the culture that EDI work is simply optional. As a department, we know that having EDI initiatives and committees in academia is essential, but they are only effective if we engage with them. Raising awareness, reducing shouldered responsibility and increasing institutional buy-in all stem from engagement with EDI initiatives.

A primary goal of the Women in Physics group is, and will always be, to empower others to facilitate change. If you have any questions on how best to get involved with EDI efforts, or recommendations on how WiP can best support you, please do not hesitate to get in touch.

Wishing you a successful year ahead,

Fern Pannell
UCL WiP Group Coordinator

Teaching

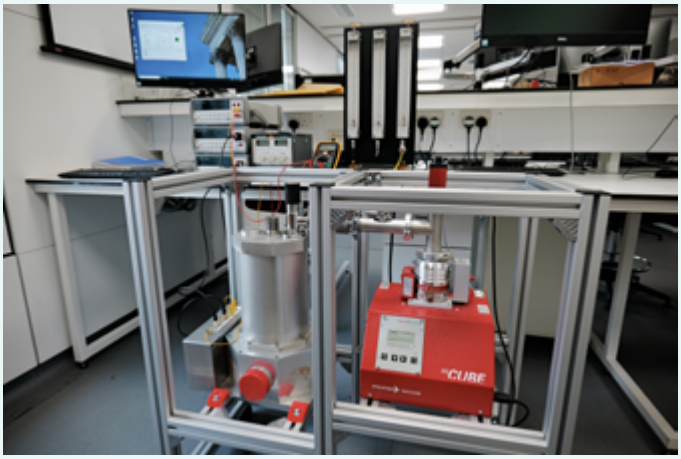
Teaching Lab Developments

In the aftermath of COVID we saw a massive increase in student numbers which we knew would affect the delivery of practical teaching in the next few years. 2022/23 saw the largest intake, which came to be known as 'the bulge'. Preparing for this bulge has been the focus of lab work for a few years now.

Due to the increased demand, a lot of cross-lab activity needed to be arranged. First year experiments ran simultaneously in Lab 1 and Lab 2. Exams were held in Labs for the first time. Year 3 project students were accommodated across all labs as well.

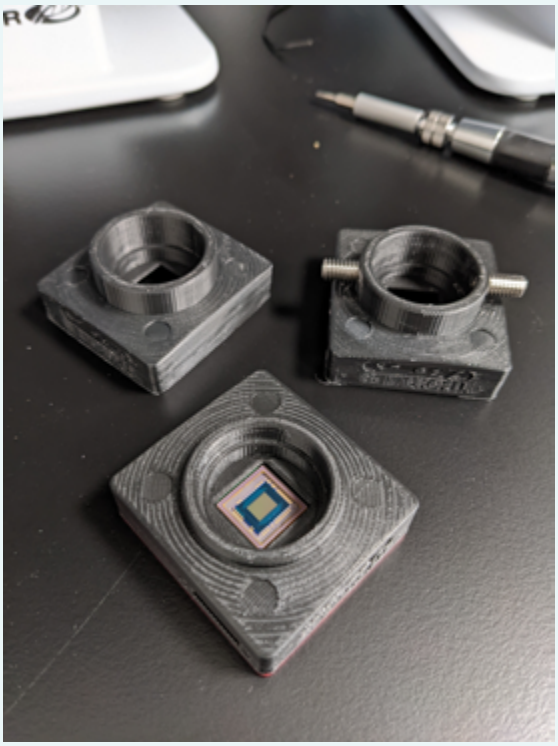
A huge help with dealing with the student numbers was the return of B4, a room integral to Lab 3 which had been loaned to HEP research group for a few years to house a cleanroom which was essential for their research. This room has now been returned and is in the process of being renovated to host third year lab experiments once again. This work is being carried out by Nick Nicolaou, Bernard Bristoll and Lee Bebbington.

The Electronics Project is a massive year 2 lab class with around 180 students. In 2022 Bernard Bristoll made new boards to accommodate the influx of students, bringing the number of available printed circuit boards to well over 100. In addition to just replicating the boards, they were

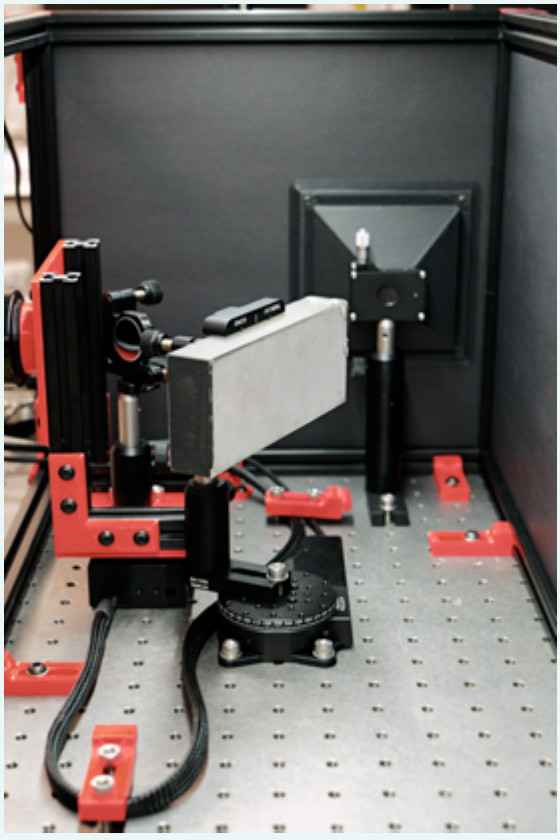


The updated low-temperature calorimetry experiment

The two instruments above replaced the three below.



3D printed CCC camera housings



New optomech in the Zeeman Effect experiment

future proofed by updating the ADC chip. This involved soldering surface mount (SOIC) chips to DIP adapters: a laborious and time-consuming process.

PhD student Fern Pannell and Dr. Nick Nicolaou worked on a new CT imaging experiment using an adaptor kit for the X-Ray diffractometers. This a niche application of the device with little to no precedent. Therefore, a lot of preparation was required fitting and testing the kit with a lot of bugs needing to be ironed out with the manufacturer. The time invested in this endeavour will no doubt result in a unique experiment which keeps UCL at the forefront of practical physics teaching.

With some additional funding, Kelvin Vine overhauled the Zeeman Effect Experiment. With increased student numbers, the apparatus was streamlined to make data acquisition quicker and more repeatable, giving the students the time they needed for analysis. 2 computerised optomechanical stages were added to aid with this. The new experiment was also constructed on a standard optical breadboard and using as many standardised optical components as possible ensuring long term longevity and ease of multiplying the kit in the future should that be necessary.

Additionally, several New Muon experiments and STM rigs have been purchased and set up to accommodate the student numbers. Bernard has updated the LabVIEW software program for the low temperature calorimetry experiment so that all the electronic instruments on the experiment can now be controlled from a lab computer.

The Lab 2 darkrooms have undergone a further revamp. New experiments were purchased and set up in the darkroom of Lab 2 to accommodate the additional students. In 2022, interferometer kits were ordered from Thorlabs. These kits contain everything we need for an experiment and represents an effective way of implementing additional experimental capacity. Moreover, a growing repository of research-grade opto-mechanics opens the door to a huge range of future experimental directions.

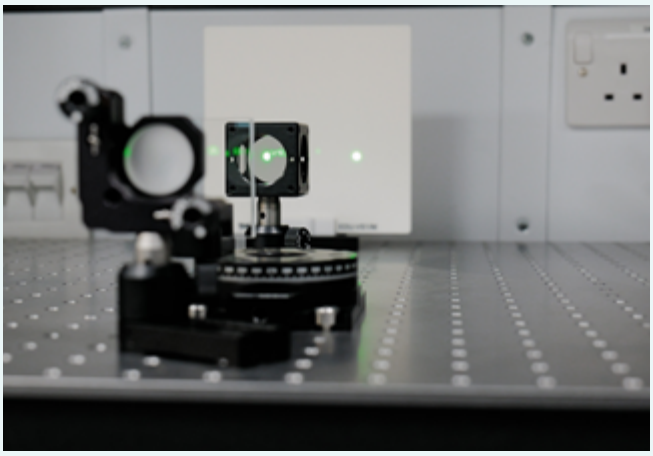
Readers of previous P&A Annual Reviews may recall that a biophysics experiment was created with Changemakers funding as a staff-student collaboration; it has now undergone a significant software and hardware upgrade for 22/23. Issues with the CCD cameras dropping frames were identified and the problem was solved by sourcing faster cameras and adapting these to the existing microscopes with new 3D printed camera bodies.

The new Noise Characterisation experiment used low noise amplifiers built in house by one of our now retired technicians. These failed from time to time due to their age but could not be replicated as critical ICs were now obsolete. A new one had to be sourced. In 2022 finally a suitable model came on the market and we quickly purchased 13 units, securing this experiment for many more years.

An effort was made to find other experiments which could be quickly and cheaply multiplied. Electrical resonance was selected because we realised that by replacing the old-school Perspex boards with solderless breadboards, the experiment could be multiplied quickly and easily. Additionally, The breadboard made it easier for students to understand the circuit, as they now build it from scratch and introduces them to the actual equipment they will use for other projects at UCL and after graduating.

Safety is very important to us and before the end of the 2022 financial year Derek Thomas was able to find funding to replace all the laser pens used to project the motion in the mechanical resonance experiment. Although the output power of these pens was measured every year, proper class 2 lasers would add a greater level of assurance. These were sourced and purchased and will be integrated into the experiment next year.

Some of the over 100 surface-mount ADCs



Some of the new optics in the Lab 2 dark room.

The Old amplifier is on the left and the modern replacement is on the right.

On a lighter note, rapper Consensus made a rap video in Lab 1. Consensus makes science focussed rap music. His objective is to spread Truth and Information through music and video. To see the finished video scan the QR code below.

Science in Action

P and A Day: A Fusion of Talent Ignites Inspiration in University Life

In an impressive celebration of creativity, community, and talent in Physics and Astronomy, the annual "PandA Day" took place on January 30, 2023, at the Bloomsbury Theatre. The extraordinary performances of people from across the department captured the attention and hearts of students and academics alike and resonated with everyone in attendance.

The PandA stage featured an impressive performance by Sovann Pandit, who took the audience on a captivating journey with his solo piano melodies. Nicola McConkey and Gavin Hesketh delivered soulful folk harmonies that resonated with the crowd. Andy Sang and Thern Khai Lim performed magic acts which left spectators in awe. Eva Aw showcased her piano and vocal mastery, and Leyla Iskandarli mesmerized with electrifying guitar harmonies. Temi Oluwole's incredible spoken word performance struck a chord, evoking deep emotions. Steve Miller's harmonica performance also stole the spotlight with its danceable "Panda Express" tunes.

The show was hosted by Noor-Ines "Panda" Boudjema, whose captivating presence and panda-inspired satire commanded the stage. Behind the scenes, Maya Maciurzynska orchestrated the production with finesse, ensuring every aspect of the show ran seamlessly and radiated brilliance.

The Physics Game Show, moderated by Charlie Drury and James Henderson, elevated the event to impressive heights. Academics like Jasvir Bhamrah, Bart Hoogenboom, Chris Howard, Alessio Serafini, Jon Butterworth, Andreas Mayer, and special guest Mark Fuller fearlessly took centre stage as contestants. Mind-bending challenges, from the "Matrixverse of Madness" to intellectual showdowns like "Physics Charades" and "Physics Does Countdown," pushed the boundaries of knowledge and ignited the participants' inventive sparks, leaving the audience in awe of their intellectual and artistic skills.

In a theatrical twist that defied gravity, the Physics play transported the audience straight into the “Squid Game” universe. With witty physics jokes, a Hannibal lecturer, and show-stopping songs like “Shoop Shoop”, “What is This Law?” and “They Enrolled in the Physics Labs, but My Name was Albert Einstein,” the play blurred the lines between academia and entertainment, sparking laughter throughout the crowd.

The Physics Sea Shanty Band, featuring Alex Thomson, Pete Bradshaw, Markus Keil, and Sergey Yurchenko, filled the air with joy as they entertained the audience with their energetic performances and nautical tunes. The infectious energy of the band brought art and knowledge together, compelling the audience to tap their feet and join in the collective celebration of the spirit of PandA Day.

Complementing the stellar performances, the PandA exhibition in the Wilkins terrace area illuminated the scientific wonders within. A mesmerizing meme competition, science-inspired art installations by Andrew Charalambous, books penned by esteemed P&A staff members, pop science experiments, and an inspiring VR show, headlined by Shana Sullivan and the ever-enigmatic Mark Fuller, captivated the imagination of all who explored this cosmic showcase.

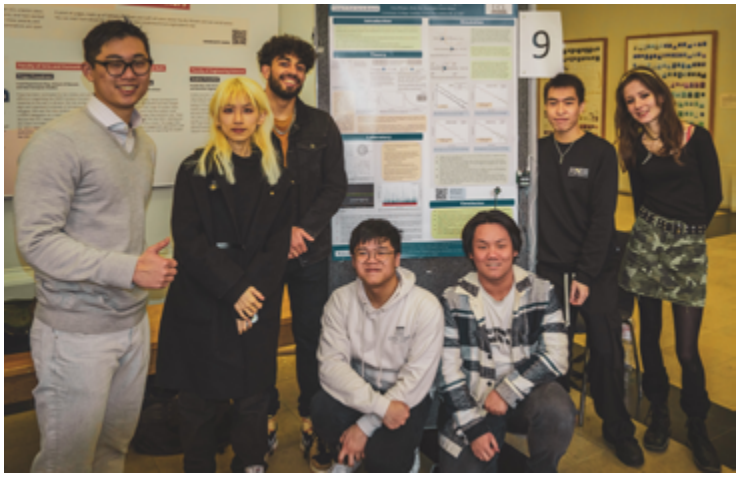
For those who couldn’t attend the event but would like to experience the remarkable blend of art and physics firsthand, the performances of PandA Day 2023 are available on the PandA Day YouTube channel (search for ‘UCL PandA’).

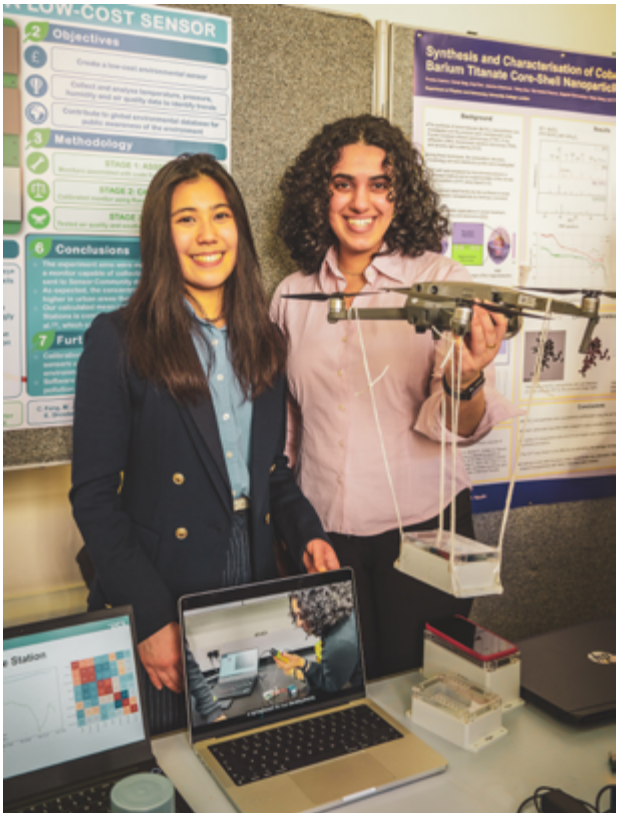
PandA Committee

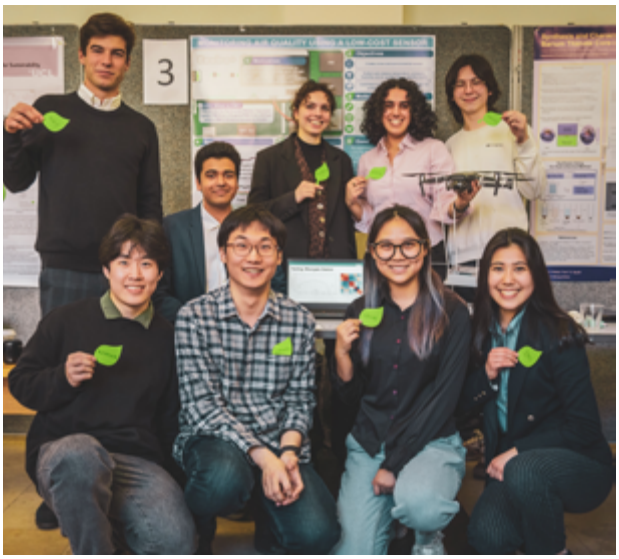
Physics Group Project – Poster Session

In this module students undertake a challenging extended open-ended project in a small group. The module culminates in a poster day, where the groups presented their project work at an event held in the North Cloisters. The students were engaged and enthusiastic. Their posters showed off high quality science and presentation skills. This event was a highlight of the module. There were 3 prizes for the posters which received the highest marks and we'd like to thank all the staff who acted as board members for the group projects.

Prof. Thanh Nguyen







Outreach & Public Engagement

Science Centre Lectures

The Science Centre was first established in 1987 by Dr Sadiq Kadifachi and it was incorporated into UCL in 1997. The Science Centre Lectures are free lectures on a range of scientific subjects for sixth form students and their teachers. They are held on Friday evenings throughout the academic year.

The talks are aimed at sixth form students and teachers, but are frequently attended and enjoyed by members of the public, teachers, academics and undergraduates. There is always a lively Q&A session at the end of the talk. Topics are ideal for those studying or preparing to study A-levels or equivalent.

Just this year we have hosted many distinguished speakers on a variety of topics with Professor Robert Palgrave from UCL Department of Chemistry discussing “The Hidden Worlds of Atoms” (see image) to Professor Hilary Downes from Department of Earth and Planetary Sciences at Birkbeck University of London passing on her passion for Asteroids and Meteorites and what they can tell us about the solar system.

Professor Robert Palgrave from UCL Department of Chemistry explosively demonstrating the volatile nature of Hydrogen at a Science Centre Lecture.

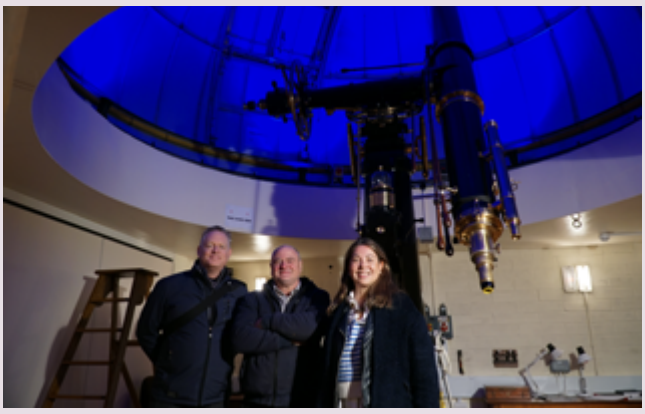
Since 2020 Lectures have been held online, and hosted over 3000 new unique visitors to add to the many thousands that have joined us in-person over the decades. I know many of us are already looking forward to next years Science Centre Lectures. A huge thanks to Iga who has been expertly running the virtual side of the lectures and a huge round of applause to Sadiq who will keeping find fantastic speakers for many more to come. The plan is to bring a few talks per year back to a UCL lecture theatre and maintain a term time weekly schedule accessible to all online. See https://www.ucl.ac.uk/physics-astronomy/outreach/science-centre-lectures

Observatory Tours

The UCL Observatory alongside the major teaching role is fantastic venue for public engagement, and we continue to host many different groups to visit on pre-arranged tours. Including UCL Astro-Group PhD and staff meetings, the Kilo-Degree Survey conference, Friday and Saturday evening public tours. As well as other notable groups from other institutions, Astronomical Societies and this this year we had a visit organised by the descendants of Thomas Cooke the maker of the Fry Telescope we operate on site (see image).

We have a bespoke range of tours and activities for schools and other children’s groups like Scouts and Guides.

A massive thank you to the guides and helpers that make these tours possible. Their knowledge and enthusiasm for Astronomy makes it come alive for the audience. Evening tours at the weekends will be running again from mid-October through to April, see https://www.ucl.ac.uk/ucl-observatory/public-outreach/public-visits



Bruce (left) and Heather (right) a descendant of the original maker (Thomas Cooke) of the Fry telescope (behind), together with Mick Pearson our exceptional technician (retired) on a visit during 2023.

Easter Residential School

Thanks to Prof Thanh Nguyen winning the prestigious Rosalind Franklin Award from the Royal Society we were able to fund a trip for school children aged between 13 and 16 to attend a residential Easter Science and Adventure Camp near the town of Liddington. With adventure activities provided by a local centre and the Science from UCL and University of St Andrews Staff. There were activities about sending communications to alien species, medical nanotechnology, and the students investigated and discussed their own solutions to meeting our energy needs. All intermixed with climbing, raft building and games to boost science confidence in and out of school. Through our evaluations we demonstrated a change in perception of these young people to the diverse range of science, and recognising themselves as the scientists we need to solve big challenges. Huge thanks again to the exceptional student ambassadors, academics and the teachers who gave up some of their Easter break to be with us, and most importantly the young students who gave so much energy to the whole experience.

Two students exploring magnetic nanoparticles at the Easter Residential Science Adventure Camp

Public Engagement with Francisco Diego

Over the last year I have given many lectures to schools and public groups. My main topic is the process of formation of solar systems in our galaxy, including our own. I talk about the formation of the Earth, emergence of life, possibilities of aliens and finally, humankind and the environmental consequences of its activities.

Lectures are based on a linear time line from the origin of the Universe to today. Along this time line, pupils hang pictures representing milestones that happened at specific times. This demonstration offers a visual reference frame for time lengths which are almost impossible to imagine. Lectures also include real meteorites and a scale model of the Earth, showing the thin shell around it where all life has always been, from the bottom of the sea to the top of the atmosphere.

In the last year I have lectured at six primary schools for a total of 400 children, and seven secondary schools for a total of 350 pupils. I also gave on-off lectures at the following special events:

- Bloomsbury festival. 85 members of the general public
- Association for Science Education Annual Conference, Sheffield (on-line) c. 120 science teachers.
- Astrobiology and Planetary Exploration seminar (UCL) 35 staff and students
- Hertford Astronomy Group 80 amateur astronomers.
- Flamsteed Astronomy Society, Greenwich, 120 amateur astronomers

The audience's response to my UCL Mini-workshop on Climate, Sustainability and Net-was very strong. The best comments came from primary school children, who understood very well the value of our environment and how difficult it would be to rebuild. There were questions about life on other planets and alien, but the main focus remained on ways to defend our environment and recover what is being lost. Older audiences shared similar ideas, emphasising the need for a change in our ways of life, following some of the concluding remarks of the lecture. Likewise, Artificial intelligence was mentioned as a very powerful tool to help model a more sustainable and harmonious planet as a necessary step before embarking in the great adventure of human exploration of the solar system. Inevitably, there were frequent and heated discussions.

Francisco Diego

Universe time line at the Harris Academy Peckham, south London. A very dynamic presentation to 200 secondary school pupils. Searching questions included queries on the origin of the Universe, lack of aliens, and the role of God.

Paradise Planet Eart at the Flamsteed Astronomy Society, Greenwich. An audience of about 100 people. Our main discussion was on the cosmological importance of the Earth and how to avoid a catastrophic end of the rich environment that supports life.

Diploma Club Monthly Lectures

After 22 years of existence, the Diploma (formerly Certificate) of Higher Education in Astronomy has aound 400 alumni, most of them Fellows of the Royal Astronomical Society, and automatic members of the 'Diploma Club'.

Created by our late Bill Somerville, the Diploma Club has become a major tradition with monthly lectures (on a Thursday at 18:30) and visits to relevant places (including MSSL, CERN, expeditions to solar eclipses and so forth).

Lecturers are usually from UCL/MSSL/Birkbeck staff and students, Diploma/Certificate alumni and occasionally other institutions. From October 2022 the lectures are back to the Harrie Massey Lecture Theatre with post-lecture receptions in room E3/7

Here is the list with the most recent lectures:

Prof Giovanna Tinetti Head of Astrophysics group (17th October 2022) "A remote journey to the planets in our galaxy"

Tim Parsons. Certificate alumnus and PhD student of Prof Raman Prinja (7th December 2022). "A Massive Star Menagerie: touring through the upper reaches of the H-R Diagram".

