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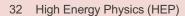
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Cover image:

Artist's impression of rocky worlds in the SDSS 1557 binary-star system.

Credit: Mark Garlick, UCL, University of Warwick, University of Sheffield.

Image page 2: UCL Front Quad.

Credit: UCL Digital Media.

Image page 18:

This artist's impression shows what the very distant young galaxy A2744_YD4 might look like. Observations using ALMA have shown that this galaxy, seen when the Universe was just 4% of its current age, is rich in dust. Such dust was produced by an earlier generation of stars and these observations provide insights into the birth and explosive deaths of the very first stars in the Universe.

Credit: © ESO/M. Kornmesser

Image page 25:

Detail of a sub-mm crack in an Al ring, imaged with an atomic magnetometer operating in electromagnetic induction tomography modality developed by Professor Ferruccio Renzoni's group.

Credit: C. Deans, L. Marmugi, S. Hussain, F. Renzoni

Image page 36:

Snapshot of a liquid water film on TiO2(110) obtained from ab initio molecular dynamics. The overlayer consists of hydroxyls (the light blue and gold spheres) arranged in a 2x1 periodicity adsorbed on the 5-fold coordinated Ti atoms (red spheres). O atoms are shown as dark blue spheres, while molecules of the liquid water film are depicted as cyan and white spheres.

Review edited by Bonita Carboo, b.carboo@ucl.ac.uk

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Welcome

I could say that 2016 has been another year of great success for UCL Physics and Astronomy, and it would be true. You will find evidence in the following pages of amazing and inspirational work from staff and students, and many reasons to be optimistic for the future. We have led major advances ranging from fundamental principles, through the frontiers of astrophysics, biophysics and particle physics, and into the development of novel applications. Our "connected curriculum" developments and substantial investment in new infrastructure at the observatory will lead to even better opportunities for the many excellent students who are here, or applying to come here.

However, events in 2016 beyond physics had a profound impact on us, both as a department and often individually. It would be disingenuous to ignore them. The UK referendum result in favour of leaving the EU is the most obvious jolt, but there are others. As I write we are in the middle of a general election, with the parties promising very different futures for education, as well as for the country.

Don't worry, I am not about to make party-political comments. In the UK, support for science is mostly perceived as non-partisan and non-controversial, which is good. But that should not lead to science being ignored.

Science will not make moral and political choices for us, or tell us what our goals should be. But it will help us determine the possibilities for achieving them in the real world. To paraphrase Richard Feynman, science is a way of trying not



to fool ourselves. In the world we live in today, which is inherently global, complex and technologically sophisticated, we can't afford to be fools any more, if we ever could. Science helps us to understand this world, and to predict

another year of great success for Physics and Astronomy

the consequences of our actions. It has brought great benefits – increased lifespan, better health, better quality of life for more people than ever before – but also great responsibilities – we can mess things up globally now, not just in our own village or country.

I've worked in international science for my whole career so far – in Geneva, Hamburg, the USA, at Oxford and UCL – always in highly international institutions. I and other UCL colleagues were amongst the 6000+ people from all over the world who discovered the Higgs Boson. That is one example of the fact that when there is a common objective, and people contribute, compete and collaborate according to their abilities, the whole is much greater than the sum of the parts.

There are some worrying trends around now toward isolationism and nationalism. Amongst other things, this damages science, and this damages the ability of the human race to thrive and survive.

UCL has a strong culture of openness to new ideas, of internationalism, and of intellectual rigour. Many at UCL have spoken out in the ongoing debate about the kind of country the UK would want to be. I hope and believe that staff, students and alumni of UCL Physics & Astronomy have a lot to offer in that same debate.

Best wishes for the rest of 2017 and beyond.

Professor Jonathan Butterworth Head of Department

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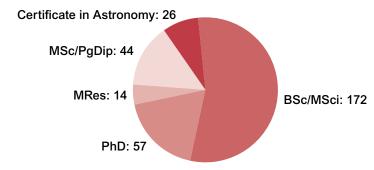
(Based in part on a speech given at the London Science March, 22 April 2017. See http://cosmicshambles.com/events/marchforscience)



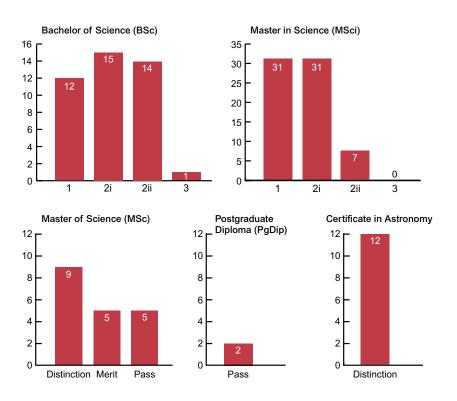
Community Focus

Teaching Lowdown

Intake



Awards



Teaching in the Physics and Astronomy Department

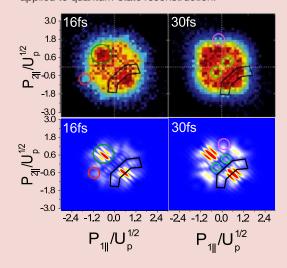
Among the teaching highlights this year, Emma Slade was awarded the Kathleen Lonsdale Medal for the top graduating student in the MAPS Faculty, and five students from the Department (Bhavin Patel, Jamie Parkinson, Harry Johnston, Luke Heng Yeo and Alastair Hsi Wen Wee) were placed on the Dean's list, which commends outstanding academic performance by graduating students, equivalent to the top 5% of student achievement. The Department has launched a new MSc in Biological Physics, reflecting our research interests in this area, and we also welcomed the first cohorts to our Scientific Computing and Quantum Technologies MSc programmes. In collaboration with the UCL Institute of Education (IOE), we are offering a new Physics Education module, which aims to provide students who have an interest in Physics and Science education at secondary level with an understanding of science teaching and learning at school.

Professor Neal Skipper

Headline Research

Controlling quantum interference in below-threshold nonsequential double ionization

For over two decades, nonsequential double ionization (NSDI) has been viewed as a classical phenomenon in which an electron, driven by a strong laser field, recollides with its parent ion and releases a second electron. The success of classical NSDI models suggested that quantum mechanical features would not survive realistic conditions. Without much evidence, these conclusions were extrapolated to the below-threshold regime, in which the recolliding electron only has enough energy to excite the second electron. Recent experiments, however, have encountered a myriad of shapes in correlated electron-momentum distributions, which could not be reproduced by classical models and were controlled by an appropriate pulse choice. The calculations by UCL researchers Andrew Maxwell and Carla Faria (Phys. Rev. Lett. 116, 143001 (2016)) suggest that such features stem from the quantum interference between different excitation channels and events, which survive focal averaging and transverse-momentum integration, and can be applied to quantum-state reconstruction.



Electron-momentum distributions as functions of the electron momentum components parallel to the laser-field polarization, for Argon in a field of peak intensity I= 10¹⁴ W/cm² and wavelength I=800nm. The upper panels show experimental results from M. Kubel et al., New J. Phys. 16, 033008 (2014), while the lower panels give theoretical computations from A. S. Maxell and C. F. De M. Faria, Phys. Rev. Lett. 116, 143001 (2016). The letters on the left-hand side of the figure give the pulse length and the shapes in the figure highlight common features.

Student Accolades

Undergraduate Awards

Departmental Awards

Oliver Lodge Prize

Best performance first year Physics

Matthew Rayment

Halley Prize

Best performance first year Astrophysics

Roman Gerasimov

C.A.R. Tayler Prize

Best performance in Communication Skills

Thomas Mellor

Wood Prize

Best performance second year Physics

Leonardo Badurina

Huggins Prize

Best performance second year Astrophysics

Xiaoxi Song

David Ponter Prize

Most improved performance

first to second year

Kieran Ng

Dr Sydney Corrigan Prize

Best performance in experimental second year work – PHAS2440

Maximilian Daniel

Best Performance Prize

Third year Physics

Jakub Mrozek

Best Performance Prize

Third year Astrophysics

Kai Hou Yip

Additional Sessional Prize for Merit

Best fourth year Physics project achieving a balance between theoretical and practical Physics

Claudio Arena

Burhop Prize

Best performance fourth year Physics

Sarunas Jurgilas

Herschel Prize

Best performance fourth year Astrophysics

Harry Johnston

Brian Duff Memorial Prize

Best fourth year project

Jamie Parkinson

William Bragg Prize

Best overall undergraduate

Emma Slade

Tessella Prize for Software

Best use of software in final year (Astro) Physics projects

Jennifer Hall

Postgraduate Awards

Harrie Massey Prize

Best overall MSc student

Paul Nathan

HEP Prize

Outstanding postgraduate physics

research in HEP **Ben Strutt**

Carey Foster Prize

Outstanding postgraduate physics

research in AMOPP
Christopher Perry

Marshall Stoneham Prize

Outstanding postgraduate physics

research in CMMP

Jon Darius Memorial Prize

Jose Martinez Castro

Outstanding postgraduate physics research in Astrophysics

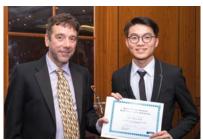
Richard Tunnard

Chris Skinner Prize

Outstanding postgraduate physics research in Astrophysics

Antonia Bevan

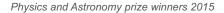












Equality and Diversity Committee

The Department of Physics and Astronomy holds the highest award given by the Institute of Physics for addressing the under-representation of women in Physics: Juno Champion. We also have a Athena SWAN Silver award from the Equality Challenge Unit for our work in increasing equality and diversity within the Department. In order to achieve and retain these accolades we not only need to ensure that our Department operates fairly, but to collect evidence that our policies and procedures are working – for both, this is the job of the Equality and Diversity committee.

We have seen some significant developments in the past year. In 2016 we ran our first ever survey of our entire PhD student body – highlights of the results include the large numbers of students who felt they are working in a friendly department where they are treated with fairness and respect, with a significant influence over their own work. Our Biennial Staff survey of all staff in the department was held in spring this year and we hope to find that we are maintaining these high levels of satisfaction among the staff as well as the PhD students.

We also analysed our undergraduate degree results and found that all students, men and women, and of all ethnic backgrounds, achieve equally highly, and we will be monitoring our results in the future to ensure that this equality of achievement is sustained.

In March 2016 the Department part-funded a delegation of students to attend the Conference of Undergraduate Women in Physics at the University of Oxford. The conference included a visit to RAL, presentations by women scientists on their career paths, and networking with other women students – it was described as a 'fantastic experience' by those lucky enough to attend.

This year we will prepare our application to renew our Juno Champion status, and will continue our efforts to promote Equality and Diversity for all members of the Department.

Dr Louise DashChair of the E&D committee



UCL students Sunayana Bhargava, Giulia Franceschini, Paula Sahd Soares, and Joanna Lis at the Conference for Undergraduate Women in Physics, Oxford, March 2016

Headline Research

Analysing exoplanets with deep learning

Today, we know of over 3600 exoplanets, i.e. planets outside of our own solar system. Though an impressive number, we know surprisingly little about them. By analysing the composition of their atmospheres, we can begin to shed light on their nature. Future space telescopes such as the James-Webb and ESA-Ariel will observe many hundreds of these atmospheres. Too many to analyse 'by hand' within the missions' lifetimes. Here at UCL, we built an artificial intelligence, RobERt (Robotic Exoplanet Recognition), to do this job for us. Based on deep learning, RobERt analysed 80,000 synthetic atmospheric models ranging from Earth like planets to hot-Jupiters. Now RobERt can rapidly categorise newly observed planets with a 98% accuracy, tell us what their chemical make ups are and even provide first insights into their climates and global cloud covers.



The earth reimagined by RobERt in the style of a Monet painting.

Science in Action

Original Research By Young Twinkle Students (ORBYTS)

In the Original Research By Young Twinkle Students (ORBYTS) program, PhD students and young postdoctoral researchers work with sixth form students to produce original publishable research related to the UCL-led Twinkle space mission to characterise exoplanetary atmospheres. Dr Clara Sousa-Silva conceived and launched the project at Highams Park School in early 2016 with three ORBYTS teams with 15 students. Dr Laura McKemmish took over leadership in mid-2016. Since then, the project has expanded to more than 30 students from 7 schools, with further expansion in the works. Perhaps most excitingly, UCL's Widening Participation Program is supporting an ORBYTS summer school for 30 Year 12 students from across the UK in August 2017.

The project involves teaching the students undergraduate-level physics, astrophysics and chemistry, then using this expertise to perform original research which, ideally, will lead to the publication of a peer-reviewed journal article with the students as coauthors. We have already submitted one paper to the Astrophysical Supplementary Series with three student co-authors.

A dedication to outreach, inclusivity and diversity is important to all of us working with ORBYTS, so we have tailored our program to be accessible to students from groups which are traditionally underrepresented in the science and space communities. We would like to gratefully acknowledge funding from SpaceLink Learning Foundation and Highgate School to run the ORBYTS teams in 2016/17.

The sixth form students involved in this project become more active, confident, engaged and independent learners with increased knowledge, technical skills and improved communication, team work and research skills. The program inspires and motivates STEM university and career choices, and produces students who are much more prepared for university-level education.

The engagement between UCL researchers and the schools (its teachers and students) developed through this program is extremely beneficial and can become quite multi-faceted; for example, increased connections to schools often leads to participation in other outreach activities, e.g. the UCL

Science Lectures for Schools, workshop sessions by UCL staff and students. High school teachers learn about the current physics research and applications, while university lecturers learn about the school curriculum which usually governs the background knowledge of their first-year undergraduates and can thus be used to improve learning.

This project gives PhD students and junior postdoctoral researchers the rather unique opportunity to be primary supervisors for research students, to lead a research team, direct a complete research project and develop their project management skills. In this way, we train our future leaders and supervisors. All ORBYTS group leaders meet regularly to provide peer support and advice; plentiful UCL training programs and their own research supervisors provide ORBYTS tutors with further support in developing and improving these new skills.

Dr Sousa-Silva started the year asking the question "When can students start performing original research?" and ended the year with the answer 'When we provide the environment for them to do so".

Clara Sousa-Silva, Laura K. McKemmish, Jack S. Baker, Emma Barton, Katy Chubb, Tom Rivlin, Jonathan Tennyson



ORBYTS tutors and students from Highams Park School at the ORBYTS Opening Session at UCL.

Photograph credit: Rebecca L. Coates



Students from Highams Park School celebrate their ORBYTS experience with lead organiser, Dr Clara Sousa-Silva.

Photograph credit: Rebecca L. Coates

Students in Action

Women's Lunch

The Women's Lunch takes place once a month during term time and was set up to provide a relaxed, supportive atmosphere for networking and discussion of issues particularly pertinent to women working in the fields of physics and astronomy. All genders are welcomed, and the tea, coffee, cake and fruit are kindly funded by the department. The founder of the women's lunch was Emily Milner in October 2014, and I took over in October 2015. The idea came about because it was noticed that the men were making professional connections and collaborations on the 5-a-side football pitch, and Emily wanted to provide similar opportunities for networking to women in the department.

The format of the lunch varies. Some weeks, senior members of staff are invited to give an informal account of their career journey, and other weeks we will discuss a specific professional issue, for example how to survive at conferences, bullying, and women in science in the media. Some PhD students represented the group with a stall at the MAPS Faculty PhesDival in June 2016, which involved an interactive unconscious bias quiz

As well as the regular lunch meeting, prominent women from outside the department have been invited to give high-profile keynote speeches. In March 2016, we welcomed Professor Dame Jocelyn Bell-Burnell who spoke about her career, from narrowly missing out on the Nobel Prize as a PhD student, to motherhood and what success means to her. This was followed in June by a talk from Professor Elspeth Garman, a prominent crystallographer, molecular biophysicist and advocate for diversity in STEM. Their pearls of wisdom will stick with us for many years to come and we look forward to continuing to welcome many more external speakers in the coming year.

By Anna Ploszajski

Physics Hackathon

The UCL Physics Hackathon returned in 2017 and saw seven teams of students compete at problem solving for a prize of £250. This two day competition, held over the road from the Physics Department at the Wellcome Collection, involved the teams picking from a list of project ideas and trying to come up with creative and interesting solutions to impress the judges.

This year the event was sponsored by Deloitte Digital, Quantcast, and ASI Data Science. With their support the competition featured some amazing equipment including a robotic arm, virtual reality goggles, and a mind control headset. The winning team built the classic video game Pong out of an LED display and some electronics, and second prize went to a team that used genetic algorithms to evolve virtual shapes that blend in to arbitrary backgrounds.

The Hackathon has been organised annually by the Physics Postgraduate Society for the last three years. It offers students the chance to hone their collaborative problem solving skills in a way they might not encounter during their degrees, as well as giving them an opportunity to engage with new technology and ideas.

By Richard Juggins



Event Horizon

It has been a fantastic academic year with the UCL Physics Society (informally known as Event Horizon). The committee would like to extend thanks to all who have participated in our many events, and to the department who have helped us enormously throughout the year.

Here is a rundown of some of the biggest events we've had this year, which also serves as a glimpse at what is to be expected in 2017–18.

Freshers week

What a jam-packed week this was! We gave the Freshers a crash-course in what it means to be a member of the society, including the second instalment of the infamous Kick-off. The Kick-off is our annual team challenge, in which teams complete a series of challenges to find the location of our welcome party. We also had club nights and a pizza picnic.