Prof Ian Crawford, Birkbeck/UCL (19th January, 2023) "Why we should build a Moon Base"

Dr Alexander Jenkins, UCL (19th February, 2023) "Over the Moon: Bridging the gap in the gravitational-wave landscape with Lunar laser ranging"

Dr Francisco Diego, UCL (23rd March, 2023) "Aliens! ... Where are you?"

Dr Paul Shah, UCL (20th April, 2023) "The Discovery of Dark Energy (or, it is alright to be wrong!)"

Prof Nick Achilleos, UCL (18th May, 2023) "The Jupiter-Ganymede Interaction"

Physics Postgraduate society

The postgraduate society has truly outdone itself this year, leaving an indelible mark on the academic community with a series of exhilarating events and accomplishments. From raising the trophy of success to hosting engaging quiz nights and enjoying delightful park sessions, this year has been a rollercoaster of excitement for all its members.

The crowning achievement of the postgraduate society came in the form of a prestigious trophy. The society participated in a highly competitive departmental research group competition, where they pitted their intellect and skills against other renowned institutions. With little to no preparation time the High Energy Physics (HEP) team emerged victorious, earning the admiration and respect of fellow students and faculty members. The trophy stands tall as a testament to their hard work and determination, fuelling the society's passion for excellence…and carnival games.

Not content to rest on their laurels, the society continued to create thrilling experiences for its members. Quiz nights became a regular fixture on the events calendar, offering an exciting opportunity for members to showcase their knowledge in a wide range of subjects. These intellectually stimulating evenings brought together students from various backgrounds, fostering camaraderie and friendly competition. With each question, the room would buzz with excitement, and the victors would revel in their triumph, while the rest anticipated the next quiz night to redeem themselves.

In addition to academic pursuits, the postgraduate society also prioritised fostering a strong sense of community and well-being among its members. They organised numerous park sessions throughout the year, where students could unwind and bond over recreational activities. These sessions provided a much-needed respite from the rigors of academia and offered a chance to forge lasting friendships. Whether it was playing sports, having picnics, or simply lounging in the sun, the park sessions offered an avenue for relaxation and revitalisation, promoting a healthy work-life balance for everyone involved.

As the year draws to a close, the postgraduate society reflects on a year of extraordinary achievements, memorable moments, and lasting friendships. The trophy, quiz nights, park sessions have all contributed to shaping a vibrant and supportive community. With each passing year, the society continues to set higher standards of excellence, ensuring that the legacy of excitement and camaraderie lives on, leaving an indelible mark on the postgraduate experience for years to come.

Teo Cobos & Katherine Milton
on behalf of the Physics Postgraduate society

Your Universe on Tour at Cally Fest

From Sunday 2nd July, we took our Your Universe activities on tour starting at Cally Fest where we had great fun interacting with people of all ages in the Discovery Zone.

This yearly event turns much of Caledonia Road into an annual celebration of everything the area has to offer with over 7000 people, listen to music, sampling food and this year exploring the physics of our Universe. Our theme this year was the Electromagnetic spectrum and linking it all to the amazing new images coming from the James Webb Space Telescope. With giant wave machine made from sweets, slinkies to interact with and model different wavelength and frequencies of light and an infrared camera to see the world in a whole new way. Once again, our undergraduate ambassadors from the department did a great job at enthusing and teaching the crowds about the Physics they learn in our department.

Your Universe on Tour went on to visit schools and we aim to bring Your Universe back home to UCL hopefully in March where we can continue to inspire everyone about the wonders of the Universe.

Two sisters at Cally Fest having fun and demonstrating the perfect wave on a slinky spring.

2023 Harrie Massey lecture with Professor Donna Strickland

The 2023 Harrie Massey lecture at UCL brought a highly distinguished speaker: 2018 Nobel Laureate Professor Donna Strickland. She won the award for developing chirped pulse amplification with Professor Gérard Mourou, and has made huge contributions to optics, lasers, and ultrafast science. The event was organized and chaired by Professor Carla Faria and took place at UCL and online. It gathered a broad audience, from prominent members of the UK attoscience and ultrafast laser community to postgraduate and undergraduate students, scientists from other areas and the general public.

Figure 1 Professor Donna Strickland explaining chirped-pulse amplification at the 2023 Harrie Massey Lecture. Picture by Alejandro Salinas.

The onsite version of the Massey lecture attracted over 300 attendees, distributed in the Chemistry Lecture Theatre 1 and the Harrie Massey Lecture Theatre. Its online version took place on Zoom, with over 300 registered participants from across the globe, and was live-streamed on the Quantum Battles YouTube channel, run by Professor Faria and co-workers, to over 100 attendees. In total, it is estimated that around 700 people participated, which by far surpasses a standard audience for a Massey lecture. There was a reception afterward, which provided the opportunity of chatting with Professor Strickland in an informal manner. She is an exceptional science communicator, and the attendees found the lecture accessible, inspiring, and fun. The event was supported by UCL Physics, UCL Chemistry, the IoP, and the London Light consortium.

Women in Light Lunch

The 2023 speaker at the Harrie Massey lecture, Professor Donna Strickland, is one of the four women to ever be awarded the Physics Nobel Prize (out of 222 Physics Nobel Laureates). While this small number sheds some light on huge inequalities, it also highlights what a role model she is to women in science. For that reason, Professor Carla Faria, who was the key organizer of the Massey lecture, also organized the Women in Light networking event at UCL, in which PhD students and early career researchers had the opportunity to interact with Professor Strickland in an informal setting, without the presence of senior academics. This was intentional, to avoid unnecessary power plays or intimidating personalities. The event was chaired by Dr Lidice Cruz Rodriguez, and included predominantly female participants from UCL, King's College and Imperial College London. There were a few brave men too!

Participants of the Women In Light lunch with 2018 Nobel Prize winner Prof Donna Strickland. Women in science are more diverse than one thinks. Picture by Henry Bennie (@uclquantum)

Many were surprised that Professor Strickland gave "brutally honest", and "unexpected" answers to their questions about her life and career. They also referred to the lunch as "an experience of a lifetime" or "the most exciting lunch I've ever had". We were honoured by her presence and are pleased that she was able to inspire and spread her knowledge to the next generation of scientists. The event, together with the 2023 Massey lecture, was four years in the making, and was extremely hard to pull off. We are grateful for the support of UCL Physics, UCL Chemistry, King's College London and the London Light consortium.

Centre for Data-Intensive Science and Industry and Doctoral Training

2022/23 has been an exciting and busy year for the Data Intensive Science and Industry (DISI) Centre and the CDT Data Intensive Science (DIS). In October 2022, we welcomed the sixth cohort of CDT DIS students, funded by the new £1.3 million STFC training grant. The cohort of 11 students brings the total number of students trained and being trained by the CDT DIS to 64 on the 6th year running. So far there have been 20 theses produced by CDT DIS students and more than 50 research articles led by the CDT PhD students published.

In 2023, the Perren PhD Prize Award, supported by the Perren Fund, has been instituted to provide recognition to exceptional original research completed by doctoral degree students from the CDT DIS. The 2020/21 and 2021/22 Perren PhD Prize winners are Davide Piras and Tarek Allam, respectively.

As part of the development strategy, the DISI Centre and CDT DIS continue to offer training opportunities to CDT students and beyond. In addition to the monthly research seminar series, we successfully organised two topical training workshops in collaboration with ORACLE for Research (February 2023) and Google-Deepmind (April 2023). The public seminar on cutting-edge applications of graph neural networks (GNNs) in the modelling of complex physical systems by Peter Battaglia, a world-leading expert in GNNS from Google-Deepmind attracted over 150 attendees. This event was a prime example of our vision for the activities of the DISI Centre moving forward with a research focus.

Following on the success last year, the DISI Centre and the Department of Physics & Astronomy (P&A) offer a 5-day 'Introduction to Machine Learning' intensive course in June 2023, which was open to PhD and MSc students in the department. The course was led by Dr Nikos Nikolaou and the Teaching Assistants team consisted entirely of current and former CDT DIS students (now postdocs at UCL).

DISI academics have also been heavily involved in national capacity building and networking activities with the Turing. As a result, two Turing Interest Groups have been set up, one in Space Science (led by Ingo Waldmann) and one on Simulation-Based Science (led by Jason McEwen).

The DIS Centre and CDT DIS have been actively involved in a number of activities to promote EDI within the Centre and the wider UCL community. In the last 2 years, the CDT have offered a scheme of two-month long summer research placement in DIS to 3rd year undergraduate students at UCL. The aim of the scheme is threefold: (a) provide undergraduates with experience and skills from working on a DIS research project; (b)

2020/21 and 2021/22 Perren PhD Prize winners - Davide Piras (left) and Tarek Allam (right

Prof Ofer Lahav (DISI/CDT DIS Co-Director) and CDT DIS graduates – Kai Hou Yip, Davide Piras and Ben Henghes at September 2022 Graduation.

In2Science programme in July 2022

Reception at the Jordan Embassy in London, 14th July 2022

raise awareness of the DIS programme amongst our undergraduate students; and (c) give more opportunities and enhance the career prospects of students from under-represented groups. The scheme was extremely popular, with approximately 25% of the third-year undergraduate students applying for it. With support from the STFC Impact Acceleration Account Discretionary Fund, we continue to run the scheme in Summer 2023.

As part of our efforts to tackle diversity issues at pre-university education, we joined the In2Science Charity programme. In July 2022, we hosted 16 year 12 students (56% female) for a week long programme of (a) lectures on STFC science by academics in the Centre; and (b) hands-on sessions in python programming and the application of Machine Learning to the discovery of the Higgs boson (see photo below). This was also an opportunity for several of our CDT students to act as mentors and demonstrators. We were the only Physics Department in the country to have an In2Science offering in 2022. The feedback we received was excellent. We were nominated by the students for In2science's "Host of the Week" award, which we won against 158 other placements. Given the success of this scheme, we will be taking part in this scheme in summer 2023.

In March 2023, the capacity building programme to enhance research links between Jordan and the UK, funded by the Newton Fund (PI: Ofer Lahav), came to an end. Over the course of 3 years, the grant enabled a number of training opportunities to students in Jordan, including (a) UCL-Jordan online workshop on Machine Learning for astronomical spectroscopy and distance learning module on Exoplanets for a total of 75 students; (b) A one-week Summer School at UCL for 25 students/mentor; (c) One month research training for 7 students and (d) A Winter School in Jan/Feb 2023 for 3 Jordanian students. Notably, 60% of students who attended the training activities are female.

Partner relationship development has moved in a positive direction as we are working on setting up framework agreements with industrial partners. Since April 2022, we have created and filled 15 Industry Placements, which includes two Innovation mini-Fellowships. Partner contributions on placements play an important part in creating more studentship opportunities for the CDT. Some industry placements have also produced results that are presented at international conferences.

Looking forward, our vision is for DISI to become a hub that fosters cross-disciplinary and industry-academia cross-talk and research collaborations in DIS topics and techniques that will deliver enhanced research outcomes and societal impact through a number of activities including topical workshops, Visiting Fellowship scheme, established network with ML/AI centres around the world and more.

Conference in honour of Professor Richard Ellis

On June 5 and 6 2023, we celebrated Richard's remarkable career and achievements via a two day meeting held at the Institute of Physics. Postponed for three years due to the pandemic, over 50 of Richard's former students, postdocs and collaborators came to London from places as distant as Sydney and Tokyo to the meeting entitled "RSE@70+: Observing the Evolving Universe."

Supported in part by the P&A Department and the Perren Fund, talks and panel discussions debated progress in observational cosmology, large scale structure, astronomical instrumentation as well as the first results from the James Webb Space Telescope. At a conference dinner held in the University of London Senate House, Richard was duly roasted in several after-dinner speeches which highlighted his vision, derring-do, good humour and remarkable frequent-flyer status!

We thank Minh Cao for all her help running the meeting so smoothly.

Ofer Lahav

Astro Elevenses

After the hugely popular ‘Astro Afternoon Tea’ last academic year, another group social was on the cards again! On the 3rd of May 2023, many group members got together for “Astro Elevenses” in the beautiful Haldane Room at UCL.

Amidst an informal setting, colleagues mingled, chatted and had fun over an indulgent and delectable selection of traybakes, loaves and cakes!

The fabulous photos were taken by our very own in-house photographers: Pascal Förster and Sushuang Ma.





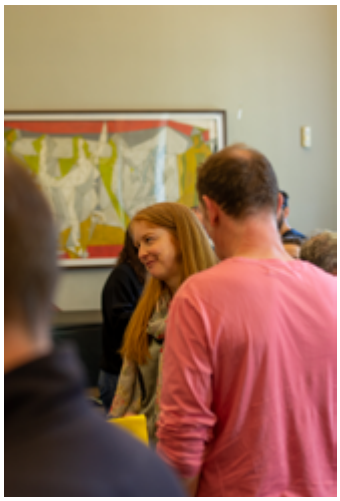













A few words from some Astro colleagues:

"The Astro Elevenses event in the Haldane Room was a huge hit with everyone who attended! It was great to see a large fraction of the entire Astrophysics group enjoying the splendid spread of cakes, biscuits and other goodies. It was also a delight to see old friends including our former Group A Head Serena Viti visiting from Leiden. Enormous thanks to Kay Nakum and Giovanna Tinetti for their foresight in proposing this get together, and for their hard work in planning this highly successful event."

Prof. Richard Ellis

"Astro Elevenses was my first taste of a summer social event at UCL and it did not disappoint! It was fantastic to catch up with so many students, postdocs, and staff in the Astro group over some wonderful cakes, juices and tea/ coffee. It's safe to say everyone enjoyed receiving a goody bag on entry; there's certainly been a few galaxy-inspired bouncy balls flying around the NWW offices! Looking forward to next year's event already. A big thank you to Kay and everyone else who helped to organise such a great event."

Richard Brooks, PhD student:

"The Astro Elevenses event was truly a pleasure. I enjoyed everything about it: the cakes, the "take away" little bags and, of course, the company! It really brought the group together."

Prof. Serena Viti

"It was super refreshing, approaching intoxicating even, to be back in person and be able to see and interact with so many valued colleagues after so long. The treats were also excellent, and very much eye candy as well!"

Prof Jay Farihi

"The Astro Elevenses party was on every astro PhD students mind from the moment Kay sent the email announcing it. The thought of sweet treats and an actual excuse not to do work for an hour was very welcomed. Colleagues gathered in the Haldane Room and enjoyed a wonderful event filled with delicious treats and thoughtful surprises in the form of space themed goodie bags, like you use to get at birthday parties when you were young. The goodie bags were filled with space themes chocolate and sweets such as 'Galaxy', 'Mars bar', and 'Haribo Starmix'. Not only could we stuff our face with chocolate, but we also got a space themed BOUNCY BALL! Turns out you're never too old to have fun with a bouncy ball.. From cups of tea and coffee to sweet pastries and cakes, the treats were a highlight of the gathering. The cozy and inviting space made for the perfect setting, and everyone had a great time catching up with each other. Overall, the group afternoon tea event was a resounding success and a great way to bond with colleagues. I'm already excited to see what toy we get next year in the goodie bags (please let there be another toy next year!)"

Mark Cunningham, PhD student

"The event was an excellent chance to meet fellow researchers in the Astrophysics Group, who I might not normally see day-to-day, and to find out what they have been up to and what science they are excited about right now."

Niall Jeffrey, PDRA

"The Astro Elevenses was a delightful occasion filled with delectable treats tailored to satisfy every palate. The event provided us with a valuable opportunity to connect, celebrate, and reinforce our sense of community, creating an inviting atmosphere that encouraged us to move around, mingle, and engage in conversations. The goody bags, featuring space-themed chocolate bars and bouncy balls, were a particular hit among everyone. Many thanks to all those who worked hard to make this event happen!"

Vinooja Thurairethinam, PhD student

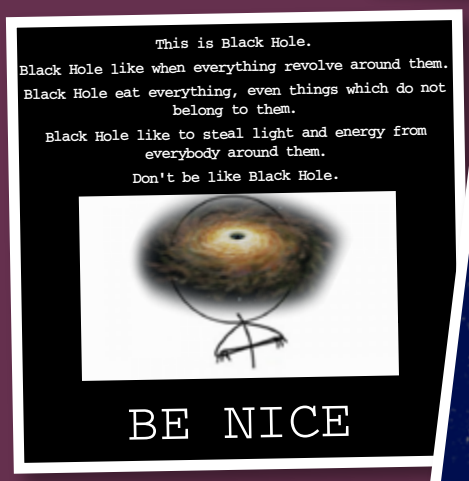
Event organised by Kay Nakum, Astrophysics Group Manager.

Research Headline

Astrophysics “Be Nice” Competition

The Astro group hosted a “Be Nice” competition in early Spring 2023. The criteria were to put together a poster, artwork, meme, music/video message, collage etc. about being kind and respectful towards all colleagues.

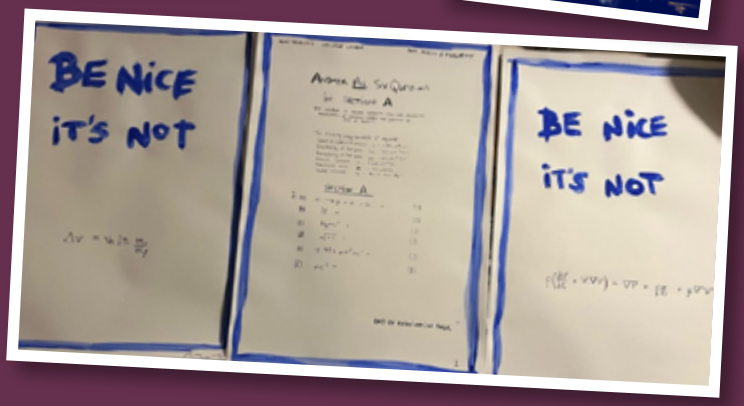
“Be Nice” is a simple term that makes a huge difference - we all want to work in a harmonious setting where colleagues feel part of a thriving community of individuals coming together to share our passion for Astrophysics; therefore, group members were asked to create something fun, sarcastic, savvy, happy or ironic. People could work by themselves or in a team. Amazon vouchers were awarded to 1st, 2nd and 3rd prize holders.



Entries were received from Mark Cunningham, Pascal Förster, Raman Prinja, Patricio Reller, Akshay Robert, Alexey Shitvov and Antonia Vojtekova.

First prize (£250 Amazon voucher) was awarded to Mark Cunningham for his amazing triptych; in his own words: “The idea behind this work was centered on the theme of ‘It’s not hard to be nice,’ so I decided to focus on things that were typically hard (and related to astrophysics/physics), such as rocket science. I opted to include the rocket equation as one of the images. Additionally, I incorporated the equation for Navier Stokes theorem as another piece, which is one of the seven Millennium Prize problems in mathematics.

For the centerpiece of the Triptych, while I was in the middle of marking undergraduates’ work, I had the idea to create a piece that resembled the layout of a typical UCL exam paper with six questions. The answers to these questions would spell out “ßE NicE”. Academics are often very creative and abstract in their thought processes, so the worlds of art and physics/astrophysics aren’t too far apart (even physically at UCL, the Slade School and astro department are beside each other!).



Having the opportunity to create art for the department with a meaningful message behind it was very welcomed, and I thoroughly enjoyed the process of making it!”

Second prize (£100 Amazon voucher) was awarded to Akshay Robert for his wonderful t-shirt art; in his own words: “For me, the ‘Be Nice’ competition was about understanding a two-word message that appears beguilingly simple but is much more profound in reality. I wanted to submit an entry that mirrored the layers of this message, by stating what might seem obvious to the overwhelming majority of our colleagues, but hopefully encourages them (and myself) to constantly assess and re-evaluate whether our thoughts and behaviour are truly inclusive and unprejudiced. I hope we can continue to maintain this attitude – in words and action – as we strive to further enrich our academic community.”

Third prize (£50 Amazon voucher) was awarded to Raman Prinja for his beautiful sketch; in his own words:

“It was a delight to support the fantastic ‘Be Nice’ competition in the Astrophysics Group. Knowing that my drawing was liked was true icing on the cake! Huge thanks to Kay Nakum for organising this lovely event.”

Again, immense thanks to all those that took the time to partake, and many congratulations to the three winners.

Event organised by Kay Nakum, Astrophysics Group Manager.

Observatory News

The UCL Observatory: where teaching meets research

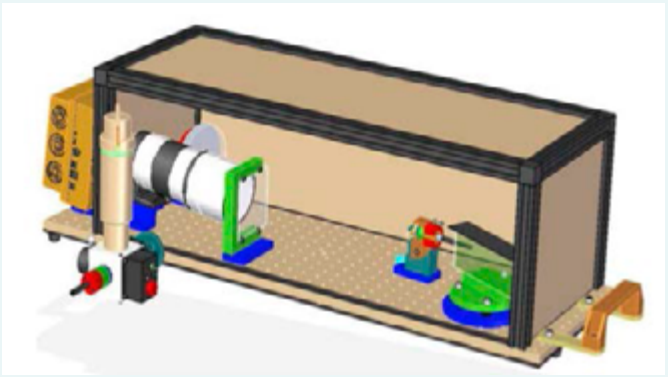
With the increase in numbers of astro students, more Astrophysics Group academics have joined the ranks of Astrophysics Group Project Mentors in Year 3, which this year included data analysis from other facilities (including space satellites and data from the far-infrared instrumentation on the 15-m James-Clerk Maxwell Telescope).

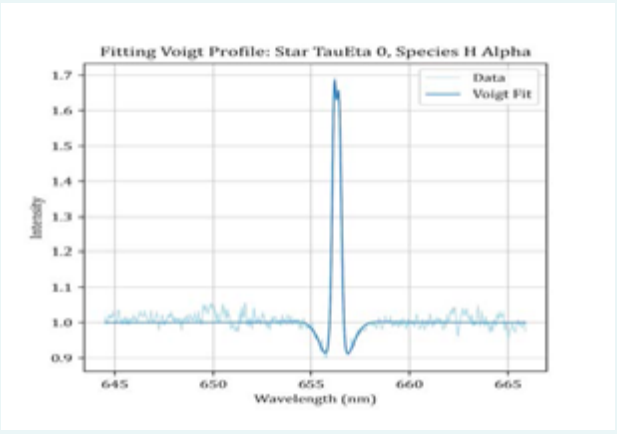
Our collection of state-of-the-art telescopes (up to 80-cm diameter aperture) as well as our older fully-mechanical instruments, allow students to learn all aspects of observing, from basic manual observing to scheduled time-critical observations in remote locations. Observations are performed with CCD and CMOS cameras and spectrographs allowing students to become familiar with the most advanced techniques in observation and data-analysis.

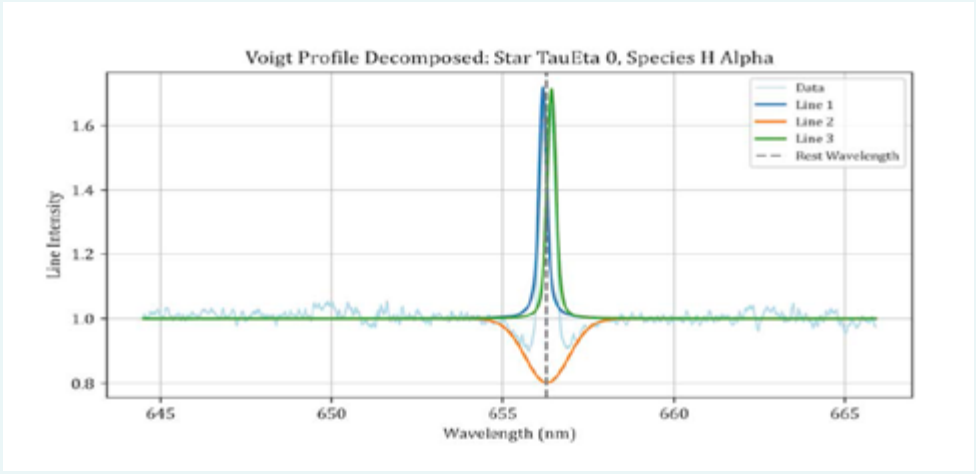
Below is a selection of Group projects and some of their findings.