Café Scientifiques

Twice each term, we hold a 'Café Scientifique', which involves a lecture given by an academic from the department in an informal setting (e.g. pub). In the first term we were glad to welcome Professor Bart Hoogenboom talking about his work in biophysics, and Dr Carla Faria talking about her work as a theoretical physicist.





Winter Ball and Boat Party

Winter Ball and Boat Party

In December and January, we held our annual Winter Ball and Boat party respectively. These were our two biggest and most anticipated events of the year. It was a chance for everyone to let their hair down and celebrate before the second term workload kicked in.

Joint Undergraduate Research Conference

For the second year in a row, we held a joint research conference with Imperial College London. The committees of both our society and the Imperial PhySoc worked tirelessly to create an event that would let the brightest from our universities showcase research projects. Also, our audience got to hear from both UCL and ICL PhD admissions.

La Palma Trip

Last year, the society took a trip to Iceland to see the Aurora Borealis. This year, we decided to take members to sunny La Palma. The main part of the trip was visiting the Observatory there and stargazing, but we also went hiking, to the beach, explored the cities on the island, and ate lots of food. It was a great way for everyone to relax before exam season began (and also do something science related, of course!)





Joint Undergraduate Research Conference

Headline Research

ESA Trip

In June, a group of society members will be taking a day trip to the Netherlands to visit the European Space Agency. Whilst there, they will be given a tour of the site, and will also have a talk by UCL alumnus. I'm sure it will be a very educational experience!

The committee and I have thoroughly enjoyed running the society this year, but now it's time to hand over to the new committee. We wish them the best of luck for next year. We are positive that the society next year will be bigger and better than it has been before.

If you are new to the UCL Physics Society, we hope this gave you a good taster of the things you could be getting up to next year!

Thanks once again to all of our members and the physics department,

Sian Brannan (Vice President) and the 2016/17 committee







La Palma Trip

Using quantum fluctuations to control the flow of classical information

Progress towards the miniaturization of electronics has produced portable computing devices. However, this trend is now experiencing a severe bottleneck because the basic electronic elements (e.g. wires and transistors) are reaching the atomic scale, where the laws of physics start being dominated by quantum mechanics. Such quantum systems typically have noisy behavior that is detrimental to the operation of traditional electronic components that are of the size of several atoms.

We have found a way to actually harness this intrinsic noise stemming from quantum mechanics for a beneficial purpose: tuning the noise to the right level can shut off the flow of information through a wire made of a line of magnetic atoms coupled to each other. This can be done by applying a modest magnetic field to the wire. As shown in the figure (panel 2), the direction of a large magnet at one end can easily order a line of atomic magnets so that the information can be read from a distant atom at the far end of the chain. This happens best when an optimal magnetic field is applied to the wire. However, when this magnetic field is decreased or increased by a small amount, the noisy nature of the atomic quantum magnets (called 'quantum fluctuations') can completely prevent the flow of information (panel 1). This is a new and low energy way of controlling the flow of information by exploiting transitions between ordered and intrinsically disordered states of coupled atomic quantum magnets.

Publication:

Gating Classical Information Flow via Equilibrium Quantum Phase Transitions

Leonardo Banchi, Joaquín Fernández-Rossier, Cyrus F. Hirjibehedin and Sougato Bose

Phys. Rev. Lett. 118, 147203 - Published 5 April 2017

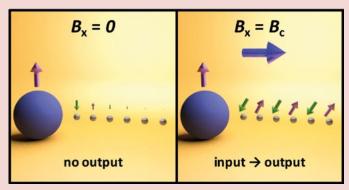


Image courtesy of Tobias G. Gill

Phys FilmMakers

Short videos are a powerful medium to communicate scientific ideas in an engaging and informative manner, as illustrated by the success of the YouTube format. There is great Physics content on YouTube, but we wanted to showcase our department's Physics and Astronomy research. At the same time, UCL is strongly supportive of innovative teaching methods, as elucidated in the Connected Curriculum objectives which emphasises (among other goals) connecting students with different subject areas, each other, staff and UCL research, as well as producing outputs aimed at a real-world audience. The Phys FilmMakers program aims to join these outreach and education aims in a mutually beneficial partnership between students, research groups and the public.

In early 2016, with financial support from the UCL ChangeMakers program, we formed a partnership between science expert, Laura, and communication expert, Rebecca, to develop and run the first Phys FilmMakers course. In this course, volunteer second year undergraduate students were given the opportunity to (1) learn how to create YouTube style videos on scientific topics and (2) engage with UCL researchers to design and produce a video on current research within the Physics and Astronomy (P&A) Department. Through a series of workshop sessions, students learn the process of film-making from pre-production (idea generation, scriptwriting, location and film planning), production (narration, interviewing, directing, audio-gaffing, lighting etc.) and post-production (editing). For the second half of the course, we partnered students with different AMOPP groups and asked them to produce a short video explaining the group's research. The four resulting videos premiered at a department-wide screening on 7th June 2016. They were a fantastic illustration of the diversity and quality of the research done at UCL, and of the creativity and skill of the student filmmakers.



Laurence
Turlej edits
video on
the ExoMol
research
group

Keen Phys FilmMakers students setting up experiment for B-roll in workshop sessions





Following from this success, the department has supported two further courses this year; PFM 2.0h for undergraduates, and Dr PFM for PhD students. The research groups highlighted in their final video productions will be from across the full range of physics subdisciplines. We look forward to a large-scale screening in mid 2017.

All videos produced by Phys FilmMakers are available on YouTube in the Phys//Film// Makers YouTube channel. Other videos produced on UCL Physics and Astronomy research, including for other purposes, are encouraged to co-upload on our channel; please email **physast.PFM@ucl.ac.uk** to let us know about your awesome videos!

Some alumni PFM students have caught the bug for video production and science interviewing; watch out for their productions on the Phys//Film//Makers YouTube channel over the coming months and into the future.

These videos and the Phys//Film//
Makers YouTube channel fulfil a
variety of outreach, publicity, widening
participation and edutainment purposes
that can significantly assist in enhancing
the impact of the UCL P&A research
scientifically and on the broader UK,
European and global public.

This voluntary extracurricular course fits very nicely with UCL Connected Curriculum objectives. Students valued the connection and access the course gave them to world-class research within the department and reported an increased sense of belonging. Their communication skills improved and diversified. The exposure to the applications of the Physics concepts they learnt in class was also praised as providing motivation, context and stimulating a deeper understanding.

Laura K. McKemmish, Rebecca L. Coates

Physics Postgraduate Society

Run by a committee of PhD students, the Physics Postgraduate Society holds events to encourage intradepartmental socialising. A strong emphasis is placed on personal improvement beyond research activities which works towards the Society's main aim - to combat the stereotype that the PhD experience is isolating with little opportunity for skills development. Student-led evening seminars are the most frequent event, held fortnightly, to provide a platform for students to practice engaging others in their work. Although the usual formula is two PhD students presenting their research followed by food and refreshments, the event has also welcomed Dr. Piotr Wasylczyk (a Visiting Lecturer at UCL from the University of Warsaw) who spoke about his research in experimental optics and materials science, and went on to deliver an excellent workshop on preparing efficient and inspiring presentations during the following event. In addition to the seminars, the committee also organise quiz nights at the beginning of every term, and the annual Hackathon. During this ambitious two-day event, small teams of students work together on a novel project and present their final work for judging by a panel of experts from various industries. It continues to attract external sponsorship and has developed a strong identity. The success of all the Society's events reflects the continuing desire for a united postgraduate student group in the Department of Physics and Astronomy.

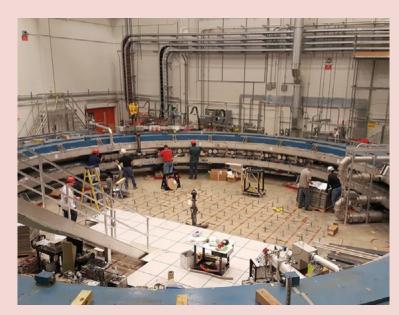


Dr. Piotr Wasylczyk delivering his workshop on effective presentations, as part of the Physics Postgraduate Society's programme of events.

Headline Research

Fermilab Muon g-2 experiment

In 2004 the E821 experiment at BNL reported a measurement of the muon's interaction with a magnetic field that was at odds with the Standard Model (SM) of Particle Physics at the level of 3.5 standard deviations. This paper has since been cited over 3,000 times as tantalising evidence of a breakdown of the SM. To confirm whether this deviation from the SM is truly significant, a new experiment at FNAL was proposed in 2009 and now the experiment is almost ready to take data. It will improve on the precision of the BNL measurement by a factor of 4. The magnet from the E821 experiment was transported to FNAL in the summer of 2013 and new detectors and accelerator components have since been built and are now being installed. For the past two years, a dedicated team has been working to improve the uniformity of the magnetic field which now has an average azimuthal uniformity of 10 parts per million RMS: far better than achieved at BNL. UCL and Liverpool University along with Boston University and FNAL are providing the tracking detectors that will measure the profile of the muon beam which is a critical component of the measurement.



Final modifications being made to the g-2 magnet prior to the installation of the detectors, ready for data taking in the summer of 2017.

Alumni Matters

The Physics and Astronomy Gala Dinner which was held on 28 October 2016 was an enjoyable evening attended by prize winners and their guests, members of the undergraduate UCL Physics Society, members of staff and Alumni. This was the fourth annual Gala Dinner event, which began in the afternoon with the second Annual Physics Lecture, given by Dr Stephen Hogan. The title of Stephen's lecture was 'Trapping and manipulating neutral atoms with electric fields - from quantum information to antimatter physics' and in his talk he described how gases of neutral atoms, prepared in selected internal quantum states by laser photoexcitation, can be transported and trapped above chip-based electrode structures using inhomogeneous electric fields. The pre-dinner Wine Reception in the department took place directly after the lecture.

The Gala Dinner at the Ambassadors Hotel in Bloomsbury opened with welcome

drinks. Jon Butterworth and Julie Smith then went on to present the awards to the prize winners. The after-dinner speech was given by Heidi Allen who graduated in Astrophysics from the department in 1996. Heidi, who is an MP for South Cambridgeshire gave an interesting insight into the beginnings of her political career.

Jon Butterworth was very pleased to invite the members of the undergraduate UCL Physics Society to attend the Annual Gala Dinner and the department would like to be able to invite members of the society to the Gala Dinner in the future.

We are very excited to announce that the after-dinner speaker at the fifth Gala Dinner to be held on 20 October 2017 will be Dr Gillian Peach. Gillian's speech will focus on 'Reminiscences from 57 years of life at UCL'. Gillian was an undergraduate and postgraduate at Royal Holloway College, University of London (1954–1960) graduating with a BSc in Mathematics in

1957 and a PhD in Theoretical Physics in 1961. Having been a Research Assistant at UCL, 1960–1965 and a Research Associate, University of Maryland, 1965–1966, she has been at UCL from 1966 to the present. Gillian's research interests centre on theoretical studies of atomic collisional and radiative processes with applications to ultracold physics and astrophysical problems.

The third Annual Physics Lecture will be given by Dr Alexandra Olaya-Castro, a member of the department's Atomic, Molecular, Optical and Positron Physics (AMOPP) group.

Tegid Wyn Jones resigned from the role as the Alumni relations head at the end of the 2015–16 academic year. We are extremely grateful to Tegid for his hard and cheerful work in this role. We hope to still see him at future dinners, and to appoint a worthy successor soon.









Teaching Fellows

This has been a busy year for the Teaching Fellows and technicians within the Department. Student numbers have risen but, as always, the team have risen to the challenge. Moreover, it is worth mentioning activities that the teaching staff do that makes them stand out. UCL has an objective to narrow the divide between teaching and research. The teaching team have fully engaged with this, both on the Bloomsbury site and in the UCL Observatory at Mill Hill. There are now two robotic telescopes at UCLO, both supporting teaching-informed-by-research for our students. Anxieties over BREXIT notwithstanding, the annual astrophysics field trip visit to Haute-Provence will take place again this year (Other news of research-in-teaching at UCLO is reported on page 18).

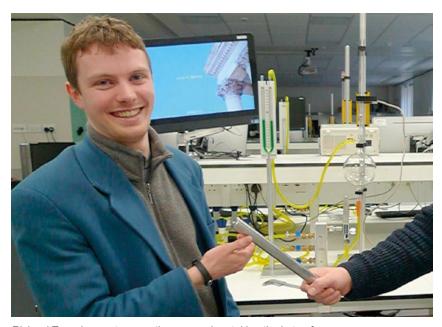
In Bloomsbury, we have created a 'virtual research group' investigating reluctance accelerators and have devised and redesigned teaching equipment and educational technologies with the help of undergraduate students. In addition, we are also contributors to the Nexus Laboratory where Academics, Teaching Fellows, technicians, postgraduate researchers and undergraduates work with each other and industry to develop laser systems for research and teaching.

Much of this work has been carried out through UCL Connected Curriculum and Changemakers funding. For example, undergraduate Richard Tweed (shown below) obtained his own funding with our help. He leads a team of students to produce Raspberry Pi data acquisition systems for use in the 1st year teaching laboratories. Student peers are working together to enhance courses. This is a perfect example of the Connected Curriculum at work.

We are helping to 'hand over the baton' to younger researchers. Increasingly, students can see that they are part of a UCL research community and we are there to support them as they develop themselves and others.

On top of this, there has been a steady increase in the pedagogical research within the department with a number of papers being resented at conferences. However, we are now moving into a new phase where Teaching Fellows will be part of an IoP-led initiative that seeks to develop physics-based Higher Education research as a distinct research area within the UK. A consortium of universities has decided to take on this challenge and, as would be expected, UCL Teaching Fellows are in the vanguard.

So, a busy year: The teaching team are making UCL a more research-led centre for physics and astronomy teaching within the UK and the students are supporting us.



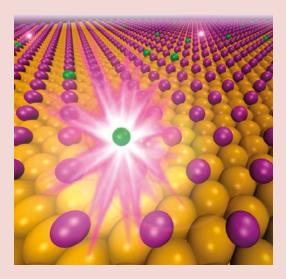
Richard Tweed, a next-generation researcher, taking the baton from Physics and Astronomy staff

Headline Research

Elements transform at the atomic scale

CMMP researchers have been involved in a detailed experiment to watch elements transform at the atomic scale for the first time. In the experiment a single drop of water containing radioactive iodine was deposited onto a gold substrate. The iodine atoms, bonded with the gold, were then observed using a combination of X-ray photoelectron spectroscopy and scanning tunneling microscopy and the observations were interpreted using density functional theory computations. The radioactive films and the decay product (125 Te) were shown to be stable in air at ambient conditions. Stable two-dimensional radioactive films have potential applications in medical imaging and cancer therapy.

Reference: www.nature.com/nmat/ journal/v14/n9/pdf/nmat4323.pdf



Nuclear transmutation of 125I to 125Te (green). Violet spheres represent the radioactive iodine atoms adsorbed on a gold (111) surface.

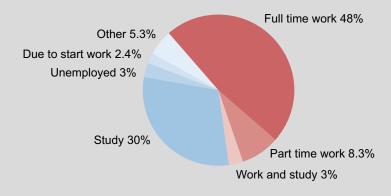
Career Profiles

Graduate Destinations

Total Number of Graduates: 167

Response Rate: 80.24%

Median Salary: £30,000
(full time employment)



Data for 2015 graduating cohort, compiled in June 2016

Alexandros Gerakis

Since the age of 14 I had made up my mind that I wanted to become a physicist thinking it would allow me to answer the "why's" of this world. Having obtained my BSc in Physics N.T.U. Athens, Greece and my MSc in "Photonics & Optoelectronic Devices" from the University of St Andrews and Heriot-Watt University, I was still uncertain as to whether I had what it took for me to pursue a PhD in Physics. I was lucky enough though to have two offers to do so, one from University of Cambridge and one from Professor Peter Barker's group at UCL. I still remember the day I first came to UCL in order to meet with Peter and his group. Coming from Northampton (where I was doing my master's thesis project) I got off at Euston and walked towards UCL's entrance on Gower Street. Needless to say how amazed I was by the Portico since I couldn't see it coming from just walking on the street!

Cutting a long story short, I decided to try my luck pursuing a PhD at Peter's group. And I haven't regretted it for a moment since! Not only was the environment both inside the group as well as generally in the department very friendly and scientifically very collaborative, but also

the research we were conducting was cutting edge, on a worldwide level. With my scientific interest lying in photonics and atomic and molecular Physics, I was able to conduct very interesting research using very sophisticated laser systems in gas diagnostics as well as ultracold molecules. As is the case with

"The research I conducted at UCL allowed me to get two postdoctoral positions in the USA"

any PhD, the process to obtain mine seemed sometimes to be lasting forever but, in the end I made it! The research I conducted at UCL allowed me to get two postdoctoral positions in the USA, one at Harvard University where I stayed for a year and one at the Princeton Plasma Physics Laboratory, where I work for the past 3 years and is where I'm writing from now. Overall, I value a lot my time at UCL and everything I gained for my five year stay there and will keep UCL in my heart. As of whether I would follow the same steps again was I given the chance? No question about it!



Princeton campus, (historic Nassau Hall is in the background), the sculpture is Henry Moore.

Luke Green. Do What You Want!