High resolution spectroscopy of the OB association in the Pleiades

Believed to have been formed in similar times from the same molecular cloud. These young stars show interesting details on the dynamics of ejected material when spectroscopically observed. Figures below show the Spectrometer used, H alpha line profile measure and the modelled components by the students.







Proj.Students: Adam Nigel, Gregor Cavlovic, Louis Smith, Thomas Ryan.

Proj.Supervisor: Prof. Giorgio Savini

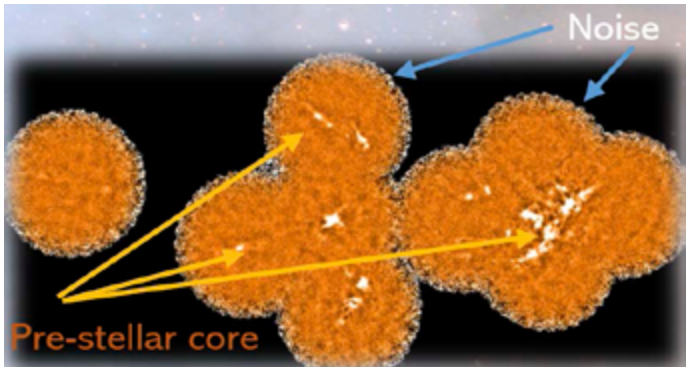
Construct a Core Mass Function

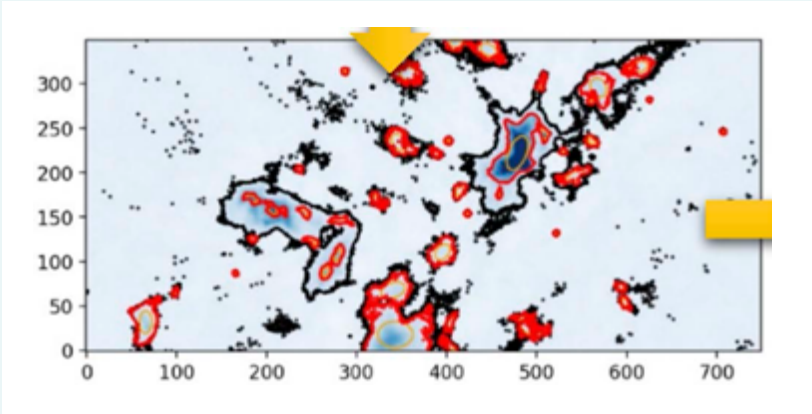
This project involved looking at the Ophiuchus molecular cloud image in the Far-Infrared (850 micron wavelength).

This large observation of nearby molecular clouds was performed to investigate low-mass star formation.

Due to their cold, and dense nature, observing in optical wavelengths is not feasible. However, far-infrared wavelengths penetrate optically thin clouds and tell us more about the denser regions resulting from gravitational collapse and fragmentation of filaments within the cloud. These regions are where pre-stellar cores, a precursor to newly formed stars, form.

Images of pre-stellar cores from the JCMT archive





Left: Contour maps with black borders indicating the areas above minimum threshold and brown ellipses indicating where the cores can be found.

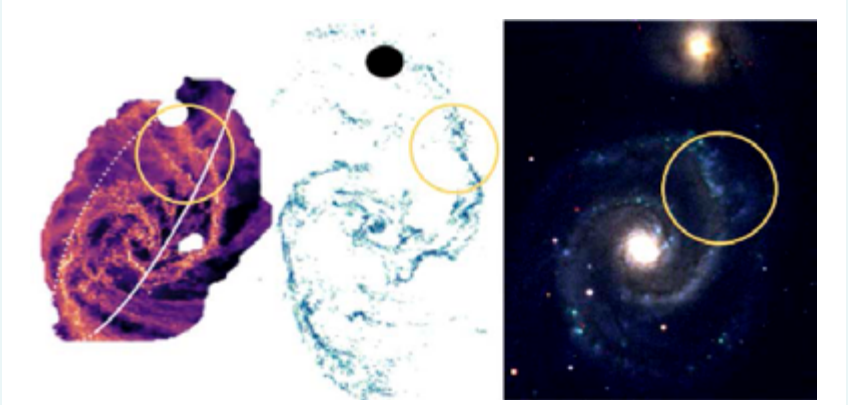
Proj.Students: N.Bensoussan, S.Chineravata, S.Hayward-Mitchell, M.Zaheer

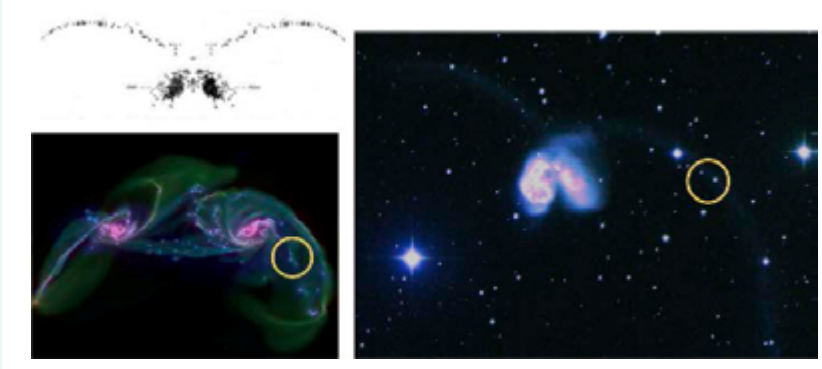
Proj.Supervisor: Kate Pattle

Enhanced star formation in interacting galaxies

Colourised image of the M51 merger (figure on the right), where students found an enhanced star-forming region in the trail caused by the tidal forces of the interaction; indicated by the blue colour which corresponds to younger stars

Final processed image of the Antennae galaxies compared to simulations (Toomre et al, 1972, and Teyssier et al, 2010). From this comparison, the tails show enhanced star formation.





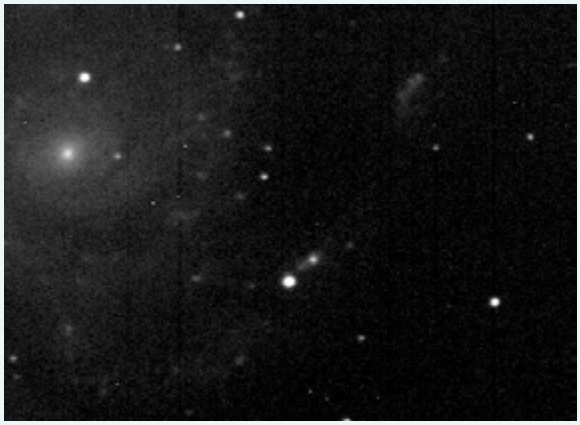
Proj.Students: Marina Ventikos, Sam Powell, Elisa Dibb-Fuller, Pranav Uchil, Gabija Posiunate.

Proj.Supervisor: Prof. Richard Ellis



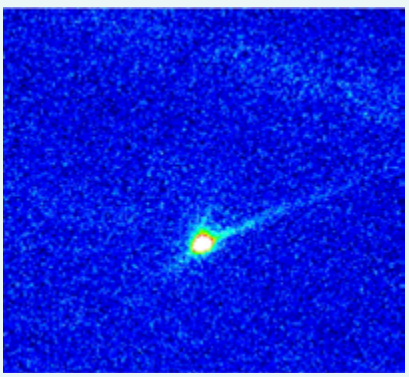
Above: A selection of Year 1 student images obtained with the robotic telescopes at UCLO. L—R: Filaments of hydrogen emission from the Jellyfish Nebula supernova remnant (Clement Jacob); the starburst galaxy NGC 4490 (Henry Bell); gas and dust in the Fish Head Nebula (Icy Lingyan Xia).

The suite of robotic telescopes at UCLO enables us to respond rapidly to newly announced 'targets of opportunity'; the bright, nearby, core-collapse supernova SN2023ixf in the Pinwheel Galaxy (M101), seen below a few days after discovery, was imaged many times throughout May and June 2023, in multiple filters, to enable us to monitor its brightness and colour evolution.



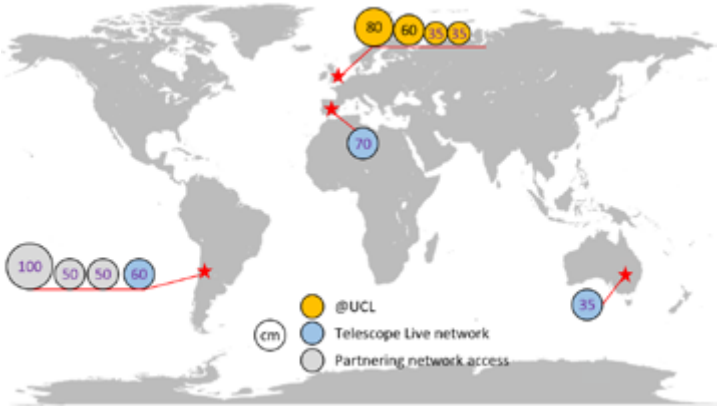
Our collaboration with the Telescope Live suite of robotic telescopes in Chile, also allows us to respond rapidly to targets which are not accessible from the northern hemisphere, or events which occur on a timeline during the morning hours.

This was the case of this observation (taken by our collaborator E.Guido) of Didymos/Dimorphos shortly after being hit by the NASA DART mission (29th Sep. 2022).



"It has been a pleasure and an honour to steer the developments at the UCL Observatory for the past 7 years, with the new large 80-cm telescope installation and the commissioning of the new fast CMOS camera, echelle spectrometer and continued developments in instrumentation. I am also glad that this role can be handed over to someone who has been a resident astronomer and teacher at the Observatory for three decades and has intimate knowledge of the importance and heritage of the facility. Dr. Steve Fossey, Supernova hunter and passionate exoplanet observer, will take over from the 1st of August. I wish him the best of luck and look forward to upcoming developments!"

Professor Giorgio Savini

"Size" map of all telescopes accessible by UCLO students.

Professor Giorgio Savini,
Director of UCLO

Centre for Space Exochemistry Data (CSED)

It has been a very busy and very exciting year for CSED.

The Ariel Space Mission reached a major milestone with the closeout of the Ariel Payload Preliminary Design Review (PDR). Paul Eccleston, UCL-CSED board member, RAL chief engineer and Ariel consortium project manager commented: "Over the course of nine months the Ariel payload team prepared 179 technical documents and addressed 364 questions (RIDs) for a panel of ESA experts, who evaluated the feasibility, performance, and robustness of the payload design". The successful completion of the PDR in May 2023 marks a crucial step forward for Ariel, demonstrating that the mission's payload design meets all the required technical and scientific specifications, and no showstoppers were found for the foreseen launch in 2029. Construction is now underway![1]

A space mission is much more than flying hardware: there is the human factor and…AI!

Giovanna Tinetti, CSED director and Principal Investigator of the Ariel consortium said: "We have other reasons to celebrate: the Ariel consortium is becoming more global, with the formal approval of NASA and JAXA contributions to Ariel and the most recent joining of the Canadian Space Agency. Over 600 scientists and engineers from 19 countries are now working on Ariel". Emma Dunford, CSED manager, added: "We organised in May an Ariel open event at the Royal Astronomical Society, to update the UK community about the progresses of Ariel and broaden the national participation to the mission. The response has been exceptional."

Building on the success from last year's Ariel Data Challenge (ADC), this year's challenge has continued to look for an AI/ML based solution to infer key properties of exoplanetary atmospheres from simulated observations of Ariel. "We already know how to do that on individual planets, using a technique called atmospheric retrieval, but this technique is unscalable to large amount of data, i.e. for a large number of exoplanets, which is what Ariel will observe. We need a fast and reliable AI alternative for the Ariel ground segment operations" explained Ingo Waldmann, CSED deputy director and Alan Turing Fellow.

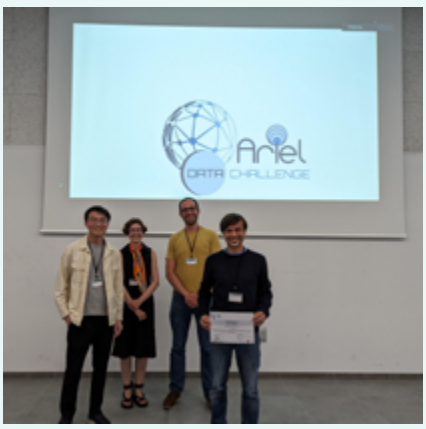
"For ADC 2022 and 2023 we built one of the largest catalogues of simulated atmospheres. Together they are by far the most diverse and realistic datasets available to the scientific community" said Ahmed Al-Refaie, Head of Data Science at CSED. "More challenges were introduced through the inclusion of stellar activity, which is a critical aspect to consider", commented Alexandra Thompson, who led the first retrieval study which includes the correction of stellar activity[2] "… and we shouldn't forget clouds!" added Sushuang Ma, who led the first retrieval study which accounts for cloud microphysics[3]. Alex and Sushuang have just completed their first year of PhD at UCL.

Unlike previous years, the ADC team at CSED has undertaken extensive promotional efforts, in collaboration with our global partners including ESA, UKSA, DiRAC and NAOJ, to ensure a global presence of this year's challenge. "The successful campaign has attracted over 250 participants from 51 countries around the world, surpassing last year's record by 25%. Figures below illustrate some of the posters we used during the mid-competition campaign, an AI (midjourney)-generated artwork with texts added during the post-processing stage", said Bex Coates, media officer at CSED who has designed the promotional campaign.

"The challenge is well loved by students, ML practitioners and academics at various stages of their careers. Our post competition analysis shows that ~40% of them are driven by the machine learning problem, followed closely by the science case. The competition has concluded, and we are currently in the evaluation stage, with the winners set to be announced in early July. The winning solutions will be showcased at both the ECML-PKDD 2023 Workshop and the upcoming Ariel Consortium meeting" has explained Kai Hou Yip, Research Fellow at CSED and ADC Principal Investigator.

Certificates are being handed out to the winners of ADC 2021 and 2022

Arianna Saba has been working at BSSL (SME affiliated to CSED), as part of her UCL-CDT industrial internship. "I focused on the science case and data analysis



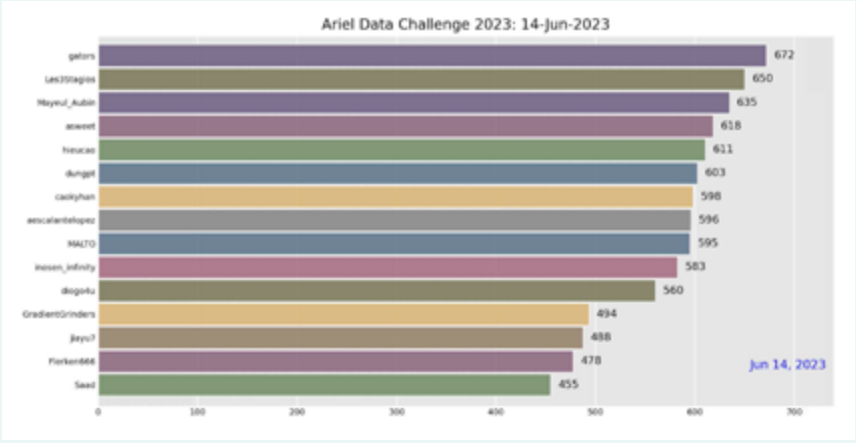
[1]https://arielmission.space/wp-content/uploads/2023/08/BXFINAL_PressRelease_Ariel-Passes-Major-Milestone-Review-_0823.pdf
[2]https://ui.adsabs.harvard.edu/abs/2023arXiv230204574T/abstract
[3]https://ui.adsabs.harvard.edu/abs/2023arXiv230113708M/abstract
[4]https://bssl.space/mauve/

pipeline for Mauve, a new 16U cube-sat to monitor stellar flaring in the UV that BSSL will launch in early 2025". "Mauve[4] has received funding from the European Union's Horizon 2020, we are now working with a number of European industrial providers to achieve optimal technical performances", has explained Giorgio Savini actively involved both with BSSL and CSED.

"It has been indeed a very busy year, with an increasing global demand for molecular and atomic opacities from ExoMol to interpret the data from JWST, ALMA and ground-based facilities with high-resolution spectroscopy capabilities[5]", has stated Sergey Yurchenko, head of spectroscopy at CSED.

"Dissemination, open access and reproducibility of data are important objectives of CSED and ExoMol visions", stated Jonathan Tennyson, FRS, Principal Investigator of ERC-funded program ExoMolHD and editor of new RAS Techniques and Instruments (RASTI) journal[6]. "We have also organised a very successful Royal Society Theo Murphy conference in February to bring together exoplanetary astrophysicists working with novel high resolution spectroscopic techniques with providers of the high-resolution spectroscopic data, both theoretical and experimental[7]".

"And talking about dissemination, we should not forget the International School for Advanced Studies, Brave New Worlds II, organised by CSED in collaboration with the Alessandro Volta foundation in Como, Italy[8]", has concluded Giovanna. "We had students from all over the world. We are grateful to Nour Skaf, honorary member of CSED, for the support of UNESCO and Breakthrough foundation to encourage the participation of students from African countries. We need more of these initiatives in the future".



A barchart race (live version on @ArielTelescope Twitter) displaying the top-15 players on 14th June, 2023, 4 days before the closing date of the competition.

Group photo of the Ariel consortium at a recent meeting in Spain.

[5]https://ui.adsabs.harvard.edu/abs/2023A%26A...674A.184L/abstract, https://ui.adsabs.harvard.edu/abs/2023AJ....166...41W/abstract
[6]https://academic.oup.com/rasti/article/2/1/216/7158700
[7]https://royalsociety.org/science-events-and-lectures/2023/02/spectroscopy-exoplanets/
[8]https://gatr2023.lakecomoschool.org

Academic Showcase

A Sample of Staff Accolades

Department Teaching Prize

This year's Departmental Teaching Prize is awarded to **Dr Steve Fossey** for sustained excellence in both teaching and student support. For many decades Steve has taught at the UCL Observatory in Mill Hill, inspiring and educating generations of astrophysics students including several current members of departmental staff. He has consistently innovated in research-led observational astrophysics education and delivering the best possible educational experience to students at the Observatory and beyond.

Since late 2019 Steve has also acted as programme tutor to our taught postgraduate students. Steve had already had an impact in this role before the pandemic hit, but his support of MSc students during and as we emerge from the pandemic has been exceptional under the most extraordinary circumstances. He has been nominated for his work in encouraging, enabling, and enhancing the capabilities of students and is a most worthy recipient of this year's Teaching Prize

Technician of the Year Award

The Physics and Astronomy Departmental Technician of the Year Award has been awarded to **Mark Sterling**.

Mark Sterling started his career as a laboratory technician in King's College for several years before joining UCL in 1992. He has established himself as the lead for all mechanical work within our teaching laboratories. He is an invaluable resource to call upon, frequently at short notice. It must be noted that he has extensive experience in the rather niche role of teaching and research-based engineering. This is something that is not commonly available outside the university context.

He has a reputation for delivery within the teaching laboratories and has developed countless experimental systems that students have been using for decades. These need maintenance and upgrade, and he has done this with vigour. However, what distinguishes him is his desire to help students to develop their own experimental systems for group and final year projects. Often, students lack the mechanical system experience to design and build their systems and so Mark gets directly involved with their work. On many occasions, he has helped students to turn a failing project into a resounding success through his calm 'can do' attitude. Indeed, he has coached students to do basic mechanical development themselves. In addition, Mark is often called upon to help those that require mechanical systems for their research work.

He is a key member of the teaching laboratory team and without him, we would struggle to meet the needs of staff and students across all our practical modules.

Outstanding Achievement Award

The Physics and Astronomy Departmental Outstanding Achievement Award has been awarded to **John Dumper.**

John Dumper has been supporting cutting edge research at UCL since the 1970's. Over the past five decades, John has been and continues to be an extremely important member of technical staff whose creative fabrication and design of high-quality scientific instruments has enabled us to perform world leading experiments. The award for Outstanding Achievement honours John's long and valuable tenure at UCL and highlights the critical role that he plays within the Physics Department and the AMOPP group. John's exceptional technical skills are accompanied by infinite patience, kindness and enthusiasm, and the department congratulates him on his long and distinguished career.

Professional Services Staff Prize

This year our Professional Services Staff Prize is celebrating excellence across the board. Once again, we received numerous nominations, with many nominated by multiple others, truly showing the impact our PS team has through the department. Every nominated individual was an example of the hard work and fortitude that goes into running a large department smoothly, alongside the equally important work of our academics, teachers, researchers and technicians. These awards show all the facets of our department, and celebrates the fantastic work done by all.

Due to the strength of the many nominations, it was impossible to choose only one person for recognition this year. We have awarded a prize winner and also a runner up prize. Both prizes this year go to members of our Teaching and Learning team, which illustrates the regard in which this demanding and complex area of the department is held.

Congratulations go to **Lisa Medici**, who has received the Departmental Professional Services Staff Prize, for her work supporting first year undergraduates as they settle into life at UCL. Her contribution to the department is outstanding, covering a wide remit of tasks to a high standard, always maintaining a friendly and competent demeanour. Lisa is seen as a problem solver, who relishes the chance to help others, and always treats others with kindness and compassion.

Congratulations also goes to **Helen Copeland**, our Senior Teaching Administrator. A newer role, Helen has stepped up to oversee all aspects of teaching and learning in the department, bringing her wealth of knowledge and vast experience to teach and assist others, creating and refining processes throughout the department. From module registration to exam processing, Helen has administered smooth and efficient work, and is praised for her reassuring and calm approach to knotty problems.

A heartfelt thank you from the management of the Physics and Astronomy Department to all the nominees and especially to the prize winners in this category. Keep up the good work.

Royal Society medal

Royal Society medal awarded to **Professor Richard Ellis**

Message from Raman Prinja

Many congratulations to Prof. Richard Ellis who has been awarded the Royal Medal, the Royal Society's highest honour for the physical sciences.

Richard was awarded the medal for "motivating numerous advances in telescopes and instrumentation, and exploiting these facilities to revolutionise the understanding of cosmological evolution". The Society noted that Richard "had foreseen the importance of applying new technologies, motivating him to raise funds, design and then exploit innovative instruments that have greatly accelerated progress [in the field]".

See UCL's press release UCL academics honoured by the Royal Society – 22 August 2022

IOP medal and prize

IOP medal and prize awarded to **Will Dunn**

Congratulations to Will Dunn who has been awarded the 2022 IOP Henry Moseley Medal and Prize, which recognises "exceptional early-career contributions to experimental physics". The award citation noted Will's paradigm-shifting work on the outer planets, in particular the discoveries of X-ray emission on Uranus and the independent behaviour of X-ray emissions in both hemispheres of Jupiter, and for leadership of the ORBYTS research-with-schools programme.

RAS Chapman Medal

Professor Nick Achilleos has been awarded the 2023 Chapman Medal from the Royal Astronomical Society (RAS) for his outstanding work on the magnetospheres of planets, in particular Jupiter and Saturn:

See UCL's press release Professor Nick Achilleos awarded medal for Jupiter and Saturn discoveries– 16 January 2023

IUPAC 2023 Distinguished Women in Chemistry/ Chemical Engineering

Professor Thanh Nguyen has been awarded the IUPAC 2023 Distinguished Women in Chemistry/Chemical Engineering. Thanh Nguyen, who is Professor of Nanomaterials at UCL, said: "I am delighted because my work is recognised by my international peers. I am proud of all the achievements by women in science and in chemistry and chemical engineering in particular."

Professor Thanh Nguyen work has advanced fundamental understanding of chemical syntheses and her physical studies of nanomaterials could be used to help with diagnosis and treatment of cancer as well as other biomedical applications.

Using cells in the lab, she has demonstrated a new way to deliver chemotherapy via magnetic nanoparticles, which has the potential to improve cancer treatment. She is also investigating a replacement for gadolinium, a contrast agent used for magnetic resonance imaging (MRI) that cannot be used in people with kidney failure and whose use has the potential to contaminate water supplies.