Curiosity never killed the cat. I didn't map my career out in front of me from a young age. I just wanted to understand why things happen, when they happen and why we respond the way we do. This life approach can take us in all directions and need not be limited to the sciences. However, in my teens nanotechnology was all the rage and I knew I wanted to be a part of it, but first - I needed to understand it. A Chemistry with French Master degree from York equipped me with some basic skills which would lead me to spend four years earning a PhD in nanoscience with Professor Nguyen T. K. Thanh at UCL and the historic Royal Institution of Great Britain. I explored chemical methods for making magnetic nanoparticles for use in biomedicine and magnetic storage. Together, in Thanh's well equipped laboratories we contributed to eight publications in high impact journals such as Nano Today.

PhD research isn't for everyone; but through the challenges I learnt many scientific and life skills that make me who I am today. From academia I came to Malvern Instruments and worked for three years as an applications specialist performing feasibility studies, demonstrations and customer training.

"I love the variety and the opportunities to meet so many people"

I now work as an international service engineer. I love the variety and the opportunities to meet so many people. I'll finish with a quote: 'suffer what there is to suffer, and enjoy what there is to enjoy'. Life is short.



Luke Green

Conor Maher McWilliams

After completing my undergraduate degree in Physics at Queen's University of Belfast I moved to UCL to study an MSc in Astrophysics in 2006. During this year I took a class in atomic physics which ignited an interest in the optical techniques used to control and manipulate atoms and molecules. This interest lead to me returning to UCL in 2008, after a year out working and travelling, to do a PhD in ultracold atomic and molecular physics.

"Following my PhD I went to work in the Trading team at OVO Energy"

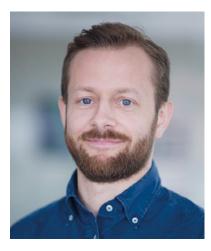
The four years of my PhD contained many highlights: working with incredibly talented people, publishing our principal results in Nature Photonics and, of course, travelling to some spectacular locations for conferences!

Following my PhD I went to work in the Trading team at OVO Energy, a small energy supplier with big ambitions based in Bristol. I joined the company when it

was four years old and still had a start up feel. The Trading team was populated by bright people with little industry experience but confidence we could figure things out; much like a PhD group in some ways. Over the last four years I have seen the company grow from 150k to over 650k customers, undergone a couple of role changes and office moves while the company have continued to be a thorn in the side of the 'Big 6' suppliers. A personal highlight during this period was setting up the Forecasting team which has become an industry leading performer. I have continually returned to the skills if not the content of my studies in physics

The electricity industry is currently going through an interesting period with the introduction of smart grid technologies, an increasing capacity of installed storage and the electrification of transport. It is an exciting time to work in energy and I have just taken on a new role focussed on these emerging sectors where there are some parallels with the experimental work I did during my PhD (it turns out stabilising the frequency of the electricity grid is much like stabilising the frequency of a laser!).

to work on a wide variety of projects.



Conor Maher McWlliams

Connected Curriculum

This article reports on an exciting student-staff collaboration in our teaching laboratories that embodies UCL's Connected Curriculum via research-based education.

Biophysics is the department's youngest research group, and until recently undergraduates had no exposure to this field in the teaching labs. In order to address this curriculum gap, a team of third year undergraduates was tasked with creating a new Biophysics experiment – a practical designed and built by students for students.

Working closely with research and teaching staff, the 'Stochastic Bombastic' student team designed an experiment based upon the random motion of microspheres in solution. With UCL Changemakers funding and departmentally-provided equipment, the team built a working prototype and wrote supporting pedagogical documentation.

December 2016 marked the project's culmination, as the experiment went 'live' in the teaching laboratory. It was enthusiastically received, and the second year pioneers relished the open-ended challenge presented to them by their peers.

This project exemplifies UCL's Connected Curriculum: the students are empowered and engaged with research, and have developed transferable expertise for their professional lives. Indeed, it has provided inspiration, with most of the development team applying for postgraduate study.

As the Stochastic Bombastic members graduate, they can be proud that they leave a tangible legacy in our teaching labs, and an enhanced UCL learning experience for future cohorts.

Dr Daven Armoogum Senior Teaching Fellow

Thoughts from the development team

"Contributing to the teaching curriculum has been immensely rewarding. I'm very proud that we've brought exposure to a new research area into the UCL teaching labs."

Gregory Marsden

"I'm doing my part to enhance the awareness of an important field that I hope to stay within. The project gave me the confidence I needed to apply for a summer scholarship [and] research."

Jessica McQuade

"By trusting us to design the experiment, we were motivated to make it the best we could. It feels great knowing that students are already benefitting from it. The project definitely made me more inclined to research."

Johan McQuillan

"It was exciting that a biophysics-based experiment was not yet part of the curriculum. This experience has helped to confirm that I would like to pursue a career in research after my degree."

Roisin Stephen



Jakub Mrozek (now Year 4) and Lily Pagano (Year 2) deliberate on the images obtained using the digital microscope for the new Biophysics experiment in Lab 2.



Jakub Mrozek discusses the Biophysics experiment his team designed and built with Year 2 students Yahel Houston and Guillermo Herrera Sanchez.



Dr Phil Jones (co-Head, Biophysics) converses with Year 2 students Yahel Houston and Guillermo Herrera Sanchez on how the new experiment is relevant to his research group's work with Optical Tweezers.



Stochastic Bombastic team members Johan McQuillan and Jessica McQuade share a moment of scientific elation with Year 2 students Lily Pagano and Lauren Fox, and Dr Daven Armoogum.

Photographs credit: Kelvin Vine

Headline Research

Thoughts from the year 2 pioneers

"For once we faced real problems - and had to come up with real solutions. The stabilisers were taken off and we were given a taste of research."

Christopher Soelistyo

"The new biophysics experiment was definitely the most fun I've had in labs. It made us feel like we were doing research for the first time. This has inspired me to think about my future studies."

Yahel Houston

"It was a great feeling to be truly immersed in the science and work as independent scientists. The experiences of collaboration and contribution were exhilarating."

Lily Pagano

"The experiment has definitely sparked my interest in Biophysics, and I will surely consider this research area when applying for a Ph.D. in a couple of years' time!"

Guillermo Herrera Sanchez

The Researcher's Viewpoint

"This is a great example of research-based teaching, using activities and resources from the Biological Physics Group to enhance the learning experience. This experiment will certainly inspire our undergraduate students, stimulate their curiosity and deliver a valuable insight into UCL research."

Dr Phil Jones,Co-Head of Biophysics Research Group

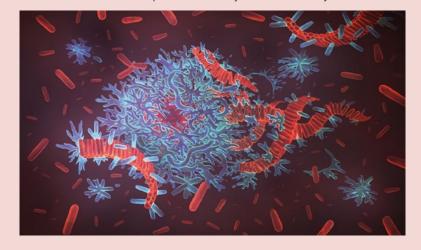
Antibiotic bullets created from breast milk

According to the Saturday morning front page of the Times, researchers had found a "new drug to wipe out superbugs", but in its infinite wisdom, the Daily Mail showed a bit more moderation: "Scientists hope protein can help in fight against disease". More specifically, Bart Hoogenboom's group (BioP and LCN) collaborated with the National Physical Laboratory to create and characterise new antimicrobial capsules. These capsules are based on a protein in breast milk that helps to protect infants against infection. They demonstrated that the capsules killed bacteria but left human cells unaffected, and next visualised the capsules as they landed on bacterial model membranes, acted as projectiles sinking into the membrane and leaving a bullet hole as a result. Such capsules can serve as vehicles for drug delivery in the body, while at the same time suppressing bacterial infections that otherwise may complicate the treatment. These results have been published in the journal Chemical Science.



Understanding the self-replication of protein fibrils

In the brains of patients with Alzheimer's disease, proteins form fibrils that intertwine and entangle with each other to form plaques. The so-called amyloid fibrils initially form very slowly, on the time scale of decades, but once the first fibrils are formed, they greatly accelerate their own replication with disastrous consequences for the brain. The physical principles of this process have been revealed by Anđela Šarić, a recently appointed BioP member and fellow of the UCL Institute for the Physics of Living Systems (IPLS), working with collaborators at Cambridge University. Using a combination of computational simulations and biophysical experiments, they showed that the seemingly complicated process of the fibril self-replication is governed by the deposition of healthy proteins onto the surface of existing fibrils. By controlling this deposition, one may restrain fibril growth and — in physiological context — its impact on the brain. This work has been published in the journal Nature Physics.



Observatory News

Research in teaching

Juno - The 'lo-spot' project

To coincide with NASA's JUNO spacecraftorbiter mission to study Jupiter's aurora and magnetosphere, UCLO and the Astrophysics Group (Nick Achilleos) have joined forces to support this mission by making targeted observations of the Jovian satellite, lo. The volcanic moon of Jupiter, spews sulphuric gases that are captured by Jupiter's magnetic field to form a rotating torus of plasma. Our first images of the torus have been obtained by Steve Fossey and undergraduate student Roman Gerasimov, using one of UCLO's Celestron 14-inch telescopes, equipped with a narrow-band (5nm) filter to isolate emission lines from ionised sulphur atoms and a mask to block out the bright image of Jupiter itself. The aim is to monitor regularly the conditions in the lo torus to provide context for in-situ JUNO observations of Jupiter's environment and aurorae. This work will be continued in 2017 by improving the focal-plane mask and routine monitoring of the torus brightness.

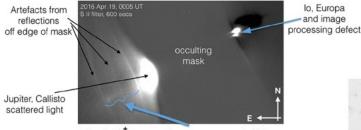
Teaching activities at the UCL Observatory have always been conducted with one eye on providing the necessary skills which astronomers (both theoretical and observational) require and the other eye on astronomy topics which are at the forefront of research. This has historically been the case, from the days when the Mill Hill telescopes were one step behind some of the best available telescopes in the field, up to the present day - where our modest apertures (up to 60cm) and London location do not prevent students and staff from making authentic scientific discoveries [1,2] in the recent years; and contributions to ongoing scientific international programmes (see below). It is in this spirit that the UCL Observatory is capitalizing on the generous donations made in the last decade to improve its facilities and invest in the acquisition of a new, larger (80cm) telescope and the modernization of some of its units (see next page).

lo, Europa

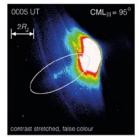
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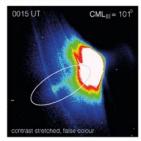
Gaia - Microlensing by a binary system

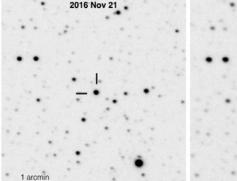
The ESA satellite Gaia is in the middle of a 5-year programme to obtain the most detailed ever census of stars in our Milky Way galaxy. As it scans the sky, Gaia also alerts ground-based observers to any star which shows anomalous behaviour and sudden variations in brightness. One recent alert has been observed since summer 2016 by many astronomers around the world, including Steve Fossey and undergraduate students, who began monitoring its changing brightness. This source turned out to be a microlensing event: an increase in the light observed from a star caused by a foreground body (a fainter binary star) acting as a gravitational magnifying lens. Observations made by students as part of their 3rd-yr undergraduate classes contribute to a light curve which will help improve models of the unusual system including critical photometry obtained by Paula Soares and Hamish Caines at the peak of one particular 'spike' in brightness. Our robotic-telescope systems also ensure that we are able to respond effectively to such events, and we will continue to monitor other Gaia alerts highlighted by the mission over the next few years.

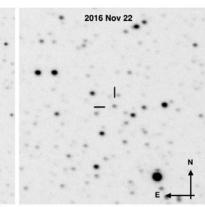


The lo S[†] torus: dawn ansa and ribbon











Recent upgrades

A new Allen building dome and the New telescope

Recent works conducted by Estates and closely supervised by Mick Pearson have been completed over the summer to replace the Allen building dome (right) and modernize the Radcliffe telescope dome so that they can both be operated safely under software control, allowing easy operation for both staff and students.

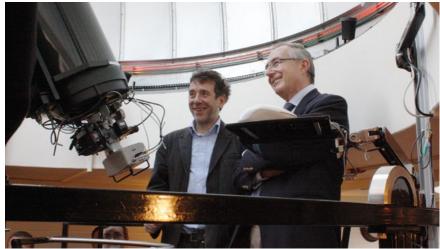
The larger aperture of the new Allen dome will allow the potential installation of the new telescope (80cm) planned for 2018 which should be in service in its first academic year in 2018–19. This will replace the current Allen telescope, originally designed for five year operation and which has been with us now for its 42nd year!

UCLO – Robo 2: double the capacity of remote observation

During the works for the Allen dome replacement Thomas Schlichter focused on the upgrade of the second C14 telescope (the 'East' unit seen on the right during a visit of the Provost after the Dome upgrade) to become fully equipped for robotic and remote operation (as is already the case of the C14 West).

Extensive electrical works have been conducted and we are now close to including this second unit to the web interface that allows observatory staff and students to plan and request observations to be conducted by those telescopes at the first instance of favourable weather (as is the model at modern ground-based research observatories).





A Preview

What are we planning for the next few years (in a nutshell)

A new 80cm primary telescope will be installed in the next two years

Potential access to remote robotic telescope: (one in Spain and one in Australia)

Re-imaging extension to add a coronograph to one of the robotic telescope

Follow up of new microlensing events and transient sources

^[1] https://arxiv.org/abs/0902.4616

^[2] https://www.ucl.ac.uk/mathematical-physical-sciences/news-events/maps-news-publication/maps1405



Academic Showcase

Staff News

Promotions

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

Promotion to Professor

Professor Bart Hoogenboom (CMMP)Professor of Biophysics

Professor Ryan Nichol (HEP)
Professor of Physics

Promotion to Reader

Dr Chamkaur Ghag (HEP)Reader in Physics

Dr Sergey Yurchenko (AMOPP)Reader in Physics

Dr Mark Buitelaar (CMMP)Reader in Nanoelectronics

Retirements

Professor Steven Miller

December 2016 saw the retirement of Steve who joined the Department of Physics and Astronomy as a Graduate Programmer in the Atomic and Molecular Physics Group, working for Jonathan Tennyson, on October 1st 1986. Steve was a founder member of the Department of Science and Technology Studies (STS), established in 1993 when a science communication team was added to the existing Department of History and Philosophy of Science. Steve progressed to become the Head of Department in STS, from 2002 until 2011. In the Department of Physics and Astronomy, Steve was responsible for developing and delivering the Science Communication programme offered to all students.



"I am not intending to disappear off the face of the academic Earth. I will be involved with RAS, astronomical observing, outreach and engagement and various other projects for the foreseeable future. My view is that my credibility would be very much enhanced by being able to cite a UCL affiliation, and I hope my activities would continue to reflect well on the University."

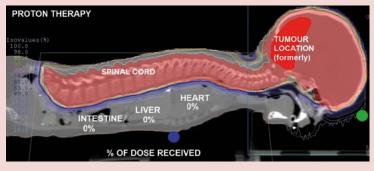
Headline Research

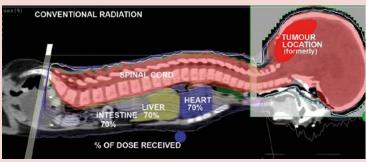
Detector Development for Proton Beam Therapy

Proton beam therapy (PBT) is an advanced form of radiotherapy that provides significantly improved cancer treatment over conventional photon radiotherapy. Due to the way protons interact with matter the dose delivered to the patient can be precisely tuned thus minimising energy deposition to healthy tissue surrounding the tumour. This is especially important for the treatment of deep-lying tumours in the head, neck and central nervous system, especially for children, who are particularly susceptible to long-term radiation damage.

To deliver such a precision treatment the proton energy (or more precisely its range in the human tissue) must be known with a sub-percent precision, which is very challenging. The UCL HEP group has been involved in developing such a detector. The design of the detector is based on a very fast plastic scintillator calorimeter that was originally developed for the SuperNEMO neutrino experiment.

The group carried out a few measurements at the UK 's currently only PBT facility at the Clatterbridge Cancer Centre near Liverpool and obtained the necessary <1% resolution required for the quality control of the beam. The main challenge now is to maintain this performance under realistic clinical conditions. It is envisaged that the UCL-developed detector will be used in many PBT facilities in the world including a new centre currently being built at UCLH that will be ready to host first patients in 2020.





The irradiation treatment plan with protons (top) and conventional X-ray radiotherapy (bottom). The two pictures illustrate the advantages of proton radiotherapy with much lower doses delivered to critically important healthy tissues.

Courtesy of the Prague Proton Beam Therapy Centre.

Pictures from www.proton-cancer-treatment.com/media/press-releases/proton-treatment-plan-for-ashya-is-ready/

Portrait of...

Derek Thomas



Derek has been at UCL for nearly 38 years, starting as a Junior Technician his role has progressed to Laboratory Superintendent, and Laboratory 1 Technician. This role involves liaising with the Director of Laboratories and other staff members who are involved in the organisation of the programme to provide the structure for the work in the laboratories. Derek also advises on the resources available for 3rd and 4th year students during projects undertaken, and preparing the laboratory for Events due to be undertaken throughout the summer months. Derek, together with the team deliver a first class and professional service to students, staff and visitors who use the laboratory facilities.

Some future project in the laboratories are: the Filmmakers Society; Work Experience and A level Students undertaking practical experiments; Undergraduate Preparatory Certificate Science Engineering (UPCSE) practical Courses; Purchasing new equipment and experiments for all 3 laboratories. Also the optics experiment for the Quantum CDT experiment, undertaken in Laboratory 2 for 3 weeks in May.