See UCL academic honoured with prestigious IUPAC award – 9 February 2023

Fellowship of the Institute of Physics (IOP)

Awarded to **Professor Carla Figueira De Morisson Faria**

Research Degrees

January 2022 – December 2022

Panagiota Chondrou
The role of SPARC in the pathogenesis of Squamous cell lung cancer
(Prof S. Janes)

Frederik De Ceuster
Simulating 3D Radiation Transport, a modern approach to discretisation and an exploration of probabilistic methods
(Dr J. Yates)

Martin Hanicinec
Towards automatic generation of chemistry sets for plasma modeling applications
(Prof J. Tennyson)

Loannis Paraskevas
Preparations for the Mu3e experiment: Magnet commissioning, beamline studies and a study of fake tracks
(Dr G. Hesketh)

Davide Piras
Accelerating inference in cosmology and seismology with generative models
(Dr B. Joachimi)

Kai H. Yip
Expect the Unexpected: Deciphering Exoplanetary Signals with Machine Learning Techniques
(Dr G. Tinetti)

Nicolas Angelides
LZ commissioning and background studies
(Dr C. Ghag)

Ben Henghes
Novel Applications of Machine Learning in Astronomy and Beyond
(Prof O. Lahav)

Sebastian B. Jones
Using charged particle test beams to constrain systematic uncertainties for the DUNE experiment
(Dr G. Hesketh)

Andrew J. W. Swan
Metal pollution and dust at white dwarfs
(Prof J. Farihi)

Gregory L. W. Barbour
Improving b-jet identification and searching for additional Higgs bosons with ATLAS
(Dr G. Hesketh)

Luke J. Batten
A Search for the Origin of Ultra-High Energy Neutrinos with ANITA-4
(Prof N. Konstantinidis)

Lucas S. Borgna
Search for pair production of Higgs Bosons decaying to four bottom quarks with data collected by the ATLAS detector
(Prof N. Konstantinidis)

Dan Ping Huang
Differential cross-section measurements for four-lepton production and implications for new physics
(Prof J. Butterworth)

Maria Nicolescu-Duvaz
Quantifying cosmic dust production in core-collapse supernovae and supernova remnants
(Prof M. Barlow)

Thomas W. Penny
A low-noise electrically levitated oscillator for investigating fundamental physics
(Prof P. Barker)

Andrei A. Cuceu
Precision cosmology from the clustering of large-scale structures
(Dr A. Font-Ribera)

Omar Jahangir
Application of Machine Learning Techniques to Direct Detection Dark Matter Experiments
(Dr G. Hesketh)

Conor P. Mc Keever
Tensor Network Simulation Methods for Open Quantum Lattice Models
(Prof M. Szymanska)

James R. Seddon
Advancing Classical Simulators by Measuring the Magic of Quantum Computation
(Prof D. Browne)

Ryan J. Marshman
Large Mass Interferometry for Understanding and Measuring Aspects of Gravity
(Prof S. Bose)

Shereif Y. Mujahed
Large-scale local-orbital DFT calculations of Si-Ge core-shell nanowires
(Prof D. Bowler)

Riccardo Tognato
Theoretical investigation of erythrocytes optical trapping in ray optics approximation
(Prof P. Jones)

Cameron D. Dashwood
Characterisation and control of electron-lattice coupling in 4d and 5d quantum materials
(Prof D. McMorrow)

Damien R. De Mijolla
Decoding astronomical spectra using machine learning
(Prof S. Viti)

Vincenzo Monachello
The development of a method to observe the weak value of spin in atomic systems
(Dr P. Barker)

Denes G. Berta
Chemical and enzymatic catalysis from a computational perspective
(Prof E. Rosta)

Charlie P. B. Donaldson
Novel Methodologies for Pattern Recognition of Charged Particle Trajectories in the ATLAS Detector
(Dr G. Hesketh)

Christian Ahart
Charge transport in bulk hematite and at the hematite/water interface
(Prof J. Blumberger)

Klaudia Gawlas
Energy transfer and spin changing in collisions of Rydberg atoms with ground-state molecules at ~ 1 K
(Prof S. Hogan)

Alfred S. P. Harwood
Coherent and Measurement-based Feedback in Quantum Mechanics
(Prof A. Serafini)

Matej Sebek
Transition metal dichalcogenides for optoelectronic applications
(Prof T. Nguyen)

Claudia L. Clarke
Irreversibility Measures in a Quantum Setting
(Prof I. Ford)

Thomas B. Farshi
Mixing and localisation in time-periodic quantum circuits
(Dr L. Masanes)

Patrick J. Roddy
Slepian Wavelets for the Analysis of Incomplete Data on Manifolds
(Prof J. McEwen)

Diana M. Serbanescu
Quantitative modelling of bacterial growth physiology, cell size and shape control
(Dr S. Banerjee)

Fabien L. Thiemann
Properties of Low-dimensional Materials Explored with Machine Learning Potentials
(Prof J. Blumberger)

Abbie C. Bray
Electron Rescattering Picture in a Strong-Field Laser Regime: Diverse Initial State Geometry under Coulomb Influences
(Prof C. Figueira de Morrison Faria)

Joel C. Forster
In Silico Evolution of Biomolecular Assemblies
(Dr A. Saric)

Benjamin P. Maddox
Quantum Sensors for Electromagnetic Induction Imaging: from Atomic Vapours to Bose-Einstein Condensates
(Prof F. Renzoni)

Qianwei Qu
Variational Calculation of Fine and Hyperfine Resolved Rovibronic Spectra of Diatomic Molecules
(Prof J. Tennyson)

Jianhua Zhu
Electronic structure of acceptor arrays in silicon
(Prof A. Fisher)

Adam H. Walker
Introducing collective order into density functional theory and modelling the magnetic reorientation transition in Ca3Ru2O7
(Prof A. Green)

Diana S. R. Ahmed
Chemical effects of magnetic nanoparticles on heavy metal removal
(Prof T. Nguyen)

Jiecheng Diao
Ferroelectric domains in barium titanate by Bragg coherent X-ray diffraction imaging
(Prof I. Robinson)

Samuel P. Grant
Towards a search for the electric dipole moment of the muon at the Fermilab Muon g-2 experiment
(Dr G. Hesketh)

Jules G. Tilly
Methods for variational computation of molecular properties on near term quantum computers
(Prof J. Tennyson)

Portrait of...

Chamkaur Ghag

How did you end up at UCL?/ What's your journey been to get here?

I studied physics at Queen Mary as an undergraduate, in the naïve hope I could learn all about our wonderful universe. The more I came to understand the limitations of human knowledge and the vast and profound open questions, the more I realised I wanted to stay in science and specifically physics. I followed up with a PhD from the University of Edinburgh where I remained as a post-doctoral researcher for some time, before a stint at University of California Los Angeles, and then onto UCL to start the Dark Matter group.

What are you working on at the moment?

Essentially the same thing I've been working on for 20 years – the experimental search for Dark Matter. A monumental amount of evidence collected over nearly 100 years points to the existence of this elusive substance that pervades the universe, making up 85% of its matter content, but has never been directly observed. I work with some of the most advanced technologies ever conceived for the hunt: the LUX-ZEPLIN (LZ) experiment, operating a mammoth xenon detector 1 mile under the Black Hills of South Dakota, and with tiny nano-scale quantum sensors, right here at UCL.

In one sentence, what is the most important question you want to answer with your research?

What is Dark Matter?

What do you most enjoy about your work?

Working with the PhD students, post-doctoral researchers, and academics I collaborate with within the Dark Matter group, more broadly at UCL, and across the UK and globe. They are invariably incredible and creative people, never short on ideas, and with the commitment to stick with a problem and learn as necessary to tackle it.

What is the most challenging thing about your work/What is the most challenging project you've worked on?

The Dark Matter challenge is to observe the faintest and rarest of signals from the galaxy; distinguishing at best a handful of Dark Matter events, signalled by only a few photons and electrons in our detectors, from amongst millions of much larger background events. We have had to get very creative to stand a chance, from working in mines or in tunnels under mountains, to spending years selecting the appropriate materials to build our experiments.

The most challenging project I've worked on is my current focus: LZ. After 10 years building and commissioning it, we, the collaboration of some 250 scientists from 37 institutions around the world, recently published first results from only a small amount of data taken to check all the LZ systems were operating as designed. They are, but more than that, with only a few percent of the exposure we will accrue over the next few years, LZ has already firmly established itself as the most sensitive Dark Matter experiment to-date, leapfrogging all other efforts around the world. We are now entering completely uncharted territory in the search for Dark Matter. We must work very hard to ensure that our analyses are mature, facing down never before seen backgrounds and anomalous event topologies, to ensure we can robustly claim discovery should LZ detect the first ever signals from Dark Matter.

If you were given unlimited resources, what would you do with them?

Invest in the rapid decarbonisation of human society, ending our reliance on fossil fuels, and on regenerating Earth's declining natural ecosystems.

If you were starting over in Physics today, what would you have done differently?

I would spend less time worrying about what I needed to do and more time enjoying and being present with the act of doing it. I'm much better now, but when I was starting out there was a huge sense of imposter's syndrome. Now I try my best to help the young researchers in the Dark Matter group come to realise they are exactly where they are supposed to be.

Who would be your dream dinner guests and what would be on the menu?

Gautama Siddhartha Buddha, Sacagawea, Frank Herbert, Mary Magdalene, Black Elk, Alan Watts, Michael Jordan, and Captain Marvel; for dinner it would be vegetarian lasagne followed by pistachio ice cream.

What is your favourite joke (pre-watershed)?

A photon is checking into a hotel and the receptionist asks, “would you like help with your luggage?”, the photon replies “no thanks, I’m travelling light”.

What’s been the best moment in your life to date?/What do you think is your most significant accomplishment/the one thing you are most proud of?

The best moment in my life to date has been the birth of my daughter, Niranjan, at home, 7 years ago. Becoming a father was the most incredible life-changing experience, followed up with the birth of my son, Anaahath, 4 years ago. I realise this is very cliché, but it is what it is.

My most significant accomplishment is probably happening right now, as the international Spokesperson of the LZ Dark Matter Experiment. It’s an honour and privilege to be in the position of leading the world’s most sensitive experiment at a time we could make a truly historic and revolutionary discovery.

The one thing I’m most proud of is the ethos of our Dark Matter group, where we operate as a family, look after one another, and go by the motto: “Do what you want!”. Happy people, free to learn and explore their creativity in a nurturing environment, do great physics!

If you could have one super-power, what would it be?

Proprioception of mind and thought. Or flying. Probably flying…

What would it surprise people to know about you?

I was once given a tarantula for my birthday, which I promptly exchanged for a pair of love birds!

Ruben Saakyan Writes

Cham came to UCL as a Lecturer in 2012 bringing dark matter research to the HEP group. It was clear from the very beginning he was a rapidly rising star. Eleven years on, he has made UCL a leading authority in the experimental hunt for dark matter and mentored and inspired dozens of young scientists to join the quest. Cham recently became the spokesperson of the international LZ experiment, the world’s most sensitive detector trying to uncover the nature of dark matter by observing its interactions with liquid xenon in a deep mine in South Dakota, USA.

Cham and I are working in physics areas that share common experimental technologies and challenges. They require complex infrastructures and instrumentation employed in deep underground laboratories. Thanks to his vision and energy we now have one of the world’s best ultra-low background facilities at the Boulby laboratory in North-East England. Without such facilities, no dark matter or other rare event experiments could be built.

Another big passion of Cham’s is environment and taking on global warming. He truly sees it as his responsibility and as a member of UCL’s Climate Change Working Group and a co-founder of Rhizome deploys rational scientific arguments to help avoid the biggest humanitarian catastrophe.

Not sure how he finds the time for all this. Perhaps it’s his famous meditation technique!

Staff News

Retirement

Professor Nella Laricchia

Prof Gaetana (Nella) Laricchia has retired from her post as Professor of Physics in the department after a long and illustrious career at UCL. Prof Laricchia came to UCL for her bachelors studies in 1980. She completed her PhD with a thesis on 'An experimental study of positron interactions and positronium formation in gaseous media' in 1986, and after periods of postdoctoral work was appointed as a Lecturer in the department in 1988. She was promoted to Reader in1996, and Professor in 2003. From 2004 to 2013 she was head of the AMOPP group.

Over her time here, Prof Laricchia was instrumental in developing and implementing a range of positron beams which she used for gas-phase scattering studies. This work involved the observation that for many gases the differential positronium formation cross-section is strongly peaked in the forward direction and leads to the generation of naturally forward-directed positronium beams. The positronium beams produced in this way, that Prof Laricchia developed, have had an enormous impact on studies of positronium-matter interactions over the last 30 years. One key observation that Prof Laricchia and her group made in this period was that in many instances the total scattering cross-sections for neutral positronium atoms interacting with gas-phase atoms and small molecules, are very similar to those for electrons of the same velocity. This feature of positronium scattering informed and motivated many of Prof Laricchia's experiments over the last decade.

In 2004 Prof Laricchia was elected a Fellow of the Institute of Physics. She was awarded the 2009 Occhialini Medal and Prize by the IoP and the Italian Physical Society for 'distinguished work on experimental positron physics', and the 2010 Thomson Medal and Prize of the IoP for her 'contributions to the development of the world's only positronium beam and its use to probe the properties of atoms and molecules'. In 2015, she was elected an Honorary Member of the Roland Eötvös Physical Society of Hungary.

Professor David Brook

David was a key scientist in the construction of some of the largest astrophysical instruments in the world and it is a source of pride to UCL that the design, assembly and testing of the large multiple lens system of the Dark Energy Spectroscopic Instrument (DESI) optical corrector took place at UCL's Optical Science Laboratory. David's work on the Dark Energy Survey is helping to collect spectra from millions of galaxies at unprecedented speed and could lead to a new understanding of dark energy and the accelerating expansion of the universe. He served the university with great distinction, and UCL is proud and honoured to continue counting David as part of the community as an Emeritus Professor.

Derek Attree

Derek Attree retired from his role as Senior Mechanical Engineer in April 2023. His career at UCL spanned close to 50 years and took in projects far and wide including balloon-borne atmospheric physics instruments and building particle physics detectors at CERN. A well-attended retirement party was held on 28th April 2023, where he was presented with a special gift constructed by Connor Godden and Anastasia Basharina-Freshville. We wish Derek a very happy retirement and look forward to seeing him back at group celebrations and other events.

Dr. Robert Flack

Rob Flack has been a member of UCL's HEP group since 2006. He was initially a post-doctoral research fellow in the neutrino group where he made important contributions to the NEMO-3 and SuperNEMO neutrinoless double-beta decay experiments including long stints running our clean-room and laboratory at MSSL. In recent years he initiated and led, along with emeritus Professor Basil Hiley and others, a programme of weak measurements and other fundamental tests of Quantum Mechanics, bringing an original and fascinating activity into the department. Rob will continue his research programme as Honorary Senior Research Fellow in the HEP group.

Promotions 2022-23

We are very pleased to announce the latest round of senior promotions; congratulations to the staff listed below on their well deserved achievements:

Dr Simon Jolly (HEP)
Professor of Visceral Physics

Dr Arijeet Pal (CMMP)
Professor of Physics

Dr Timothy Scanlon (HEP)
Professor of Particle Physics and Data Intensive Science

Dr Ingo Waldmann (Astro)
Professor of Astrophysics

Research Spotlight

Atomic, Molecular, Optical and Positron Physics (AMOPP)

Research in the **Atomic Molecular Optical and Positron Physics** (AMOPP) group encompasses precision tests of fundamental physics with atoms, molecules and nanoparticles composed of matter and antimatter; foundations of quantum mechanics; quantum optics, sensing, computing and many-body physics; atoms and molecules in strong and short-wavelength laser fields; optical biophysics, and molecular physics and spectroscopy.

The last year has seen several significant changes in personnel in the group. **Prof Gaetana (Nella) Laricchia** retired from her post as Professor of Physics in autumn 2022. Prof Laricchia's research in positron and positronium physics extended a long history of activities in this area in the department. She was a member of the academic staff since 1988, and was head of the AMOPP group from 2004 to 2013. Throughout her long and illustrious career Prof Laricchia was awarded numerous prizes including the 2009 Occhialini Medal and Prize (Institute of Physics and Italian Physical Society) and the 2010 Thomson Medal and Prize (Institute of Physics). Prof Laricchia made important contributions to the evolution of the AMOPP group over the last two decades, and through this has left a great legacy in the department. For this we are extremely grateful. We wish her a healthy and fulfilling retirement.

To enhance the activities in the group in what has become a strategically important research area within the department of exploiting **quantum technologies for fundamental physics** – or more specifically precision tests of fundamental physics using atomic molecule and optical (AMO) techniques – we were joined in summer 2023 by a new lecturer Dr Luke Caldwell. Dr Caldwell has moved from a postdoctoral position at JILA, NIST, and the Department of Physics at the University of Colorado in Boulder. There he worked on an experiment with cold trapped HfF+ ions, that resulted in what is now the most precise upper bound on the electric dipole moment of the electron. At UCL Dr Caldwell will establish a new laboratory to exploit arrays of ultracold polyatomic molecules to place new bounds on symmetry-breaking in beyond-Standard-Model physics. This work complements existing world-leading activities in the AMOPP group on **tests of bound-state quantum electrodynamics (QED) and antimatter gravity** (Cassidy and Hogan), **dark matter detection** (Barker in collaboration with researchers in the HEP group), **absolute neutrino mass measurements** (Hogan in collaboration with researchers in the HEP group), **tests of the quantum nature of gravity** (Bose and Barker), and **post-classical quantum gravity** (Oppenheim).

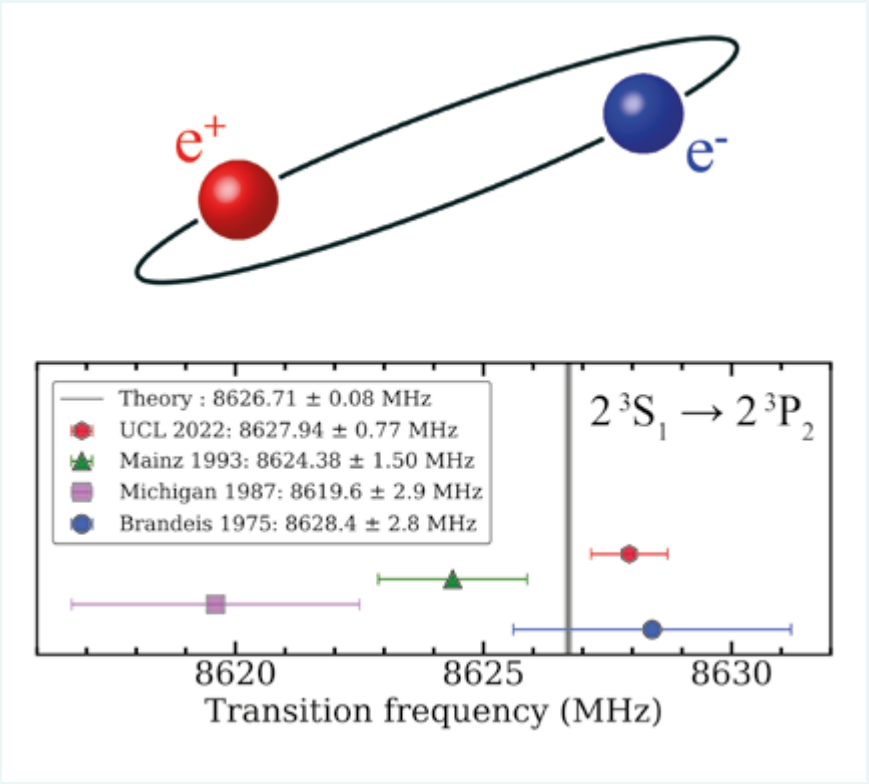


Figure 1 Precision measurements of the n=2 fine-structure in the positronium atom. Adapted from Sheldon et al. Phys. Rev. Lett. 131, 043002 (2023).

In the last year we have also had changes in our support staff. Our IT Systems Manager Fabian Garza left after an extended period working in the group. And we were delighted to welcome a new group administrator Miss Amalia Bountoureli who started with us in autumn 2022.

Notable research output in positronium physics (Cassidy) over the last year includes the most precise measurements ever made of the 2 3S1 – 2 3P2 fine-structure interval for tests of bound state QED (Figure 1). Significant advances have also occurred in experiments with levitated nanoparticles (Barker and Monteiro) including the demonstration of methods to probe and orient these systems, simultaneous cooling of all six degrees of freedom (translation and rotation), and sympathetic cooling and squeezing two nanoparticles.

In addition, a wide range of theoretical work has been carried in relation to the realisation of superpositions of spatially separated momentum states of nanoparticles for tests of the quantum nature of gravity, tests of the weak equivalence principle in the quantum

regime in which matter and gravity are both treated quantum mechanically, and the implementation of new quantum sensors to detect space debris by changes in local gravitational field gradients (Bose).

In the area of quantum information processing, work has been reported on error correction in surface codes for quantum computing, and the use of Majorana quasiparticles as topological qudits with which to perform computational operations (Brown). Studies have also been carried out on analogue quantum simulation of condensation and non-equilibrium phases of matter in hybrid light-matter cavity quantum electrodynamics (cavity-QED) settings, and on a new form of superfluidity that could be observed using existing experimental techniques, and in which a low-density quantum fluid is populated by topological defects, but remains in an ordered phase because of restrictions on its collective dynamics (Szymanska). Physical scenarios have also been identified in which the behaviour of a quantum system tends to become classical because of its interaction with a fundamentally classical field, and consequently the measurement postulate of quantum mechanics is not needed. This research has been carried out in the context of tests of the quantum nature of gravity (Oppenheim). Work has also been reported on the use of Gaussian thermal states in quantum devices such as refrigerators or batteries, and the implementation of the methods of optimal control to enhance precision in the estimation of Hamiltonian parameters in the presence of noise (Serafini).

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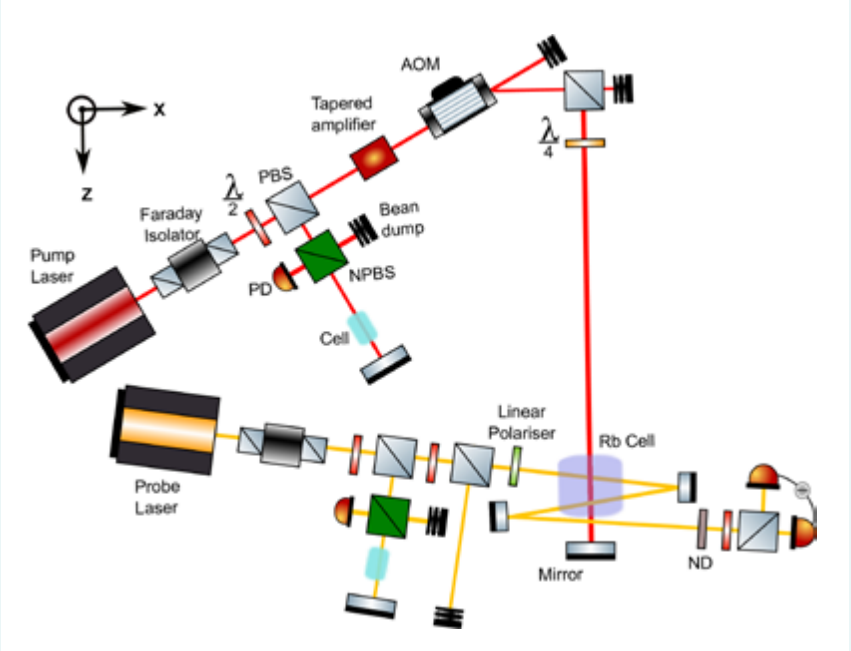


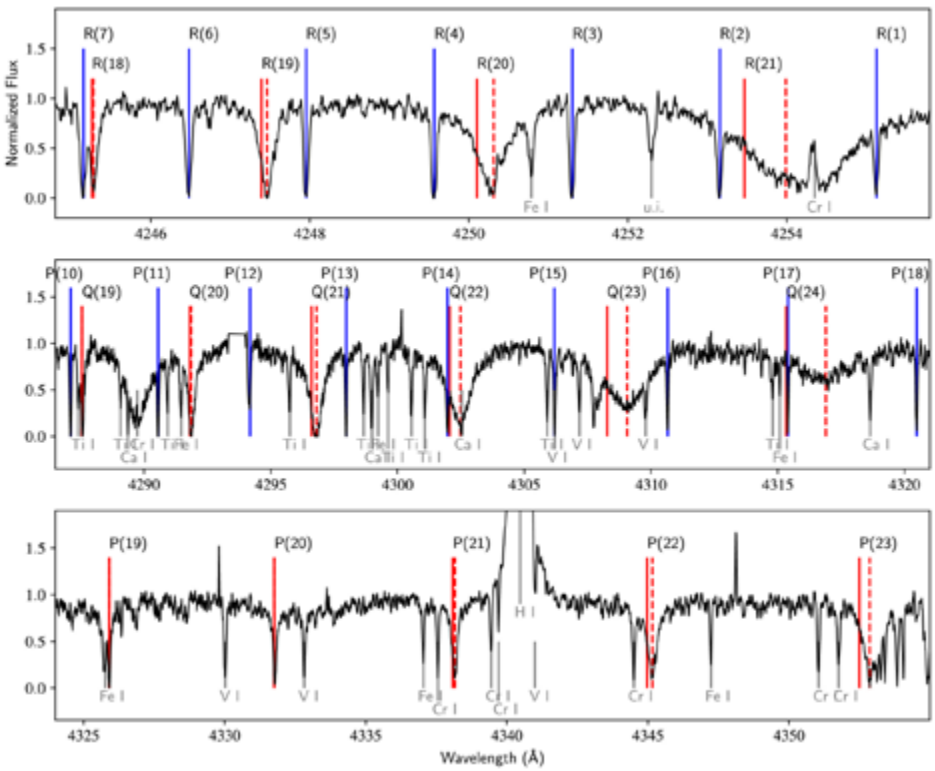
Figure 2 Experimental setup of a radio-frequency atomic magnetometer. From Yao et al. Optics Express 31, 27287 (2023)

have also been carried out on analogue quantum simulation of condensation and non-equilibrium phases of matter in hybrid light-matter cavity quantum electrodynamics (cavity-QED) settings, and on a new form of superfluidity that could be observed using existing experimental techniques, and in which a low-density quantum fluid is populated by topological defects, but remains in an ordered phase because of restrictions on its collective dynamics (Szymanska). Physical scenarios have also been identified in which the behaviour of a quantum system tends to become classical because of its interaction with a fundamentally classical field, and consequently the measurement postulate of quantum mechanics is not needed. This research has been carried out in the context of tests of the quantum nature of gravity (Oppenheim). Work has also been reported on the use of Gaussian thermal states in quantum devices such as refrigerators or batteries, and the implementation of the methods of optimal control to enhance precision in the estimation of Hamiltonian parameters in the presence of noise (Serafini).