At UCL a highlight of Derek's achievements has been to participate in the preparation of solid thin films by the

technique of Vacuum Evaporation where he has enjoyed developing mirrors. In his spare time Derek raises money for different charities by participating in bike rides throughout England. He is also an Animal lover and has been a member of the RSPCA since 1985 and participates in raising money for the Society.

Derek enjoys his work and helping and assisting students, staff and others in order for an objective to be achieved which makes it the more rewarding.

Derek's advice is to listen to those who have experienced life. They have seen it, done it and lived it.

"I have made many friends whilst working at UCL, some of whom have become close friends. The people, the challenges and task, makes every day a changing day at UCL."

John O' Brien, Physics and Astronomy Superintendent of Laboratories from April 1992 until May 2013 writes:

Derek Thomas arrived at UCL in 1979 to begin his career in the Physics and Astronomy department first, as a trainee/apprentice technician then as the lab 1 technician before becoming the Superintendent of Laboratories.

Derek spent his first year in the teaching laboratories where he learnt the use of the equipment and the practicalities of physics teaching experimentation. He then spent a year in the P&A workshop, which was then located in the Physics Building basement, where he was instructed in the necessary skills needed to manufacture the kit used in the teaching labs (also research labs) and the importance of accuracy when doing so.

Come 1982 Derek moved, as part of his training, to the Electrical Engineering department where for two years he worked in the electronics division.

Then, in 1984, the position of lab 1 technician became open; Derek applied and got the job working under the then superintendent, John Atkinson.

During his tenure; lab 1 has been used for a number of different events such as the annual Women in Physics conference aimed at 5th/6th year school students to attract them to a career in science. The students attended a lab class so as to put their skills to the test by conducting the first year experiments. In all cases Derek liaised with the organisers of the events and set out the lab accordingly and was then on hand in case of problems.

In 1992 there was a change in the teaching labs with the introduction of stand-alone computers replacing the cluster of 'dumb' terminals which was then present in the labs. These new machines stood in clusters of four and sharing a printer (twelve computers per lab). This meant new skills for Derek to learn in their use and maintenance. These computers were cutting edge 386 DX's using DOS and windows 3.3 Phew!

As we moved through the nineties and into the 2000's the teaching labs were moving towards the most dramatic change seen in many years and that, of course, was the refurbishment of all three teaching labs with Lab 1 being the first to be modernised. Derek, now the deputy superintendent/estate liaison officer, was heavily involved with the planning process meeting with architects, planners and builders to discuss and put forward ideas as to what we needed.

Derek is now the Superintendent of Laboratories, still 'running' Lab 1 and is the department's Radiation Safety Officer and is using the experience gained from 38 years at UCL to excellent effect.

In Memoriam

Professor F. W. Bullock (24 April 1932 – 2 May 2017)



The High Energy Particle Physics group reports the death of **Fred Bullock** with great sadness.

A UCL man through and through, Fred came to the Physics Department as an undergraduate in 1950. After graduation in 1953 his research career started in the early days of the Bubble Chamber Group which focused on such chambers filled with heavy liquids such as propane and freon. This culminated in the design of the 1.4 m heavy liquid chamber which was installed at the Rutherford Laboratory. This chamber was exposed to particle beams produced by the 7Gev Nimrod synchrotron and photographs of beam particles interacting with the heavy nuclei in the liquid were analyzed in laboratories in the UK and Europe.

By the mid 1960's Fred became involved with the group's plans to join a French led European collaboration which aimed to expose the large 4m long Gargamelle heavy liquid chamber to the CERN neutrino beam. He led the effort at UCL to install the three large Gargamelle scanning tables and to establish the scanning and data acquisition teams. Such was his success that at the first data

collection meeting at CERN it was clear that UCL had the cleanest and most reliable data set in the collaboration. His calm leadership, both managerial and scientific inspired great loyalty among the scanners, the computer staff and the academics which remained right up to his retirement.

The Gargamelle experiment was to make the famous discovery in 1973 of the Weak Neutral Current– the effect of the Z0 particle, for which the collaboration was to receive the prestigious 2009 EPS prize 36 years later. This extraordinary experiment also went a long way to establish that the proton has a quark-gluon substructure.

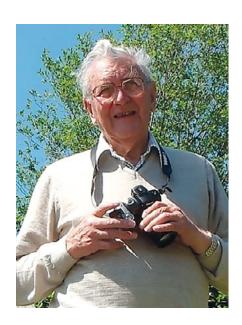
By the late 1980's the Bubble Chamber era was coming to an end and Fred led the way to the DESY electron proton collider where the proton substructure could be studied in a vastly greater kinematic range. And towards the end of his career he was one of the group members who led the way to the ATLAS collaboration at CERN where the exciting new generation of group members were to contribute to the discovery of the Higgs Boson.

As a diligent and committed university teacher Fred devoted his efforts predominantly to courses on optics and for many years he chaired the Departmental Teaching Committee with calmness and wisdom. Towards the end of his career he became a noted Vice-Provost and is remembered above all for stressing the importance of undergraduate teaching at an institution which then prized its research qualities above all else.

Those of us privileged to have known Fred Bullock will not forget his qualities of leadership, integrity, probity, friendship, loyalty and above all his calmness and quiet authority.

Tegid Wyn Jones

Professor T. C. Griffith (8 July 1925 – 26 March 2016)



It is with much sadness that we share the news that **Professor Ceiri Griffith** passed away on the 26th March 2016.

Following a PhD at the University of Wales, Aberstwyth (1948), his early career began as a nuclear physicist at UCL.

At the suggestion of Sir Harrie Massey, Ceiri established at UCL what has been referred to as "the cradle of positron physics" discovering, with his colleague George Heyland and their team in the early 1970s, the first efficient positron moderator, developing the first monoenergetic positron beam and performing the first accurate measurements of total scattering cross sections for positrons. His enthusiasm, balanced by his calm and rigorous approach, was infectious, and crucial to the many key contributions that he and members of his team have made to the subject. His legacy to physics remains very much alive at UCL and around the world.

Staff Accolades

Corday-Morgan Prize

Awarded to Professor Angelos Michaelides

For the most meritorious contributions to chemistry. In particular, the prize acknowledges his work on the development of computational methods and applications that have significantly advanced understanding of several important chemical systems. Professor Michaelides' work crosses both chemistry and physics by using computer simulations to better understand the elementary processes occurring at interfaces. Amongst other things, his group is currently researching a fundamental, molecular-level description of water at interfaces and how ice forms, which will have broad implications from an improved understanding of the climate to better tasting ice cream.

EPSRC Doctoral Prize

Awarded to Dr Ying Lia Li

Dr. Ying Lia Li has been awarded an EPSRC Doctoral Fellowship. She will be the second person in Physics & Astronomy to get an award since 2014.

Fellowship of the American Physical Society

Awarded to Professor Angelos Michaelides and Professor Hiranya Peiri

Professor Michaelides' appointment was based upon the recommendation of the Division of Computational Physics, for his "fundamental contributions to computational simulations of solids and surfaces, particularly adsorption problems, most notably water-solid interfaces."

Professor Peiris was appointed APS Fellow upon the recommendation of the Division of Astrophysics, for "significant contributions to the Wilkinson Microwave Anisotropy Probe project, Planck analyses, and the application of advanced statistical techniques to a wide range of astronomical data."

Hans-Fischer Fellowship by the Institute of Advanced Studies, Technical University Munich (TUM)

Awarded to Professor Jochen Blumberger

The Fellowship, named after TUM Professor and Nobel Prize Winner Hans Fischer, is given to 'outstanding international scientists who intend to explore innovative, high-risk topics together with a TUM Research group.'

Humboldt Fellowship

Awarded to Dr Ji Chen

To support his future research with Professor A. Alavi's group at Max Planck Institute in Stuttgart.

Maxwell Medal and prize of the Institute of Physics

Awarded to Dr Alexandra Olaya-Castro

For her contributions to the theory of quantum effects in biomolecular systems – in particular, to the understanding of exciton-vibration interactions and the emergence of nontrivial quantum behaviour in photosynthetic complexes.

Nano-Micro Letters Researchers Award

Awarded to Professor Angelos Michaelides

This is a prize from the journal Nano-Micro letters to recognize research excellence in the field of nano and micro science.

Royal Microscopical Society Medal

Awarded to Professor Bart Hoogenboom

A new series of Medals was launched by Royal Microscopical Society in 2014 to coincide with its 175th anniversary. The series is designed to recognise and celebrate individuals who make outstanding contributions to the field of microscopy across both the life and physical sciences. Dr Bart Hoogenboom (UCL Physics & Astronomy and London Centre for Nanotechnology) has been awarded the RMS Medal for Scanning Probe Microscopy – for outstanding progress made in the field of scanning probe microscopy.