Experimental work in the area of quantum sensing has been reported in relation to the implementation of high-sensitivity unshielded radio-frequency atomic magnetometers (Figure 2), the optimisation of these devices using neural networks, and their use in electromagnetic induction imaging (Renzoni). High-precision absolute static-field magnetometry and vector electrometry with applications in absolute neutrino mass measurements have been performed with atoms in circular Rydberg states, and robust and tuneable microwave-dressed Rydberg-atom qubits have been realised for interfacing with superconducting circuits (Hogan).

In the study of atoms and molecules in strong and short wavelength laser fields, results have been reported on effects of two-path electron interference when an atom is ionised by a high-intensity short laser pulse, the use of machine learning methods to enhance quantum mechanical effects in these strong-field ionisation processes, and effects arising from the use of elliptically polarised laser fields in photoelectron holography (Faria). Research has also been carried out to demonstrate the one-to-one mapping between the direction of electron emission and the relative phase of a linearly polarised ionisation laser pulse in the vacuum ultraviolet region of the electromagnetic spectrum used for ionisation and a circularly polarised

Figure 3 Calculated AlH transitions (continuous red and blue vertical lines) in the blue spectrum (black curves) of Proxima Centaur. From Pavlenko et al. MNRAS 516, 5655 (2022).



infrared laser pulse used to accelerate the ionised electron in the continuum, and to realise a semiclassical model to describe correlated multielectron dynamics in the ionisation of atoms in high intensity infrared laser fields (Emmanouilidou).

In the area of optical biophysics experiments have been reported in which time- and polarization-resolved fluorescence, and polarized two-photon absorption spectroscopy were used to provide new insights into enzyme binding mechanisms of the coenzymes nicotineamideadenine dinucleotide (NAD) and nicotineamide adenine dinucelotide phosphate (NADP). These play key roles in the regulation of metabolism (Bain). Theoretical work was also carried out to study the coupling of the vibrational modes of biomolecules to optical cavities for applications in photosynthetic exciton transport (Olaya-Castro).

Finally, the ExoMol project to compute spectral line lists of small molecules under conditions expected in Exoplanet atmospheres (Tennyson and Yurchenko) has continued to expand with recent calculations for LiOH, YO and CH+. This work has resulted in, what is now, in excess of 50 line lists. These have also allowed the first identification of AlH in the blue region of the emission spectrum of the nearest star to the Sun, Proxima Centauri (Figure 3). Calculations were also performed to determine electron scattering cross sections for N2, and N2+. Experimental work in this area has included electrostatic trapping, and studies of slow decay processes, of vibrationally excited Rydberg NO molecules, and the observation of resonant energy transfer in collisions of Rydberg atoms with polar molecules at temperatures below 100 mK for the first time.

Members of the group continue to organise leading international conferences that span the broad range of research topics in which we are active. For example, this year Prof Carla Faria and her team organsed a workshop on '*Quantum Battles in Attoscience*'. This covered chirality, symmetry and tailored fields; the attoscience of solids; and addressed the question 'how quantum is atto?'. Prof Stephen Hogan and his team, together with researchers from Harvard and the University of Innsbruck, organised a large conference on '*Frontiers in Rydberg Physics: From few-body interactions to many-body quantum simulations*'. This covered the state-of-the-art in quantum computing, simulation and sensing with neutral atoms in Rydberg states, cold Rydberg chemistry and precision measurement.

The 2023 AMOPP **Harrie Massey** Lecture was given by the 2018 Nobel Prize winner Prof Donna Strickland (University of Waterloo). This event was coordinated by Prof Carla Faria and included lab tours given by staff and PhD students, and a lunch including a question-and-answer session with Prof Strickland – with priority attendance for female PhD students and postdocs in the department. This was a very successful and inspiring event, that benefitted a broad range of members of our departmental community at all career stages.

This year's **Carey Foster Prize** 'for outstanding postgraduate physics research in AMOPP' was awarded to Dr George Katsoulis for his theses on '*Attosecond phenomena in atoms and molecules driven by intense and ultra-fast laser pulses*'.

Astrophysics (Astro)

An exciting year for the UCL Astro group, marked by many scientific discoveries and achievements, such as the launches of the European Space Agency's missions Juice, to explore Jupiter's icy moons, and Euclid, embarking on a quest for the 'dark Universe',

ESA's Jupiter Icy Moons Explorer (Juice) was launched on an Ariane 5 from Europe's Spaceport in Kourou on 14 April. After an eight-year journey to Jupiter, it will make detailed observations of the gas giant and its three large ocean-bearing moons: Ganymede, Callisto and Europa. This ambitious mission will characterise these moons with a powerful suite of remote sensing, geophysical and in situ instruments to discover more about these compelling destinations as potential habitats for past or present life. Juice will monitor Jupiter's complex magnetic, radiation and plasma environment in depth and its interplay with the moons, studying the Jupiter system as an archetype for gas giant systems across the Universe.

"One of the prime science goals for the J-MAG is to isolate, from the complex magnetic environment of Ganymede, the small magnetic signal corresponding to induced currents flowing in the subsurface ocean which is likely to be present. The variability and strength of this induced field signal will hold important clues as to the salinity, depth and thickness of Ganymede's ocean."

Professor Nick Achilleos
Science team for the Juice's J-MAG instrument

ESA's Euclid mission left Earth on a SpaceX Falcon 9 rocket on July 1st heading to the second Lagrangian Point, a stable hovering spot about 1.5 million kilometres from Earth. Euclid will observe billions of galaxies to create the biggest ever 3D map of the sky. Hundreds of scientists will be involved in processing the raw data into summary statistics that can be compared with current models of the universe. The algorithms that will be used are advanced developments in their own right.

Prof. Benjamin Joachimi is the deputy lead of the team at the end of this critical process. "If you look at a single galaxy it cannot tell us much," he explains. "But lots of galaxies can tell us about the properties of the universe. Every step of the ground segment has to be perfectly done, any tiny mistake can mess up the science that comes out at the end. Some of the accuracy requirements can be measured as parts per million." A key open question, he explains, is how "clumpy" the distribution of dark matter is. Analysis of the cosmic microwave background predicts that dark matter ought to be more clumpy today than weak lensing techniques currently find it to be, but no one has a good theory to explain it.

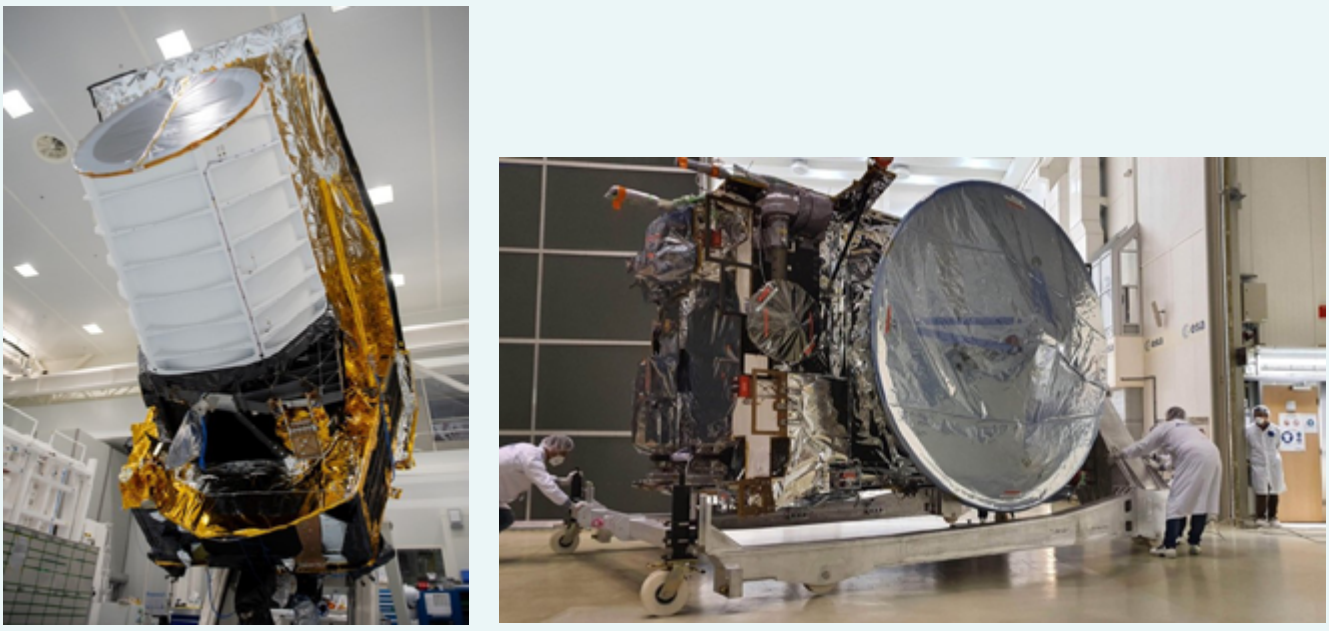


Figure 1: Euclid's (left) and Juice's flight models (right).

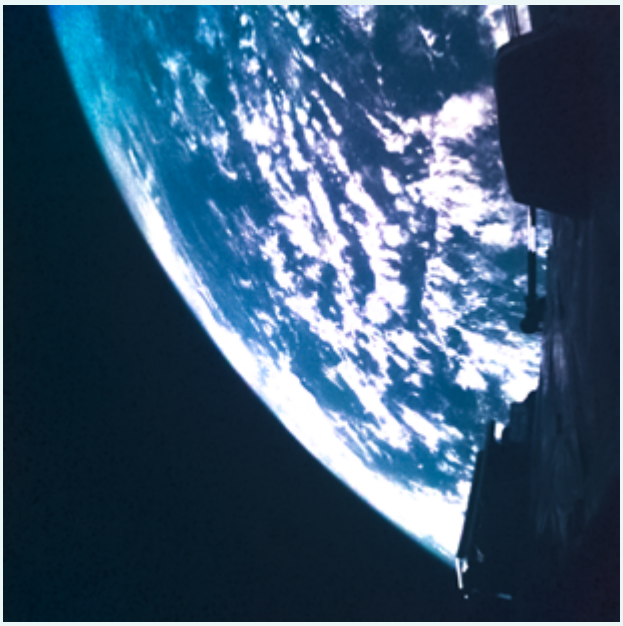


Figure 2: Shortly after launch on 14 April, ESA's Juice captured this stunning view of Earth.

In a study led by Astro PhD student Matthew Rickard[1], two massive touching stars (known as contact binaries) in a neighbouring galaxy were observed on course to become black holes that will eventually crash together. The stars are in partial contact and swapping material with each other, with one star currently "feeding" off the other. They orbit each other every three days and are the most massive touching stars yet observed.

"Thanks to gravitational wave detectors Virgo and LIGO, dozens of black hole mergers have been detected in the last few years. But so far we have yet to observe stars that are predicted to collapse into black holes of this size and merge in a time scale shorter than or even broadly comparable to the age of the universe. Our best-fit model suggests these stars will merge as black holes in 18 billion years. Finding stars on this evolutionary pathway so close to our Milky Way galaxy presents us with an excellent opportunity learn even more about how these black hole binaries form."

Matthew Rickard

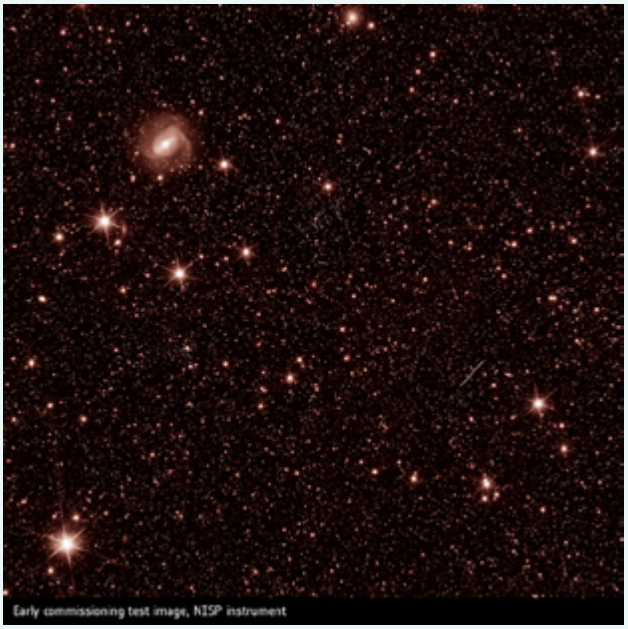


Figure 3 – Euclid's first test images captured from the two instruments: the VISible instrument (VIS) and the Near-Infrared Spectrometer and Photometer (NISP). Euclid's VIS, built at UCL-MSSL, will take super sharp images of billions of galaxies to measure their shapes. NISP has a double role: imaging galaxies in infrared light and measuring the amount of light that galaxies emit at various wavelengths. These mesmerising results indicate that the space telescope will achieve the scientific goals that it has been designed for – and possibly much more.

[1]https://www.aanda.org/articles/aa/full_html/2023/06/aa46055-23/aa46055-23.html

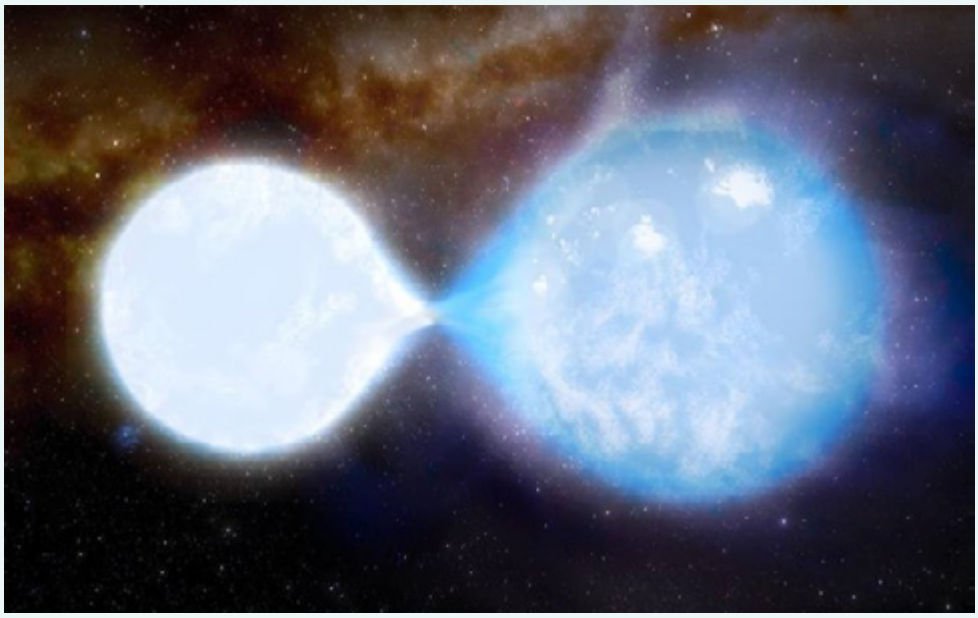


Figure 4: An artist's impression of the binary star. The smaller, brighter, hotter star (left), which is 32 times the mass of our Sun, is currently losing mass to its bigger companion (right), which has 55 times the mass of our Sun. The stars are white and blue as they are so hot: 43,000 and 38,000 degrees Kelvin respectively. Credit: UCL / J. daSilva.

Planets form in disks made of gas, dust, and ice that surround young stars. These 'protoplanetary' disks are vast structures, covering regions of space many times larger than the entire Solar System. They are also chemically complex, with compositions that vary dramatically from the centre to the outer edge. A young planet grows by accreting material from the disk, and we can therefore expect the composition of a planet to be directly related to the region of the disk in which it formed. Drawing links between the composition of planets and disks is fundamental to understanding planetary formation processes.

Two elements of particular importance are carbon and oxygen, both of which are among the most abundant elements in the Universe. In a protoplanetary disk, most of the carbon and oxygen is locked into in simple molecular species such as CO and H2O. In the warm inner part of the disk, these molecules can easily exist in the gas phase. In the outer parts of the disk, further from the central star, temperatures decrease and molecules 'freeze out' on to the surfaces of dust grains. Different molecules freeze out at different temperatures, so the overall effect is that the total amount of carbon or oxygen in the gas phase varies as a function of radius.

In a new paper published in Nature Astronomy[2] and led by Astro PhD student Luke Keyte, ALMA (Atacama Large Millimeter/ sub-millimeter Array) observations of CS and SO were used to uncover an entirely unexpected chemical variation in a protoplanetary disk. "We found that these molecules trace an azimuthal variation in the C/O ratio", explains Luke. "Unlike the 'classical' radial variations described above, this variation affects only a small angular region of the disk. This is the first time such a variation has been observed". Astro faculty members Dr. Mihkel Kama and Prof. Jonathan Rawlings were co-authors of the paper.

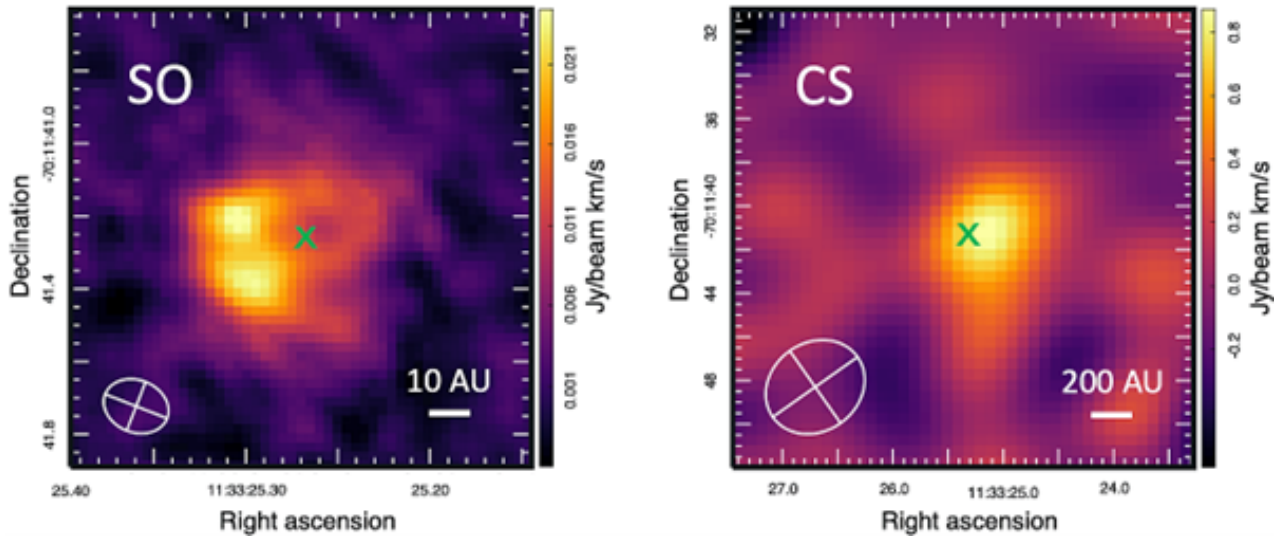


Figure 5: observations of both the CS and SO molecules using ALMA, towards a protoplanetary disk called HD 100546 (Keyte et al. 2023). The observations show emission from molecular gas at millimeter wavelengths. In each of these observations it is clear that the emission is asymmetric, i.e. offset from the central star (denoted by the green 'x'). The SO emission is offset on one side of the disk, while the CS emission if offset on the other side.

[2]https://www.nature.com/articles/s41550-023-01951-9

Biological Physics (BioP)

The Biological Physics (BioP) group continues to expand its research activities addressing complex and open scientific problems at the interface between biology and several areas of physics, including classical mechanics, optics, physical chemistry, quantum physics, and quantum chemistry. This year BioP welcomed the arrival of Dr Nick Bell, a new lecturer in Experimental Biological and Optical Physics.

After more than decade of supporting and championing BioP, Prof Bart Hoogenboom stepped down as Head of Group with this role now being assumed by Prof Alexandra Olaya-Castro. We would like to thank Prof Hoogenboom for all his work as former BioP Head of Group.

In January 2023, Dr Nick Bell joined UCL Physics and Astronomy with his lab being based at the UCL Laboratory for Molecular Cell Biology (LMCB). Dr Bell is interested in the biophysics of protein-DNA interactions that underpin the structure and maintenance of the genome. His lab will be developing cutting-edge new techniques that use magnetic fields and fluorescence microscopy to probe the dynamics of these molecular interactions at high spatial and temporal resolution down to the level of single molecules.

A particular focus of the lab is the study of DNA repair. The DNA in our cells constantly accumulates different forms of damage. This damage can be caused by factors outside the cell such as UV light but also from the by-products that the cell produces during natural processes such as metabolism. Proteins in the cell nucleus recognise and repair different types of DNA damage. Dr Bell is interested in studying how these proteins function and how small molecule drugs can alter their dynamics. Failure to correctly repair DNA damage can lead to cancer and other diseases. By understanding the fundamental processes by which these proteins work this research will inform the progression of new therapies. An example of this work is the recently published study using magnetic force spectroscopy to understand how key human DNA repair proteins assemble around sites of DNA breaks [1].

Dr Maxim Molodsov and his lab currently based at the Francis Crick Institute, continue to develop cutting-edge research on how complex intracellular rearrangements result from interactions between specific groups molecular machines and non-motor molecules in lab conditions with the ultimately goal of unravelling both the mechanistic principles underlying intracellular rearrangements, and understanding the differences in these mechanisms between different types of cells.

Molodsov's lab recently reported a groundbreaking study on the role of cohesin in cell division. Cohesin is a protein complex that was identified for its function in physically holding two sister DNAs during cell division, which is essential for correctly passing genomes from one generation to another. Recent research just in the last few years, discovered that cohesin has another role – it can spatially organize DNA, which is important for gene expression, repair, and recombination. Cohesin performs this function by physically moving along DNA and extruding DNA loops as illustrated in Fig. 1. However, what mechanism cohesin uses to achieve this and how it works as a molecular machine is poorly understood.

Cohesin can undergo two major conformational changes: the bending of the molecule's long coiled-coil domains and the engagement/disengagement between the cohesin's two ATPase head domains. To propel itself along the DNA and extrude DNA loops, conformational changes in cohesin must generate mechanical force and determining these forces is essential for understanding the mechanism of cohesin movement. To achieve this, Molodtsov group used optical tweezers, which was previously instrumental for understanding how other molecular machines such as kinesin, dynein or myosin generate forces.

They discovered that the two conformational changes in cohesin generate forces by different molecular mechanisms. The bending of coiled coils is driven by the Brownian fluctuations and happens even in the presence of non-hydrolysable ATP analogues. On contrary, the ATPase head engagement is a power stroke that uses energy of ATP to generate up to 15 pN of force. The group showed that high energy of the ATPase engagement may be stored in the mechanically strained form of NIPBL molecule, whose association with cohesin is required for cohesin movement, and released during the disengagement. These findings, which have been reported in Nature Communications [2], suggest that cohesin combines two unconventional force generating activities in one molecule and pay the way for understanding how these activities may power different aspects of cohesin-DNA interaction.

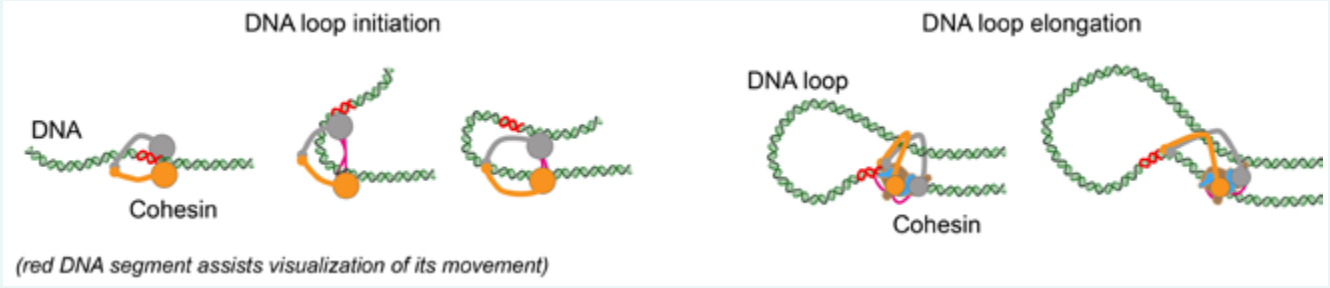


Fig. 1. Illustration how two major conformational changes in cohesin protein complex (consisting of orange, grey and magenta domains) drive initial DNA bending (left) and elongation of DNA loops (right). Red segment marks discrete position on DNA to assist visualization of its movement. Linear size of the cohesin complex is ~ 50 nm.

Professor Thanh Nguyen and her lab based at the UCL Healthcare Biomagnetic and Nanomaterials Laboratories at the Royal Institution, continue advancing transformative research in nanomaterials for biomolecular and biomedical sciences and nanotechnology. Her lab is pioneering the development of nanoparticles for efficient removal of toxic substances from wastewater such as hexavalent chromium (Cr^{6+}), which is a highly toxic substance that poses risks to the environment, economy, and human health. Removing it safely from wastewater is a pressing need. One promising approach involves using adsorption and a natural process involving microbes to transform the harmful Cr^{6+} into a less harmful form (Cr^{3+}). Prof Nguyen's research aims to tackle this issue by developing spherical and flower-like manganese ferrites ($Mn_xFe_{3-x}O_4$) nanomaterials using a polyol solvothermal synthesis process [3].

Nguyen's lab created different types of nanomaterials and identified the one that has the best ability to attract and bind with Cr6+. They then investigated how well this nanomaterial can work together with special bacteria (*Shewanella oneiden* MR-1) to transform Cr^{6+} into a less harmful form given by the trivalent state, i.e. C^{r3}+ (see Fig. 2). The results revealed that the oxidation state of the manganese precursor has a significant effect on the Cr^{6+} adsorption effectiveness of the manganese ferrites nanoparticles. Interestingly, the spherical ($Mn_{0.2}{}^{2+}Fe_{2.8}{}^{3+}O_4$) nanoparticles exhibited the highest efficiency in capturing Cr^{6+} compared to the flower-shaped ones i.e 16.8 ± 1.6 mg/g which is 1.4 times higher than that of flower-like ($Mn_{0.8}Fe_{2.2}O_4$) nanomaterial. This effect was attributable to the relative excess of divalent manganese in $Mn_{0.2}{}^{2+}Fe_{2.8}{}^{3+}O^4$. When they combined these spherical nanomaterials with the special bacteria, they observed a remarkable enhancement in the detoxification of Cr^{6+} compared to using the bacteria alone. This approach not only works well but is also cost-effective and produces less waste in the process. It's a step forward in finding an efficient way to remove Cr^{6+} from wastewater, with minimal leftover waste.

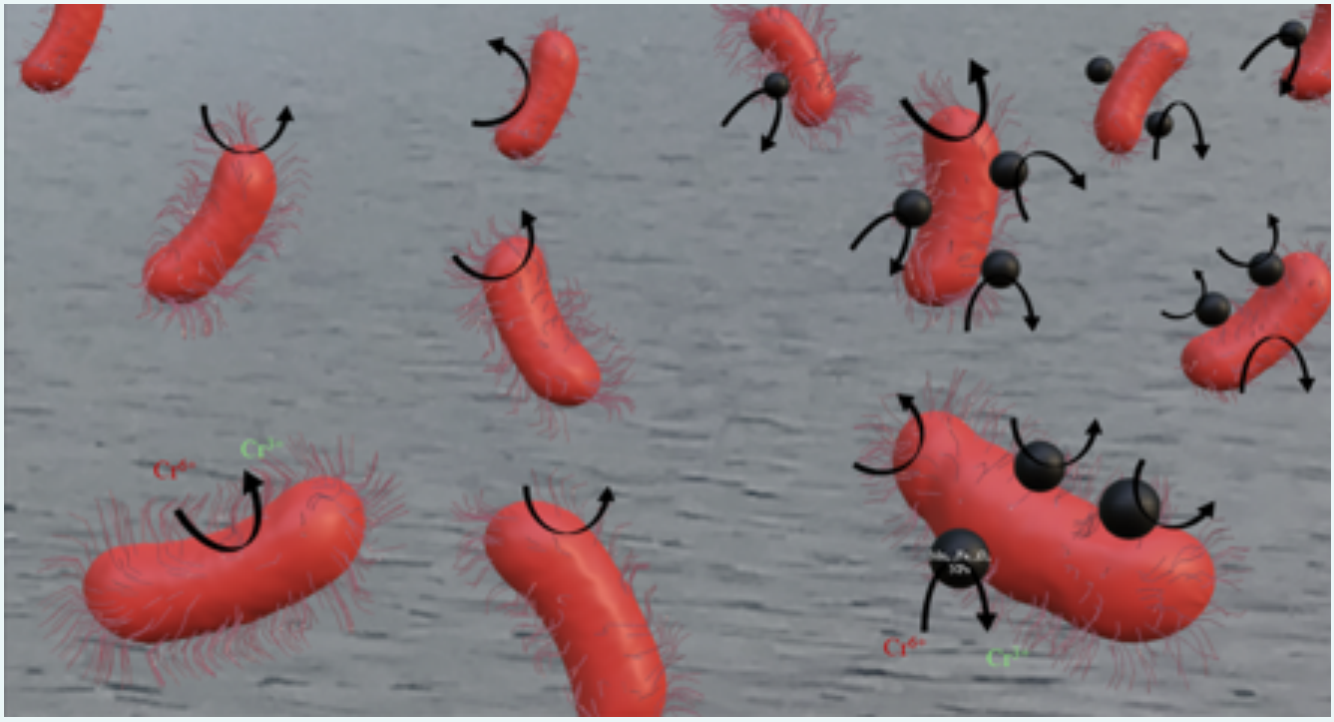


Fig. 2. Illustration of the removal of Cr6+ via interactions between manganese ferrite nanostructures (in black) and the bacteria Shewanella oneiden MR-1 (in red).

[1] N A.W. Bell & J. E. Molloy, Single-molecule force spectroscopy reveals binding and bridging dynamics of PARP1 and PARP2 at DNA double-strand breaks, PNAS, 120, e2214209120 (2023) https://doi.org/10.1073/pnas.2214209120

[2] Pobegalov, G., Chu, LY., Peters, JM., and Molodtsov, MI. Single cohesin molecules generate force by two distinct mechanisms. Nat Commun 14, 3946 (2023). https://doi.org/10.1038/s41467-023-39696-8

[3] D S. Raie et al., Enhanced detoxification of Cr6+ by Shewanella oneidensis via adsorption on spherical and flower-like manganese ferrite nanostructures, Nanoscale Adv. 5, 2897-2910 (2023). https://doi.org/10.1039/D2NA00691J

Condensed Matter And Material Physics (CMMP)

The Condensed Matter & Materials Physics Group (CMMP) has 23 permanent academic staff who cover a very wide range of research in condensed matter and materials physics using experimental, theoretical and computational approaches. Research in CMMP can be broadly divided in Scattering and Microscopy, Energy and Electronic Materials, Magnetic and Ferroic Materials, Quantum Materials, Statistical Mechanics and Soft Matter and Theory and Modelling of Materials. Techniques developed and applied include neutron and X-ray scattering, atomic-scale fabrication, scanning tunnelling microscopy, thermodynamic measurements, theory and computational modelling. The CMMP maintains strong connections with the UK central facilities at Harwell, with the Thomas Young Centre for the Theory and Simulation of Materials and Molecules and with the London Centre for Nanotechnology (LCN).

This year has seen a number of changes in leadership roles in CMMP. Congratulations to Professor Steven Bramwell who has taken over from Professor Andrew Fisher as the new LCN Director – it is reassuring to see that LCN leadership stays firmly in the hands of CMMP! In turn, Professor Jochen Blumberger has taken over from Steve as Head of CMMP.

In 2022, we said farewell to Professor Franco Cacialli who accepted an appointment at the University of Bolzano, in the North of Italy. Franco has been a longstanding member of CMMP. Having joined the group in 2001 as a Royal Society University Research Fellow he established an internationally highly recognized research group in experimental organic semiconductor research and device applications. A fellow of the American Physical Society, he co-authored over 200 publications, holds 6 patents, coordinated several EU Marie-Curie Research Training Networks and received a Royal Society Wolfson Research Merit Award. We wish him best of luck with setting up a new research group in his native Italy.

We would like to congratulate this year's winner of the Marshall Stoneham Prize for the best PhD thesis in CMMP: Dr. Cameron Dashwood, supervised by Professor Des McMorrow, for his experimental thesis on "Characterisation and control of electron-lattice coupling in 4d and 5d quantum materials", and Dr. Denes Berta, supervised by Professor Edina Rosta, for his computational thesis on "Chemical and enzymatic catalysis from a computational perspective".

This year has also seen the introduction of the CMMP seminar series, expertly organised and coordinated by Dr. Frank Kruger and Dr. Roger Johnson. Roger, who is also CMMP's EDI representative, has introduced and organised the first edition of the Student Research Connection, an online event where undergraduate students from UK Physics departments participated in engaging talks in condensed matter and materials science by world-leading experts (including one Nobel Prize Laureate) and in virtual lab tours.

As to research, our PIs have continued to make important progress in understanding the world of condensed matter and materials. Two highlight contributions, one by Professor Green's group on simulating quantum phase transitions using Google's quantum computer and one by Professor Howard's group on structure determination of meteorite material can be found on pages 52 respectively 51 of this review. Professor Howard's work on alternative battery concepts received media coverage by the Daily Star and was featured in the APS Physics magazine. A selection of this year's other research highlights in the CMMP group is given below.

Expanding the Horizons of Semiconductor-based Quantum Technology

The pursuit of scalable quantum electronic devices in semiconductors faces numerous challenges. Currently, much focus is placed on fabricating phosphorus donor devices (qubits) in silicon. However, recent findings reveal fundamental problems in scaling up this technology to accommodate large numbers of qubits. Now, a groundbreaking study led by Dr. Steven Schofield (CMMP) in collaboration with Professor Neil Curson and Taylor Stock (UCL EEE) [1], suggests that switching from silicon to germanium as the host substrate for quantum devices could overcome this limitation. They demonstrate that arsenic atoms can be fully incorporated into the (001) surface of germanium at room temperature, eliminating the need for thermal annealing that currently hinders device scale-up in silicon. These findings represent a significant advancement in germanium-based quantum electronic devices and highlight germanium's potential as a material for large-scale, donor-based quantum technological devices.

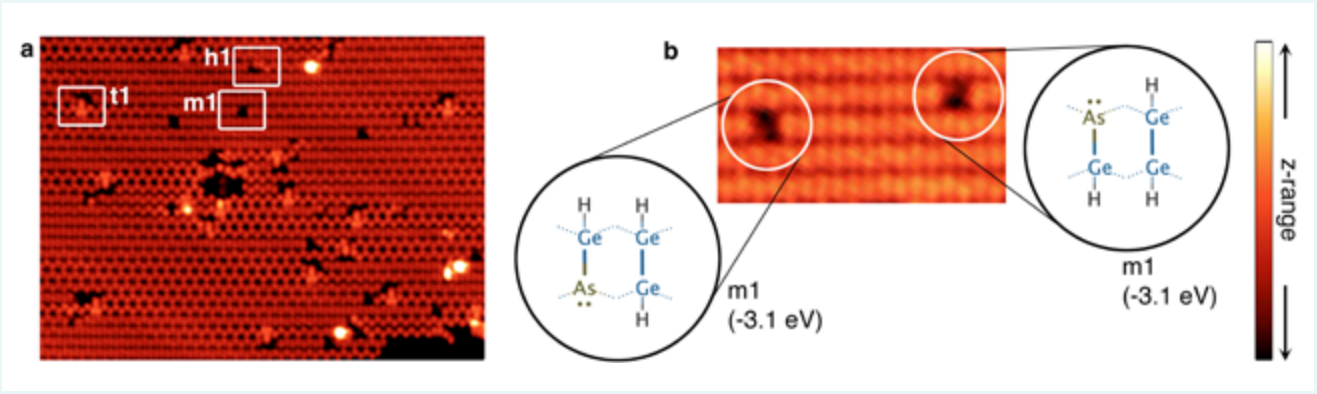


Fig. 1: Exposing atomically clean germanium (001) surfaces to arsine (AsH3) under ultra-high vacuum conditions (a). This process produced a feature consisting of an incorporated arsenic atom with three hydrogen atoms attached to adjacent germanium sites (b).

A new transparent conducting metal for photovoltaics applications

In photonics, including photovoltaics, materials are required that conduct electronic charges and are *transparent* to light. Such materials are rare - the industry standard is Indium-Tin-Oxide (ITO), which is problematic because indium is a scarce and expensive element. Now, Dr. Robin Perry's group, which specialises in materials discovery and crystal growth, together with Professor David Scanlon (Chemistry, UCL), have discovered a new transparent conducting metal, $ZnSb_2O_6$, one of only five known examples. Furthermore, its properties are competitive with ITO with the added value that its constituents are cheap and non-toxic, making it ideal for scaled-up manufacturing.

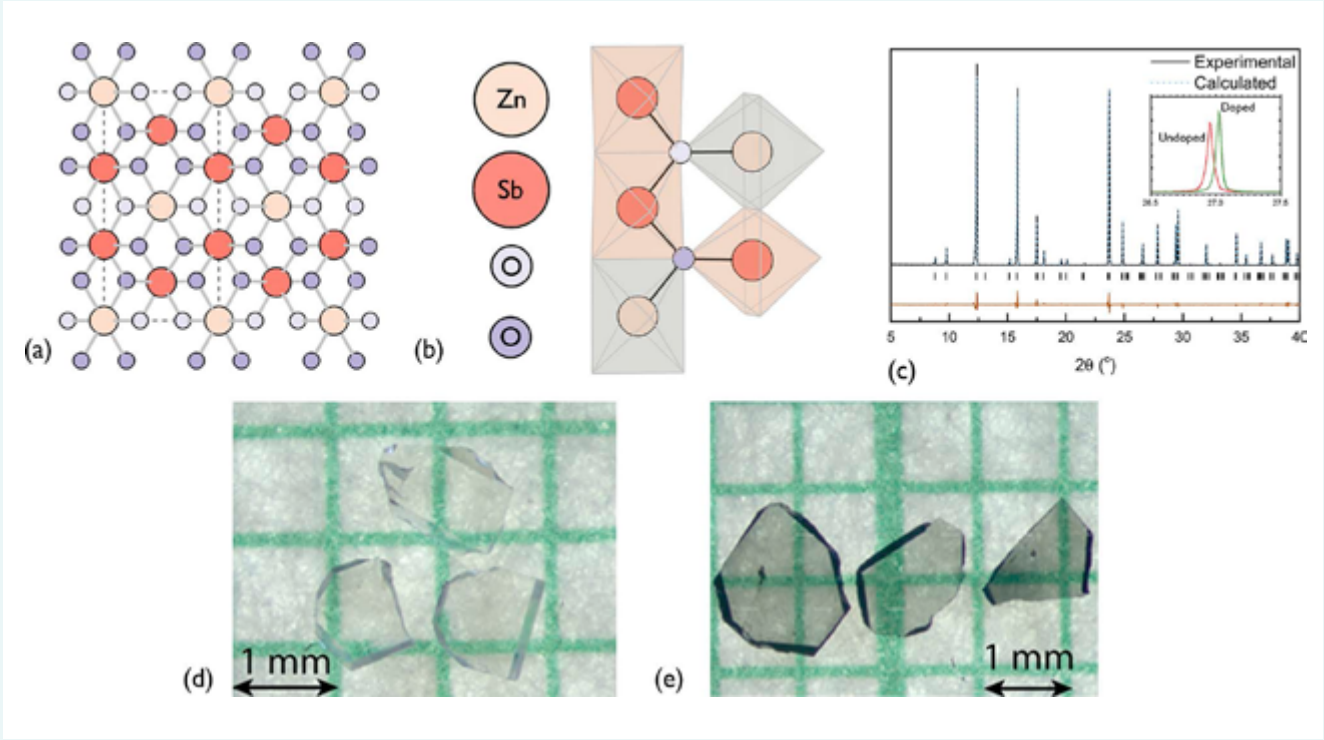


Fig. 2: The rutile crystal structure (a,b) and X-ray patterns (c) of ZnSb2O6. Pure crystals shown in (d) are transparent but semiconducting. When they were doped with ~5% Gallium, the crystals became metallic but remained transparent to light.

Magnetic Hard-Axis Ordering in Anisotropic Kondo Materials

Fluctuations in strongly interacting electron systems lead to a plethora of exotic ordering phenomena [3]. In magnetic materials they can drive a reorientation of magnetic moments away from the direction favoured by the crystal environment. A team of researchers from Dr. Frank Kruger and Professor Andrew Green's groups have now provided a theoretical explanation of why magnetic hard-direction ordering is observed in a large number of Kondo lattice materials. The key idea is that the fluctuations associated with the quantum mechanical entanglement of local moments and conduction electrons strongly renormalise the magnetic anisotropy experienced by the composite magnetic objects, a rather generic mechanism that had previously been missed. They demonstrated that the effect occurs in a broad range of situations and reproduced theoretically the crossing of magnetic susceptibilities observed in experiments.

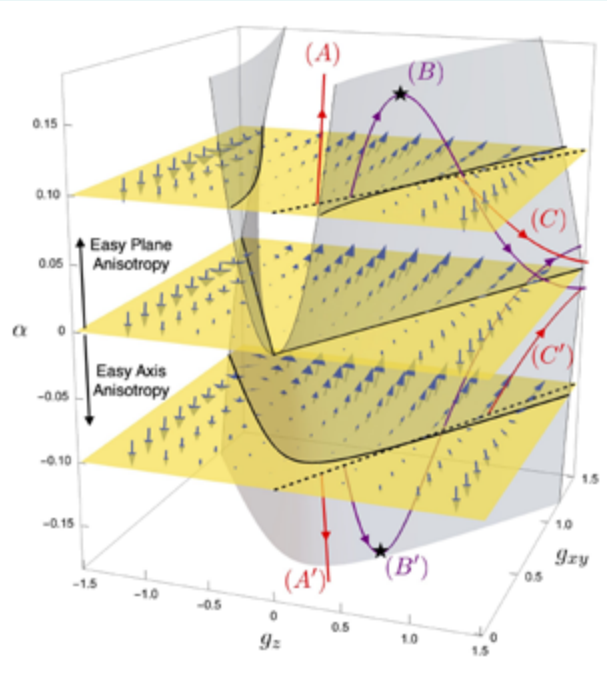


Fig. 3: Renormalisation group flow of the Kondo couplings and the single-ion anisotropy. The fluctuations associated with the Kondo effect result in a sign change of the renormalised anisotropy, corresponding to a crossing of magnetic susceptibilities.

Exciton transport in organic semiconductors

Designing molecular materials with very large exciton diffusion lengths would remove some of the intrinsic limitations of present-day organic optoelectronic devices. Yet, the nature of excitons in these materials is still not sufficiently well understood. Here, Drs. Samuele Giannini and Wei-Tao Peng from Professor Jochen Blumberger's group have introduced Frenkel exciton surface hopping, a highly efficient method to propagate excitons through truly nano-scale materials by solving the time-dependent Schrödinger equation coupled to nuclear motion. They find that In materials featuring some of the highest diffusion lengths to date, the exciton propagates via a transient delocalization mechanism, reminiscent to what was recently proposed for charge transport. On this basis, a path is charted out for rationally improving exciton transport in organic optoelectronic materials.

Research Headline

Shock-formed carbon materials with intergrown sp3- and sp2-bonded nanostructured units

Around 50,000 years ago an iron meteorite crashed in the painted desert in northern Arizona leaving behind a crater more than 200m deep and 2km in diameter. The impact, estimated to be the equivalent of more than 600 Hiroshima atomic bombs, generated a high-speed shockwave.

In 1967, scientists investigating the meteorite announced the discovery of a new form of diamond, which they speculated to have been formed in the extreme impact conditions. Terrestrial diamonds are normally crystals with cubic symmetry but these ones appeared to have a hexagonal crystal structure. The new material was named lonsdaleite after the pioneering British crystallographer, Professor Dame Kathleen Lonsdale, the first female professor at UCL.

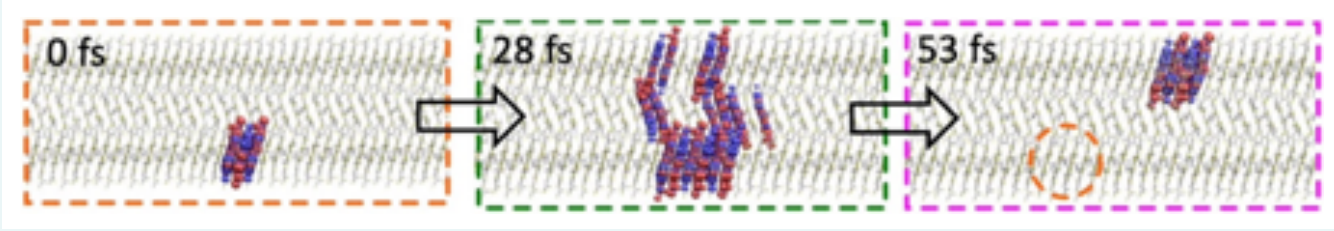
Since then Lonsdaleite has been reportedly found in several other meteorites and sedimentary rocks. Scientists also speculate that the unique hexagonal diamond could lead to properties that are superior to conventional cubic diamond. In fact, it was becoming apparent that experimental data obtained from natural and synthetic samples were at odds with the idea that lonsdaleite is a unique form of pure hexagonal diamond.

Now, Professor Chris Howard, Hector Lancaster (CMMP) with collaborators from Arizona, UCL Chemistry, Grenoble, Milan, Bath and Budapest used latest electron microscopy, X-ray scattering and Raman spectroscopy to probe the meteorite samples in unprecedented detail. Their results not only challenged the prevailing view of the mineral as consisting of single phase hexagonal diamond but revealed a remarkable complexity of intimately bonded diamond and graphene nanostructures, named diaphite, within the mineral. Through the recognition of the various graphene and diamond stackings, one can now begin to understand the pressure-temperature conditions that occur during asteroid impacts and the rich variety of diaphites that can form.

Peter Nemeth et al. *Proc. Nat. Acad. Sci USA* 119, e2203672119 (2022)

Fig. 1: Carbon inclusions in the Canyon Diabolo meteorite. Credit:Laurence Garvie, Arizona State University.

Fig. 4: Caught in the act: quantum dynamical simulation of exciton transport in an organic crystal (DCVSN5) illustrating the transient quantum delocalization mechanism.



References

[1] Hofmann, Stock, Warschkow, Conybeare, Curson, and Schofield, Angew. Chemie - Int. Ed. 62, e202213982 (2023).
[2] Jackson et al. ACS Energy Lett. 7, 3807–3816 (2022).
[3] M.P. Kwasigroch, Huanzhi Hu, F. Kruger, A.G. Green, Phys. Rev. B 105, 224418 (2022)
[4] S. Giannini, W. -T. Peng, L. Cupellini, D. Padula, A. Carof, and J. Blumberger, Nat. Commun. 13, 2755 (2022).

Research Headline

Simulating groundstate and dynamical quantum phase transitions on a superconducting quantum computer

This work uses Google's Rainbow device – a quantum computer that shares its architecture with the Sycamore chip used by Google in 2019 to demonstrate quantum supremacy – to demonstrate how a type of mathematical tool called tensor networks can be used to simulate quantum systems.

Quantum computers offer the opportunity to explore problems thought be unfeasible on classical computers. Potential applications include the ability to simulate chemical reactions and material properties that could revolutionize drug discovery or search for new battery materials. Current quantum computers do not have the required computational resources. However, they give researchers the ability to test the future applications of quantum computers.

PhD graduate and First Author Dr. James Dborin from Professor Andrew Green's group said: "Finding challenging but feasible problems that can be implemented on current devices is crucial. As well as demonstrating current progress, these serve to highlight required improvements. Ideally, these problems would be solved more efficiently when suitably powerful quantum computers are developed, as compared to current classical computers." The team describe how problems that best display these properties can be found in condensed matter systems. Problems in this area can be scaled to fit current machines while retaining scientific and technological relevance.

Tensor networks provide the best classical approach to simulating condensed matter systems, but more importantly the researchers show that tensor network methods can be directly translated to quantum circuits. This work shows the utility of tensor networks in constructing efficient quantum circuits, with potential quantum advantage in the next generation of quantum computers.

James Dvorin, Vinul Wimalaweera, F. Barratt, Eric Ostby, Thomas E. O'Brien, A. G. Green,

Nat. Commun 13, 5977 (2022)

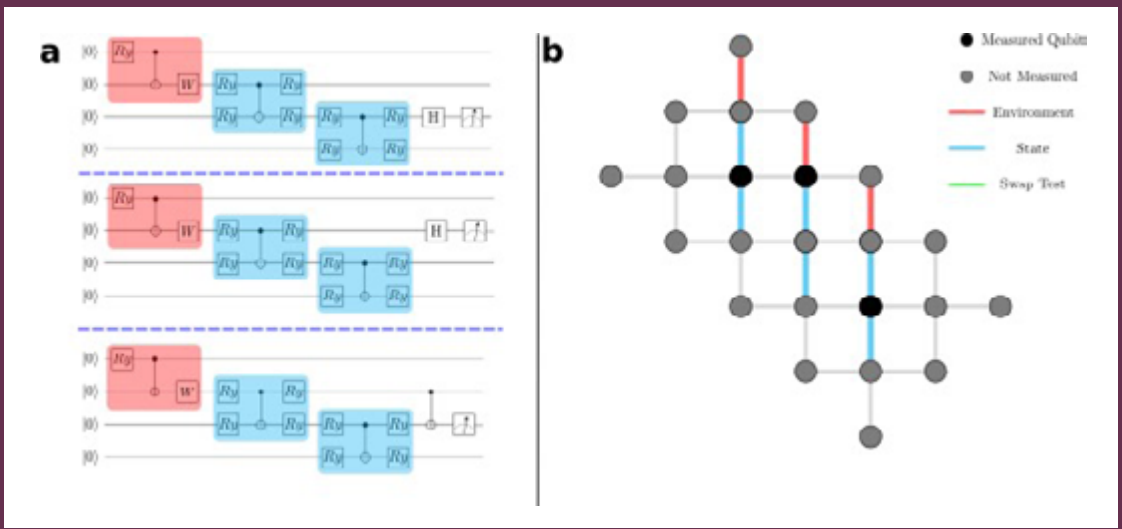


Fig. 1: Translationally invariant matrix product space circuits used to calculate quantum critical systems, e.g., the quantum Ising model, in the thermodynamics limit, on Google's Rainbow device.

High Energy Physics (HEP)

High Energy Physics (HEP) looks at extremely small sizes, or equivalently, at extremely high energies. Its aim is to explore the underlying nature and foundations of the entire physical universe, as well as the forces and laws that govern its development.

As one of the largest particle physics groups in the country our research at UCL HEP covers a wide range of areas, from theoretical physics and exploring the world's highest energy proton-proton collisions at the Large Hadron Collider (LHC), to unlocking the mysteries of neutrinos, searching for elusive dark matter, exploring new physics with precision muon studies and much more. In addition to fundamental physics research, we are involved in several interdisciplinary and knowledge exchange projects and are active in promoting particle physics in schools and among the general public.

While the main strands of our research in fundamental particle physics are outlined below, a vital area of the group's activity is in applications of the technology that we develop. Most notably, we continue to play an important role in developments around proton beam therapy, in particular delivering instruments for verifying the range of therapeutic proton beams, in close collaboration with UCLH and others. We are also increasingly active in seeking applications of our technology and expertise to help tackle some of the challenges resulting from global heating and climate change.

New arrivals over the last year include Sonia Escribano (proton therapy), Andrew Stevens and Joe McLaughlin (Dark Matter and LZ), Jayesh Bhatt (DUNE and LUXE), Flavia Cicala (SBND and DUNE), Mohammad Hassanshahi (Quantum Computing for HEP), Chayan Majdumar (Theory) and Melissa Yexley (ATLAS). Welcome to all of them!

More information on the UCL HEP group activities can be found at: **http://www.hep.ucl.ac.uk/research.shtml**

ATLAS and the Energy Frontier

ATLAS and the Large Hadron Collider (LHC) are now well into their new run, aiming to double the existing dataset and significantly extend the discovery reach for new physics beyond the Standard Model. UCL have leadership in several areas, and a pioneering analysis of di-Higgs production featured in the last annual review was published earlier this year. A lot of technical work continues to take place preparing for the high-luminosity phase of the LHC, scheduled to start towards the end of this decade, and its associated detector upgrades.

The future of the energy frontier after the LHC is a subject of much debate in the field at the current time. At UCL we are making key scientific contributions to this question, in particular through R&D into new and innovative plasma-acceleration techniques via our participation and leadership in the AWAKE project.

Neutrinos and Dark Matter

The group has a long-standing tradition of initiating and leading international experiments exploring new physics with neutrinos and searching for dark matter. In the past year we have made significant contributions to neutrino oscillation experiments (NOvA, DUNE and SBND) and neutrinoless double beta decay experiments (SuperNEMO & LEGEND). Both SuperNEMO and LEGEND are now collecting data, and the analysis of the first LEGEND data – led by UCL – is now well underway.

The Short-Baseline Neutrino programme at Fermilab has reached an exciting milestone this year, with the completion of the assembly and installation of the Short-Baseline Near Detector (SBND). SBND will take its first neutrino data, measuring an unprecedentedly large number of neutrino argon interactions, and playing an important role in the search for new types of neutrino. There is growing involvement in Time Projection Chamber (TPC) commissioning at UCL, building on current leadership in the detector assembly and installation.

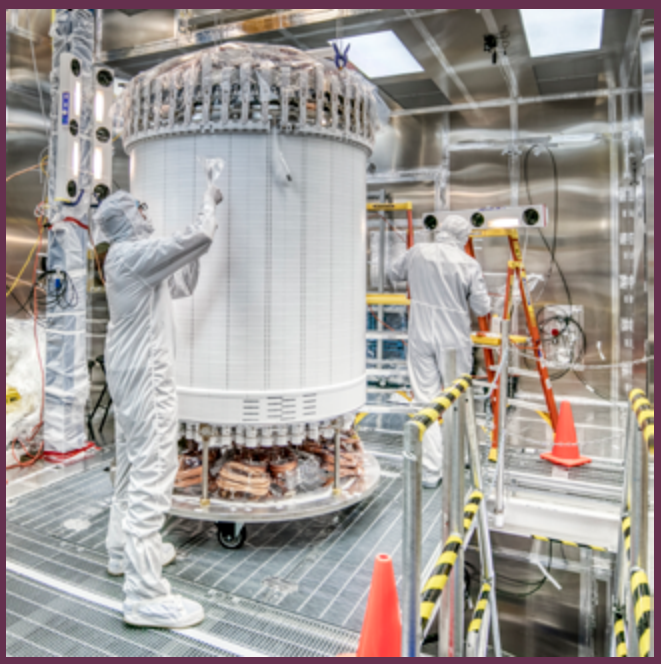
Installation of the completed SBND Time Projection Chamber into the cryostat in Fermilab (Nicola McConkey)

Research Headline

The Search for Dark Matter with LZ

The existence of *Dark Matter* was first inferred in the early 1930s via its gravitational footprint in galaxy clusters. Since then, the true nature of Dark Matter has become one of the foremost mysteries in particle physics and astronomy. Several theoretical efforts have presented various solutions to the problem. The most promising is that of a yet-to-be discovered particle species—generically referred to as Weakly Interacting Massive Particles (WIMPs)—left behind as a thermal relic of the big bang, and now pervading the universe with an abundance five times greater than that of baryonic matter.

Within the UCL HEP group and led by Professor Chamkaur Ghag is a team of outstanding graduate students and postdocs working in the LUX-ZEPLIN (LZ) collaboration. LZ is a Dark Matter search experiment situated one mile underground in the Sanford Underground Research Facility (SURF) in Lead, South Dakota, USA. It is a cryogenic Time Projection Chamber (TPC) containing an active mass of 7 tonnes of liquid xenon as a target for potential WIMP scattering events off xenon nuclei. Following the merger of the (US based) LUX and (UK based) ZEPLIN experiments, the development of the LZ detector was spearheaded in part by UCL over the course of 10 years, especially in the tremendous campaign to meet unprecedented low background detector requirements. Every detector component was screened for trace levels of radioactive contaminants with cutting edge assay techniques including gamma ray spectroscopy with High Purity Germanium (HPGe) detectors, Inductively Coupled Plasma Mass Spectrometry (ICP-MS), and for radon emanation. UCL was the central institution in developing these techniques in the UK, establishing new national facilities now benefitting the particle physics community around the world. UCL's role in the project not only ensured the detector is quiet enough to expose any hint of WIMPs, but also allowed construction of the key background model against which the significance of any possible signal will be evaluated. During the on-site construction of the detector over the last few years, UCL students and post-docs bore key responsibilities, including maintaining strict cleanliness protocols as well as the commissioning of the inner TPC - the very core of the experiment.



The long road to completion of the construction of the LZ detector has recently culminated in publication of results from LZ's first science run, comprising 60 live-days worth of data—a mere 6% of the planned exposure for the experiment. UCL played major roles in the analysis of this first dataset that has delivered constraints on WIMP interactions that surpass all previous experiments to firmly establish LZ as the world-leader in the hunt for Dark Matter. These results have been published in Physical Review Letters, with the article selected as an Editor's Suggestion. This is only the beginning for LZ, and with Professor Ghag elected as the international Spokesperson for the collaboration for the next two years, UCL are at the very frontier of the search for galactic WIMPs as we lead LZ into the next phase of its 1000 live-day mission. LZ will drive deep into entirely unexplored parameter space in the search for WIMPs and the elusive prize of a first direct observation of Dark Matter in our galaxy.

The LZ detector, led by UCL and searching directly for the feeble interactions of dark-matter particles, has completed an initial science run and the results offer the most stringent constraints on dark matter over a wide range of parameter space (see the corresponding research highlight). In parallel, exciting new quantum techniques for searching for other forms of dark matter are being pioneered here at UCL in close collaboration with the AMOPP group.

Flavour Physics

One of the most promising avenues in the search for answers to the outstanding questions in particle physics is to pursue the precision frontier rather than the energy frontier. Having initiated UK participation in a new ultra-precise measurement of the muon's magnetic dipole moment, UCL is now playing a leading role in the search for exotic decay modes of the muon including conversion to 1 or 3 electrons/positrons. Over the next few years these projects will offer real discovery power, complementary to the direct particle-production searches at the LHC.

Astroparticle Physics

UCL has a long-standing participation in the ANITA balloon experiment, searching for ultra-high energy cosmic-ray neutrino interactions in the Antarctic icesheet. We are now actively involved in the successor instrument, named PUEO, scheduled for launch in late 2024. In parallel, UCL have initiated UK participation in the planning and design of a new underwater neutrino telescope, P-ONE, to be deployed in the Pacific Ocean.

Quantum Technologies

UCL (HEP and AMOPP) lead the Quantum Technologies for Neutrino Mass (QTNM) project. Over the last year this project has progressed through initial studies to a design for an atom trap and cyclotron radiation detection system that is currently being implemented. A number of important milestones have been achieved along the way, including a demonstration by Hogan's group at UCL that Rydberg atom magnetometry can be used to map magnetic fields with the precision required for a future neutrino mass experiment. The investigation of how quantum computing can be used to speed up and solve previously inaccessible problems in particle physics, as well as other areas of physics, is another topic that is being led by the HEP group at UCL.

Theory

UCL is leading in several efforts exploring the properties of neutrinos, and using them as a gateway to look for new physics beyond the Standard Model. This includes theoretical and phenomenological studies interpreting experimental results and proposing novel processes and mechanisms as signatures of new physics in the neutrino sector. A crucial process in this regard is nuclear double beta decay, and the HEP theory group work closely with experimentalists on LEGEND and SuperNEMO on this topic.

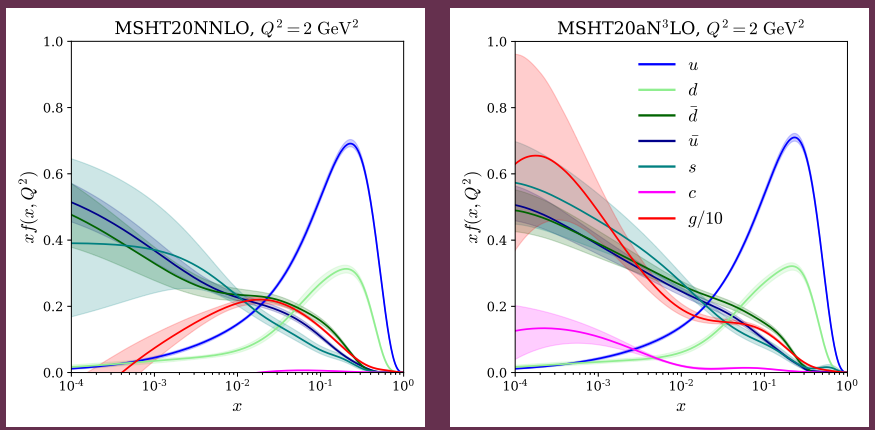
The world-leading work by members of the UCL HEP group on the structure of the proton is detailed in a research highlight piece. The HEP theory group is also engaged in collider physics research through the development of high precision Monte Carlo simulations of LHC collision events. Most recently, the group has been focused on the decades-old problem of quantifying and improving the precision of parton-shower simulations, the most widely used theoretical tools in particle physics. The group has enjoyed recent success in this area developing and demonstrating, for the first time, full-fledged parton shower simulations

Research Headline

Approximate N3LO Parton Distribution Functions

Recent very-high energy particle accelerators use hadrons as the colliding particles in order to obtain the maximum collision energy. The best-known example of this is the Large Hadron Collider (LHC) at CERN, which is currently operating, and uses the most obvious hadrons, i.e. protons. Although colliders can obtain higher energies when using these particles than when using electrons, there is a disadvantage, they are not fundamental particles, but are bound states consisting of the fundamental particles, quarks, antiquarks and the particles providing the strong force, gluons. These are collectively known as partons. This means that a description of how the protons interact in collisions depends on knowledge of the parton distribution functions (pdfs) describing how the proton is made up of partons in terms of both the energy fraction (x) each parton carries of the proton's energy and of the energy scale, (Q2), of the collision. The manner in which these pdfs evolve between scales can be calculated as a power series in the strong coupling constant, as can the cross-section describing the interaction between two partons in a collision, but the intrinsic functions of x of the pdfs require extraction from comparison to experimental data and fitting free parameters. The group at UCL, known as MSHT and led by Robert Thorne, has been a world-leader for obtaining pdfs for many years.

Until recently the state of the art for the applying the perturbative calculations for PDF evolution, cross-sections, and transition of quarks through regions where the scale is similar to their mass has been next-to-next-to-leading order (NNLO). However, in 2022 the UCL group of McGowan, Cridge, Harland-Lang and Thorne produced the first approximate next-to-next-to-next-to-leading (aN3LO) pdfs. Various pieces of information were already known about the N3LO contributions to pdf evolution, the transition through quark mass thresholds, and some collision cross sections. The UCL group drew this all together in a self-consistent manner and devised a means to parameterise the not yet known parts, with procedures to define their intrinsic uncertainties. The group have hence been able to extract the first set of aN3LO pdfs, along with a theoretical uncertainty on these pdfs, alongside the usual uncertainty in pdfs due to the uncertainty on the experimental data being fit. Moreover, the correlations between these two forms of uncertainty are automatically maintained. This results in a change compared to the pdfs obtained at NNLO while fitting to exactly the same data and using the same procedures (except for the N3LO corrections), and also a more complete understanding of the full uncertainties. The NNLO and aN3LO pdfs are shown in the figure. These pdfs now allow both the most accurate determination of pdfs available, and also the most realistic representation of their total uncertainty, and are the appropriate ones to use for any collision process where the cross-section is known to N3LO, the most important example being the production of Higgs bosons.



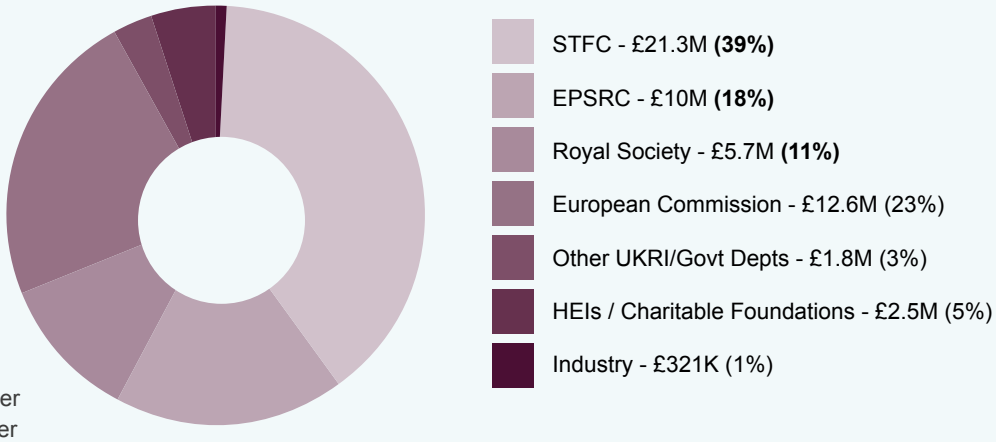
The MSHT20 NNLO pdfs and their uncertainties (left) and the MSHT20 aN3LO pdfs and their uncertainties (right).

Research Statistics

Research statistics

Active Grants and Contracts

In the last financial year (Aug 2022 – Jul 2023), the Department of Physics and Astronomy held an overall amount of £54 million in grants, divided between 117 live projects, held by 62 Primary Investigators.



Applications

In the same period 113 applications were submitted, of which 23 were awarded and 14 unsuccessful. However 73 are still awaiting response, as funder decision times are often long.

More helpfully, if we look at the 21-22 period, 91 applications were submitted, of which 34 were awarded, and 57 unsuccessful. This gives us a 37% success rate for applications; a one in three chance.

Astrophysics (Astro)

Solar System Consolidated Grant 2019-22; STFC Science and Technology Facilities Council; Achilleos, N, £457,240

Implementation of Coupled-Thermosphere-Ionosphere-Plasmasphere Model in ESA's Virtual Space Weather Modelling Centre (VSWMC); ESA European Space Agency; Achilleos, N, £39,370.08

Europlanet - Research Infrastructure 2020-2024; Achilleos, N, £51,091.73

Predicting the upper atmospheric response to extremes of space weather forcing; NERC Natural Environment Research Council; Aruliah, A; £49,225.00

DRivers and Impacts of Ionospheric Variability with EISCAT-3D; NERC Natural Environment Research Council; Aruliah, A; £95,222.20

X-raying the Gas and Ice Giants; STFC Science and Technology Facilities Council; Dunn, W; £573,248.52

First Light; European Commission H2020; Ellis, R; £2,068,100.29

UCL Astrophysics PATT Travel Grant 2020-22; STFC Science and Technology Facilities Council; Farihi, J; £37,279.12

UCL Astrophysics PATT Travel Grant 2023-2024; STFC Science and Technology Facilities Council; Farihi, J; £27,430.16

Postdoctoral Enrichment Award 2022; ATI Alan Turing Institute; Jeffrey, N; £2,000.00

DiRAC-3 Operations 2019-2022 - UCL; STFC Science and Technology Facilities Council; Jenner, C; £2,672,032.64

DiRAC-3 Operations – 2022-23 extension - UCL; STFC Science and Technology Facilities Council; Jenner, C; £267,605.82

DiRAC-3 Operations 2023-26 – UCL – Additional Grant; STFC Science and Technology Facilities Council; Jenner, C; £318,609.20

DiRAC Operations 2023-2026 - UCL; STFC Science and Technology Facilities Council; Jenner, C; £660,470.03

Photometric redshift estimation and DESC-related software development; STFC Science and Technology Facilities Council; Joachimi, B; £313,767.64

Euclid UK Science Ground Segment Bridging Grant Phase III; UKSA UK Space Agency; Joachimi, B; £676,068.00

Spectral Characterisation of Exoplanet Hosts and Other Stars; EC Horizon Europe Innovate Underwrite; Kama, M; £240,154.00

Newton Fund for capacity building in data intensive science in the Middle-East; STFC Science and Technology Facilities Council; Lahav, O; £303,213.09

UCL/IAR Submillimetre Polarimetry Exchange Visits ; Royal Society; Pattle, K; £12,000.00

The Role of Magnetic Fields in ISM Evolution and Star Formation; Royal Society; Pattle, K; £662,130.75

Quantum Simulators for Fundamental Physics Version A ; STFC Science and Technology Facilities Council; Peiris, H; £622,975.64

Post Doctoral Enrichment Awards 2021; ATI Alan Turing Institute; Piras, D; £2,000.00

Understanding the Hubble sequence; Royal Society; Pontzen, A; £356,433.96

GMGalaxies - Understanding the diversity of galaxy morphology in the era of large spectroscopic surveys; European Commission H2020; Pontzen, A; £1,451,241.59

Cold gas as a probe of galaxy evolution: multi-phase outflows at high resolution; Royal Society; Saintonge, A; £106,838.00

Cold gas as a probe of galaxy evolution; Royal Society; Saintonge, A; £352,852.69

UCL Astrophysics Consolidated Grant 2021-2024; STFC Science and Technology Facilities Council; Saintonge, A; £780,046.90

Dynamics of the Milky Way with Gaia; Royal Society; Sanders, J; £540,863.92

6 Month Bridging - Litebird Bid For Bilateral Consortium - UKSA; UKSA UK Space Agency; Savini, G ; £26,303.68

Ariel Space Mission 2022 - 2025; UKSA UK Space Agency; Tinetti, G; £455,806.54

The Interstellar Medium And Star Formation In Extreme Galactic Environments; Royal Society; Viti, S; £12,000.00

AstroChemical Origins; European Commission H2020; Viti, S; £450,516.10

Deciphering super-Earths using Artificial Intelligence; European Commission H2020; Waldmann, I; £1,280,995.39

Co-Sponsored PhD: “Enabling data-driven searches in ESA Astronomical images for the first time with deep learning”; ESA European Space Agency; Waldmann, I ; £40,769.23

Co-Sponsored PhD: “Enabling fast modeling of large interdependent data sets using graphical neural networks”; ESA European Space Agency; Waldmann, I; £71,428.57

Post Doctoral Enrichment Awards 2021; ATI Alan Turing Institute; Yip, K; £2,000.00

Liquid density-functional modelling of rovibrational molecular spectroscopy and dynamics in quantum solvents; Royal Society; Yurchenko, S; £6,000.00

Atomic, Molecular, Optical and Positron Physics (AMOPP)

Laser refrigeration on the nanoscale: From nanocryostats to quantum optomechanics; EPSRC Engineering and Physical Sciences Research Council; Barker, P; £729,666.70

Development of Levitated Quantum Optomechanical Sensors for Dark Matter Detection; STFC Science and Technology Facilities Council; Barker, P; £404,758.50

Fundamental science and technology with levitated cavity optomechanics; EPSRC Engineering and Physical Sciences Research Council; Barker, P; £745,510.00

Uncovering the Nonclassicality of Macroscopic Systems; Royal Society; Bose, S; £131,250.00

Levitated Quantum Diamonds; STFC Science and Technology Facilities Council; Bose, S; £121,505.00

MACON-QC: Many-Body Phases In Continuous-Time Quantum Computation; EPSRC Engineering and Physical Sciences Research Council; Bose, S; £326,701.09

Non-Ergodic Quantum Manipulation; EPSRC Engineering and Physical Sciences Research Council; Bose, S; £570,712.68

Measurement-based entanglement of single-dopant As spin qubits; EPSRC Engineering and Physical Sciences Research Council; Bose, S; £70,981.09

Nonclassicality of the Harmonic Oscillator Persisting Up to the Macroscopic Domain; EPSRC Engineering and Physical Sciences Research Council; Bose, S; £451,886.88

Unlocking The Potential Of Quantum LDPC Codes For Low-overhead Fault-tolerance; EPSRC Engineering and Physical Sciences Research Council; Browne, D; £451,886.88

Compilation And Verification Of Quantum Software In The Noisy And Approximate Regime; EPSRC Engineering and Physical Sciences Research Council; Browne, D; £276,946.37

Software Enabling Early Quantum Advantage; EPSRC Engineering and Physical Sciences Research Council; Browne, D; £217,076.65

Prosperity Partnership in Quantum Software for Modeling and Simulation; EPSRC Engineering and Physical Sciences Research Council; Browne, D; £328,200.00

Making quantum processors robust: from theory to practice; Innovate UK; Browne, D; £25,732.86

Quantum Computing and Simulation Hub; EPSRC Engineering and Physical Sciences Research Council; Browne, D; £252,643.08

Quantum error correction in materials simulations using machine learning based optimization; National Physical Laboratory; Browne, D; £40,000.00

Reliable and Robust Quantum Computing; EPSRC Engineering and Physical Sciences Research Council; Browne, D; £57,062.92

Production of positronium atoms, ions, and molecules; EPSRC Engineering and Physical Sciences Research Council; Cassidy, D; £853,721.00

Precision Microwave Spectroscopy of Positronium; EPSRC Engineering and Physical Sciences Research Council; Cassidy, D; £949,020.84

Quantum Sensing for Antimatter Gravity; STFC Science and Technology Facilities Council; Cassidy, D; £368,762.00

Exotic forms of matter in molecules driven by Free-Electron Lasers; Leverhulme Trust; Emmanouilidou, A; £180,939.00

AQuA DIP: Advanced Quantum Approaches to Double Ionisation Processes; EPSRC Engineering and Physical Sciences Research Council; Figueira De Morisson Faria, C; £388,202.00

Exploring Pump-probe Schemes For Attosecond Quantum Technologies; Institute of Physics; Figueira De Morisson Faria, C; £37,106.00

IT from Qubit; Simons Foundation; Oppenheim, J; £473,650.81

Low-frequency magnetic field synthesis; Defence Science and Technology Laboratory; Renzoni, F; £50,000.00

Solving the puzzle of the nuclear magnetic octupole moment; Leverhulme Trust; Renzoni, F; £107,447.00

Gamma-ray coherent emission in a Bose-Einstein condensate of 135mCs isomers; Air Force Office of Scientific Research; Renzoni, F; £75,015.00

Pushing the Boundaries of Stochastic Resonance: Noise-assisted Image Processing; Royal Society; Renzoni, F; £12,000.00

DELTA; Innovate UK; Renzoni, F; £429,897.08

Far From Equilibrium Quantum Simulators; EPSRC Engineering and Physical Sciences Research Council; Szymanska, M; £850,350.00

Quantum and many body physics enabled by advanced semiconductor nanotechnology; EPSRC Engineering and Physical Sciences Research Council; Szymanska, M; £361,968.00

Towards quantum-based realisations of the pascal; European Commission H2020; Tennyson, J; £56,000.00

UK Atomic, Molecular and Optical physics R-matrix consortium (UK AMOR); EPSRC Engineering and Physical Sciences Research Council; Tennyson, J; £368,071.34

Quantum Simulations for Real Problems ; Rahko Ltd; Tennyson, J; £24,575.00

Radiative transport modeling in technological plasmas and combustion; STFC Science and Technology Facilities Council; Tennyson, J; £360,511.22

Exploring complexity and scalability of Near-term Quantum Computing algorithms for Quantum Chemistry; Rahko Ltd; Tennyson, J; £33,000.00

ExoMolHD: Precision spectroscopic data for studies of exoplanets and other hot atmospheres; European Commission H2020; Tennyson, J; £2,017,327.64

Biophysics (BioP)

Additional BioP grants are held through the London Centre for Nanotechnology (LCN).

Development of Biocompatibility and Colloidal Stability of Ultrasmall Iron Oxide Nanoparticles asalternative T1 MRI contrast agents from routinely used Gadolinium complexes; Royal Society of Chemistry; Nguyen, T; £10,000.00

Chemical synthesis and characterisation of doped iron oxide nanoflower for magnetic hyperthermia cancer treatment; Royal Society of Chemistry; Nguyen, T; £9,999.99

Comprehensive market research of magnetic nanoflowers for cancer treatments ; EPSRC Engineering and Physical Sciences Research Council; Nguyen, T; £20,000.00

Real-time tracking stem cells in vivo using dual mode NIR-II fluorescence and magnetic resonance imaging ; Royal Society; Nguyen, T; £12,000.00

Bio-optomechanics: controlling molecular vibrations on a chip; EPSRC Engineering and Physical Sciences Research Council; Olaya-Castro, A; £99,698.36

Revealing unambiguous signatures of quantum coherence in photosynthetic complexes on a photonic chip; Gordon and Betty Moore Foundation; Olaya-Castro, A; £1,480,212.59

Condensed Matter and Materials Physics (CMMP)

Additional CMMP grants are held through the London Centre for Nanotechnology (LCN).

Understanding solvation and redox transformations at oxide/liquid water interfaces from machine learning-accelerated ab-initio molecular dynamics; Pacific Northwest National Laboratory ; Blumberger, J; £48,221.01

Advancing first principles computational modelling of electron transfer processes at molecule/electrode interfaces; Pacific Northwest National Laboratory; Blumberger, J; £36,548.34

Diamond masers – a new quantum technology platform; Royal Society; Breeze, J; £681,965.49

Room Temperature Continuous-Wave Inorganic Maser; EPSRC Engineering and Physical Sciences Research Council; Breeze, J; £257,411.20

CAM-IES - Centre for Advanced Materials for Integrated Energy Systems; EPSRC Engineering and Physical Sciences Research Council; Cacialli, F; £83,733.10

Spin physics in Two-Dimensional Layered Ferromagnets; EPSRC Engineering and Physical Sciences Research Council; Howard, C; £20,391.94

Graphene Flagship Core Project 3; European Commission H2020; Howard, C; £30,539.84

Strain-tuning of Magnetic Frustration in Quantum Materials; Diamond Light Source; Johnson, R; £27,280.00

Correlated Non-Equilibrium Quantum Matter: Fundamentals and Applications to Nanoscale Systems; European Commission H2020; Pal, A; £1,237,716.24

Bionet - Dynamical Redesign of Biomolecular Networks; European Commission H2020; Rosta, E; £797,394.63

Novel Enhanced Sampling Methods in Multiscale Modeling; EPSRC Engineering and Physical Sciences Research Council; Rosta, E; £541,660.34

THOR - TeraHertz Detection Enabled by Molecular Optomechanics; European Commission H2020; Rosta, E; £185,901.96

Defect Functionalized Sustainable Energy Materials: From Design to Devices Application; EPSRC Engineering and Physical Sciences Research Council; Shluger, A; £470,810.80

From MEMImpedance To Complex-valued Neural Networks; EPSRC Engineering and Physical Sciences Research Council; Shluger, A; £14,513.28

Degradation and dielectric breakdown in modern HfON based devices; Synopsys Inc; Shluger, A; £36,000.00

Molecular dynamics simulation of interface structure of interface structure and interface diffusion phenomena for the Cu/TiW system; Infineon Technologies Austria AG; Shluger, A; £40,000.00

Atomistic calculations of relevant point defects near the SiC/SiO2 interface; Infineon Technologies Austria AG; Shluger, A; £45,000.00

New paradigms of quantum many-body dynamics; EPSRC Engineering and Physical Sciences Research Council; Turner, C; £463,724.32

FNR - Fundamentals of Negative Capacitance: Towards New Low Power Electronics; EPSRC Engineering and Physical Sciences Research Council; Zubko, P; £464,861.00

Materials for Neuromorphic Circuits; European Commission H2020; Zubko, P; £219,210.05

High Energy Physics (HEP)

Uncovering the Origin of Neutrino Masses through Direct Searches and Global Fits; STFC Science and Technology Facilities Council; Agostini, M; £529,519.28

SoftWare InFrastructure and Technology for High Energy Physics experiments; STFC Science and Technology Facilities Council; Butterworth, J; £106,373.63

NEw WindowS on the universe and technological advancements from trilateral EU-US-Japan collaboration; European Commission H2020; Chislett, R; £72,000.00

South-Eastern Particle Theory Alliance Sussex - RHUL - UCL 2020-2023 - UCL Node; STFC Science and Technology Facilities Council; Deppisch, F; £124,598.00

Neutrino Masses And New Physics; Royal Society; Deppisch, F; £87,500.00

Ultra-fast three and four-electron dynamics in intense electro-magnetic laser fields; EPSRC Engineering and Physical Sciences Research Council; Emmanouilidou, A; £430,851.06

Searches For Beyond The Standard Model Physics With Hadronic Topologies; STFC Science and Technology Facilities Council; Facini, G; £64,863.10

XENON FUTURES: R&D for a Global Rare Event Observatory - Phase 1; STFC Science and Technology Facilities Council; Ghag, C; £117,773.00

XENON FUTURES: R&D FOR A GLOBAL RARE EVENT OBSERVATORY; STFC Science and Technology Facilities Council; Ghag, C; £61,887.16

LZ Spokesperson Support; STFC Science and Technology Facilities Council; Ghag, C; £200,000.00

UCL Experimental Particle Physics Consolidated Grant (2019-2022); STFC Science and Technology Facilities Council; Ghag, C; £3,785,064.00

Spanning multi-TeV to GeV scales for collider discoveries and measurements; European Commission H2020; Hamilton, K; £291,630.34

Developing Quality Assurance Tools for Proton Beam Therapy; STFC Science and Technology Facilities Council; Jolly, S; £304,452.99

Quality Assurance Range Calorimeter for Proton Beam Therapy; STFC Science and Technology Facilities Council; Jolly, S ; £364,766.58

Quality Assurance Detector for Proton Beam Therapy; STFC Science and Technology Facilities Council ; Jolly, S; £384,435.04

ATLAS Phase-2 Upgrades – Construction project; STFC Science and Technology Facilities Council; Konstantinidis, N; £970,302.00

Upgrade Of The ATLAS Detector At The LHC (2023-26); STFC Science and Technology Facilities Council; Konstantinidis, N; £643,658.14

CDT in Data Intensive Science 2017; STFC Science and Technology Facilities Council; Konstantinidis, N; £2,666,566.88

CDT in Data Intensive Science 2022; STFC Science and Technology Facilities Council; Konstantinidis, N; £1,370,168.00

Upgrade Of The ATLAS Detector At The LHC (2023-26); STFC Science and Technology Facilities Council; Konstantinidis, N; £643,658.14

UCL Experimental Particle Physics Consolidated Grant (2022-2025); STFC Science and Technology Facilities Council ; Korn, A; £4,912,955

UCL Experimental Particle Physics Responsive PDRA Call (2023-2025); STFC Science and Technology Facilities Council; Korn, A; £259,720.04

Search for dark matter with quantum sensors; Royal Society; Malik, S; £615,507.09

Commissioning Studies For The Time Projection Chambers In The SBND Experiment; Universities Research Association Inc; Cicala, F; £8,904.22

Piecing together the Neutrino Mass Puzzle in Search of New Particles with Precision Oscillation Experiments and Quantum Technologies; STFC Science and Technology Facilities Council; McConkey, N; £568,542.44

DUNE Construction Grant; STFC Science and Technology Facilities Council; Nichol, R; £350,947.00

Support for Machine Learning Based Surrogate Models for Emulating the Extreme Scale Simulation of Tokamak plasma; UK Atomic Energy Authority; Nurse, E; £32,000.00

Determination of Absolute Neutrino Mass Using Quantum Technologies ; STFC Science and Technology Facilities Council; Saakyan, R; £2,027,333.34

Deep Learning in the CHIPS water Cherenkov detector; Czech Technical University in Prague (CTU); Scanlon, T; £48,000.00

Exploring the Higgs Sector and Probing for New Physics using H->bb; Royal Society; Scanlon, T; £370,348.57

Enhancing H-bb: Exploring the Higgs Sector and Discoving New Physics; Royal Society; Scanlon, T; £199,796.22

CHROMIUM; European Commission H2020; Thomas, J; £2,287,002.17

Peering at Neutrino Oscillations with a Magnifier; Royal Society; Thomas, J; £1,289,464.41

Standard Model Phenomenology; STFC Science and Technology Facilities Council; Thorne, R; £366,312.00

LEGEND: Neutrinoless Double-Beta Decay and Germanium Detector Technology ; STFC Science and Technology Facilities Council; Waters, D; £23,840.00

Production of high quality electron bunches in AWAKE Run 2; STFC Science and Technology Facilities Council; Wing, M; £286,284.04

Advancement and Innovation for Detectors at Accelerators; European Commission H2020; Wing, M; £104,000.00

Production of high quality electron bunches in AWAKE Run 2; STFC Science and Technology Facilities Council; Wing, M; £416,424.64

Staff Snapshot

Staff snapshot

Head of Department
Professor R. K. Prinja

Deputy Head of Department
Professor F. Renzoni

Astrophysics
Head of Group: Professor G. Tinetti

Professors:
A. L. Aruliah, G. Savini, N. Achilleos, M. J. Barlow, A. P. Doel, R. Ellis, J. Farihi, B. Joachimi, O. Lahav, H. Peiris, A. Pontzen, R. K. Prinja, J. M. C. Rawlings, G. Tinetti, A. Saintonge, S. Viti, I. Waldmann, S. Yurchenko

Associate Professors
F. Abdalla, S. Fossey,

Lecturers: M. Kama, J. Sanders

Senior Research Fellows:
A. Al-Refaie, F. Diego, S. Nadathur, K. Pattle, M. Tessenyi, A. Tsiaras, R. Wesson

Research Fellows:
C. Cadiou, Q. Changeat, C. Circosta, J. Davies, W. Dunn, E. Hang, N. Jeffrey, A. Jenkins, G. Joshi, F. Kirchschlager, A. Loureiro, M. Marcha, D. Millas, M. Niculescu-Duvaz, N. Nikolaos, D. Piras, S. Pyne, M. Rocchetto, A. Saxena, F. Schmidt, A. Shitvov, M. Tang, A. Tenneti, N. Tessore, L. Whiteway, G. Yip

Marie Curie Early Stage Researcher
R. O'Donoghue, M. Keil

Professional Services:
E. Dunford, J. Fabbri, C. Jenner, K. Nakum, M. Rangrej, R. Raupp, A. Williams

Computing, Engineering and Technical Staff:
S. Boyle, J. Deacon, E. Edmondson, M. Pearson, T. Schlichter, S. Sullivan

Atomic, Molecular, Optical and Positron Physics
Head of Group:
Professor S. Hogan

Professors:
A. Bain, P. Barker, S. Bose, D. Browne, D. Cassidy, A. Emmanouilidou, C. Figueira de Morisson Faria, S. Hogan, T. Monteiro, A. Olaya-Castro, J. Oppenheim, F. Renzoni, A. Serafini, M. Szymanska, J. Tennyson, S. Yurchenko

Research Fellowships:
T. Blacker, L. Masanes

Research Fellows:
B. Augstein, T. Babij, A. Callison, P. Comaron, B. Cooper, L. Cruz Rodriguez, A. Ferrier, R. Ghosh, H. Gomes, G. Katsoulis, B. Maddox, C. Nation, M. Pezzella, O. Polyansky, A. Pontin, D. Rose, A. Sokolov, A. Svesko, D. Toniolo, J. Zou

Professional Services:
A Bountoureli

Computing, Engineering and Technical Staff:
J. Dumper, F. Garza, C. Godden, F. R. Jawad, F. Noyes

Biological Physics
Head of Group:
Professor A. Olaya-Castro

Professors:
A. Bain (also AMOPP), J. Blumberger (also CMMP), G. Charras (Cell and Developmental Biology), B. Hoogenboom, P. Jones, T. Nguyen, A. Olaya-Castro (also AMOPP), I. Robinson (also CMMP)

Lecturer: T. Michaels

Senior Research Fellows:
Z Hadjivasiliou (Crick), M. Molodtsov (Crick)

Senior Research Associates: T. Le

Research Fellows:
T. Blacker, C. Bortolini, L. Chu (Crick), D. Khoromskaia (Crick), L. Mosby (Crick), G. Pobegalov (Crick), Q. Wu

Professional Services:
S Abdulkadir, J. Gill-Thind

Condensed Matter and Materials Physics
Head of Group: Professor J. Blumberger

Professors:
J. Blumberger, D. Bowler, S. Bramwell, F. Cacialli, A. Fisher, I. Ford, A. Green, C. Howard, D. McMorrow, I. Robinson, A. Shluger, N. Skipper, M. Szymanska, S. Zochowski, P. Zubko

Associate Professors:
M. Buitelaar, F. Kruger, A. Pal, E. Rosta, R. Perry, S. Schofield

Lecturers:
J. Breeze, R. Johnson, C Perez Martinez

Research Fellows:
R. Darkins, T. Foldes, S. Gehrke, S. Ghosh, T. Greenland, R. Hafizi, L.Ishibe Veiga, A. James, Z, Koczor-Benda, K. Kwakwa, B. Mukherjee, E. Parsons, J. Richter, D. Rose, M. Szyniszewski, B. Villis, C. Yin

Marie Curie Trainee: E. Stylianidis
Most Research staff are employed through the LCN

Professional Services: J. Levin, D. Ottley

Computing, Engineering and Technical Staff: A. Gormanly, S. Patel, F. Sidoli

High Energy Physics
Head of Group: Professor D. Waters

Professors:
J. M. Butterworth, M. Campanelli, F. Deppisch, C. Ghag, K. Hamilton, N. Konstantinidis, R. Nichol, E. Nurse, R. Saakyan, J. A. Thomas, R. S. Thorne, D. Waters, M. Wing

Associate Professors:
G. Hesketh, S. Jolly, A. Korn, T. Scanlon

Lecturer:
R. Chislett, G Facini, N. Nikolaou

Principal and Senior Research Associates:
A. Basharina-Freshville, R. Flack, P. Sherwood, B. Waugh

Ernst Rutherford Fellows:
M. Agostini, J. Dobson, N. McConkey

Royal Society University Research Fellows: S. Malik

Research Fellows:
S. Bash, F. Cicala, J. M. Carceller, D. Cooke, T. Cridge, S. Escribano Rodriguez, T. Fruth, S. Grant, C. Gutschow, S. Jones, N. Kimura, Y. Ma, A. Martynwood, V. Monachello, G. Oliviero, S. Rettie, L. Shi, A. Stevens, A. Sztuc, R. Verheyen, S. Vergani

Professional Services:
A Bountoureli

Computing, Engineering and Technical Staff:
P. Bizouard, G. Crone, E. Edmondson, C. Godden, T. Hoare, E. Motuk, M. Warren

Teaching
Director of Undergraduate Teaching:
L. Dash

Director of Postgraduate Studies: S. Zochowski

Undergraduate Careers Officer: J. Farihi

Professor (Teaching): P. Barlett

Associate Professors (Teaching): D. Armoogum, E. Ashgrove, S. Boyle, S. Fossey, L. Dash, N. Nicolaou

Lecturer (Teaching): J. Bhamrah, F. Diego Quintana, J. Frost-Schenk, G. Giannopoulos, M. Szumilo

Laboratories

Director of Laboratories: P. Bartlett

Superintendent of U/G Physics Laboratories: D. Thomas

Senior Teaching Laboratory Technician: B. T. Bristoll

Laboratory Technician: E. Milner, M. A. Sterling

Experimental Development Officer K. Vine

The Workshop: High Precision Design and Fabrication Facility (HPDFF)

Physics, Chemical and Biochemical Engineering Facility: R. Saakyan

Admissions Tutors: A. Aruliah (MSc), F. Diego (Astronomy Certificate), J. Blumberger (Postgraduate Research), P. Jones (Undergraduate)

Schools Liaison Officer: C. Howard

Programme Tutors: D. Armoogum (Undergraduate), S. Fossey (MSc), N. Nicolaou (Undergraduate), J. C. Rawlings (Astronomy Certificate), S. Zochowski (PhD)

UCL Observatory

Director: G. Savini

Senior Observatory Technicians: M. Pearson (Mechanical and site officer) T. Schlichter (Computing and Instrumentation Officer)

Observatory Technician: S. Sullivan

Professional Services

Departmental Manager: L. Coletti Campbell

Deputy Departmental Manager: L. Keepking

Senior Staffing and Communications Officer: B. Carboo

Senior Research Officer: R. Martin

Senior Finance Officer: A. Balcuinas

Research Administrator: Josh Grimond

Education Support Team

Senior Postgraduate and Student Finance Administrator: N. Waller

Teaching and Learning Manager: S. Lovell

Senior Teaching Administrator: H. Copeland

Postgraduate Taught Teaching and Learning Administrators: S. Begum, S. McGrath

UG Teaching and Learning Administrators: T. Crorie, L. Medici

Postgraduate Research Teaching Administrator: J. Bristow

Student Advisor: R. Edmonds

Research Groups

Astrophysics Group Manager K. Nakum

AMOPP/HEP Research Group and Operations Administrator Amalia Bountoureli

Biological Physics (BioP) Research Administration Officer: J. Gill-Thind

Finance Officer and CMMP Research Group Administrator: J. Levin

Centre Manager (Centre for Space Exoplanet Data): E. Dunford

Thomas Young Centre (TYC) and Materials and Molecular Modelling (MMM) Hub Coordinator: K. Stoneham

Project Manager and Scientific Officer (The Centre for Planetary Sciences): J. Fabbri

Project Manager (Cosmoparticle Physics (CPP) Initiative) and Executive Assistant: R. Raupp

Project Manager (Euclid): M. Rangrej

Safety Officer and Estates Manager: L. Bebbington

Outreach and Public Engagement

Outreach Coordinator and Ogden Science Officer: M. Fuller

Science Centre Organiser: S. Kadifachi

Doctoral Training Centre

CDT Manager, CDT in Data Intensive Science (DIS): M. Cao

CDT Manager, CDT in Data Intensive Science (DIS) and Industry: E. De Ben Rockson

Computing and IT:

Computing Manager and IT Coordinator: B. Waugh

Computing Administrator (HEP): T. Hoare

IT Systems Managers: F. Garza (AMOPP and BioP), F. Ihsan (Teaching and Learning)

Visiting Professors, Honorary Professors and Emeritus Staff: A. Aylward, P. Beltrame, S. Bridle, A. Charalambous, R. Cohen, M. Coupland, I. Crawford, J. Drew, M. M. Dworetsky, M. Ellerby, J. Ellis, M. Esten, I. Ferreras, F. Fernandez-Alonso, J. Fordham, I. Furniss, M. J. Gillan, A. H. Harker, C. Hirjibehedin, B. Hiley, C. Hilsum, P. Hobson, I. D. Howarth, J. W. Humberston, T. W. Jones, N. Kaiser, A. Kravtsov, M. Lancaster, B. R. Martin, G. Materlik, K. A. McEwen, J. McKenzie, A. Michaelides, D. J. Miller, S. Miller, R. Maiolino, W. Newell, G. Peach, R. Radogna, A. Slosar, A. Stevens, P. J. Storey, D. N. Tovee, C. Wilkin, D. A. Williams

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