Royal Society Fowler Award

The Fowler Award for Astronomy awarded to Dr Andrew Pontzen

Andrew Pontzen is an exceptionally creative theorist. He has done important work in a number of different areas spanning the range from theoretical work on anisotropic cosmologies, numerical simulations of galaxy formation, through to the dynamics of dark matter halos. His work on the effects of supernovae feedback in flattening the inner density profiles of dwarf galaxies offers a solution to a long-standing problem of the Cold Dark Matter model. In recognition of his unusual combination of analytic ability, computational skills and originality, Andrew Pontzen receives the Fowler Award of the Royal Astronomical Society.

Fellowship of the Royal Society

Awarded to Professor Jennifer Thomas

Jenny Thomas is known for her pioneering work in high-energy particle physics. In particular, Jenny has made major contributions to the study of neutrinos. She is a leader in the development and analysis of neutrino oscillation measurements. Since 2010 she has led the international MINOS collaboration at Fermilab, near Chicago. She has extended the scope of this experiment to search for sterile neutrinos over a world leading range.

She has played a leading role in detector development, pushing novel applications of and innovations in tracking detectors and very recently a system to apply mobile technology to photon detector readout.

STFC Science Board

Professor Ofer Lahav has been appointed to the STFC Science Board. The Science Board provides the STFC with a strategic scientific overview and advice on all of the programmes STFC supports.

Ofer Lahav is Perren Chair of Astronomy at University College London (UCL). His research area is observational Cosmology, in particular probing and characterising Dark Matter and Dark Energy. His works involves advanced statistical methods.

Headline Research

Professor Lahav leads the UK consortium of the Dark Energy Survey (DES), and for many years he co-chaired the international DES Science Committee. He also holds leadership roles in the next-generation projects, e.g. Dark Energy Spectroscopic Instrument (DESI) and Large Synoptic Survey Telescope (LSST). He is the Principal Investigator of a European Research Council (ERC) Advanced Grant on 'Testing the Dark Energy Paradigm'.

UCL Physics & Astronomy Teaching Prize

Awarded to Professor Raman Prinja

The Physics & Astronomy Departmental Teaching Prize for 2015-2016 has been awarded to Professor Raman Prinja. In his role as Chair of the Teaching Committee over the past 5 years he has worked tirelessly to bring the delivery of our teaching programmes up to a level that both students and staff could be proud of. He has instilled a professionalism into our practices that gives our teaching the importance that it deserves. His initiatives, such as the use of Teaching Fellows in the labs, have successfully matched resources with needs to give students a much better experience and allow all staff to focus on the tasks at hand. He has represented the Department on many College committees, carrying our flag high.

Professor Prinja's practices what he preaches, as he is one of our teaching stars: his teaching on our first-year module 'Atoms, Stars and the Universe' has been very well received by all students and probably warrants an award by itself. He also continues to help steer our course in the Natural Sciences interdisciplinary programme. And his teaching is not bounded by UCL's walls, as he is also an award-winning author of popular science books for all ages.

Now that he has stepped down from the role of DTC Chair, it would be appropriate that he be presented with this award in acknowledgement of his many contributions, past and ongoing, to teaching in the Department. No one is as deserving.

Dr Stan Zochowski Physics Programme Tutor

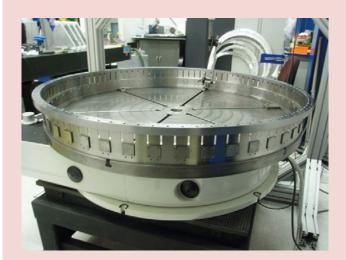


Dark Energy Spectroscopic Instrument enters construction phase

The Dark Energy Spectroscopic Instrument (DESI) has now been approved by the US Department of Energy to move forward to the construction phase.

DESI is a 3-D sky mapping project and it will measure spectra of 35 million galaxies to provide new clues about Dark Energy. Observations at the Mayall 4-meter telescope in Arizona will be starting in 2019.

UCL is one of the founding institutions of DESI, and part of the UK consortium within DESI that received funding from STFC towards this project. The optical corrector, a system of 6 large lenses, is being assembled at UCL. This is based on UCL's experience with an earlier project, the Dark Energy Survey (DES), which is now in full operation. Peter Doel and David Brooks lead the instrumentation work at UCL. Filipe Abdalla, Jay Farihi, Andreu Font-Ribera, Ofer Lahav (DESI:UCL representative), Hiranya Peiris, Andrew Pontzen and Amelie Saintonge, together with their PhD students and post-docs, have been working on the science preparations of the project.



A cell which will hold one of the DESI lenses (about 1 meter across), assembled at UCL's Optical Science Laboratory.

Research Degrees

December 2015 - December 2016

Gioacchino Accurso

Measuring molecular gas in galaxies with applications to star formation efficiency (Dr A. Saintonge)

Ahmed F. Al-Rafaie

Efficient production of hot molecular line lists (*Prof J. Tennyson*)

Nicola Baccichet

Study of payload technologies for future far-infrared space-based interferometers (Dr G. Savini)

Emma J. Barton

Hot molecular line lists for extrasolar planets and industry (*Prof J. Tennyson*)

Francesco Bausi

Innovative solutions and applications for polymer light-emitting diodes (*Prof F. Cacialli*)

Aizhan Bestembayeva

Biophysical properties of the transport barrier in the nuclear pore complex (Prof B. W Hoogenboom)

Antonia M. Bevan

Dust-affected models of characteristic line emission in supernovae (*Prof M. Barlow*)

Jonathan Bloxsom

Thermal and magnetic studies of spin ice compounds (*Prof S. T. Bramwell*)

Peter R. Davison

Probing bb production with the ATLAS detector at the LHC (Dr G. G. Hesketh)

Kirsty Dunnett

Non-equilibrium phase transition to the polariton OPO regime (Dr M. H. Szymanska)

Rebecca J. Falla

Search for Higgs boson pair production in the bbbb final state at the Large Hadron Collider (*Prof N. Konstantinidis*)

Samuel Fayer

Interactions of positrons and positronium (*Prof G. Laricchia*)

David P. W. Freeborn

Measurement of vector boson pair production using hadronic decays of high transverse momentum W and Z bosons at the ATLAS detector (Dr M. Campanelli)

Christopher R. Fury

Acousto-optical trapping and manipulation of microbubbles (Dr P. H. Jones)

Maire N. Gorman

Calculation of linelists for chromium hydride and manganese hydride (Dr S. Yurchenko)

Gregor M. Hannappel

The role of fluctuations near antiferromagnetic and spin-triplet nematic quantum critical points (Dr A. G. Green)

James A. Holloway

Generating brilliant X-ray pulses from particle-driven plasma wakefields (Prof M. Wing)

Ludovica Intilla

Study of ZnO properties applied to thin film transistors (*Prof F. Cacialli*)

Hilal Küçük

Measurement of the inclusive-jet cross-section in proton-proton collisions and study of Quark-Gluon jet discrimination at 8 TeV centre-of-mass with ATLAS experiment at the LHC (Prof M. Wing)

George Kelly

Molecular emission in active centres of nearby galaxies (*Prof S. Viti*)

Patrick Lancuba

Rydberg-Stark deceleration and trapping of helium atoms above electrical transmission-lines (Dr S. Hogan)

Ying Lia Li

Cooling and sensing using whispering gallery mode resonators (*Prof P. Barker*)

Laura Manenti

Liquid argon time projection chambers for dark matter and neutrino experiments (Dr C. Ghag)

Jose Martinez Castro

Atomically thin stacks of polar insulators: a route to atomic-scale multiferroics (Dr C. F. Hirjibehedin)

Gianluca Messina

An investigation into the magnetic properties of low dimensional 3d magnets (*Prof N. T. Skipper*)

Mukaddes M.Metbulut

Bichromatic state-independent trapping of Caesium atoms (*Prof F. Renzoni*)

Giuseppe Morello

A machine learning approach to exoplanet spectroscopy (Prof I. D. Howarth)

Joseph O'Connor

Three-flavour neutrino oscillations in MINOS+ (*Prof J. A. Thomas*)

Patrick Owen

Herschel studies of core collapse supernova remnants at infrared wavelengths (*Prof M. Barlow*)

Radhika Patel

In Situ studies of clay hydration for the enhanced exploration of oil and gas (Prof N. T. Skipper)

Andrei T. Patrascu

The universal coefficient theorem and quantum field theory (Prof J. Tennyson)

Christopher D. Perry

Conclusive exclusion of quantum states and aspects of thermo-majorization (*Prof J. Oppenheim*)

Nathan M. Pilkington

The impact of interior plasma dynamics on the shape and size of Saturn's magnetosphere (Dr N. A. Achilleos)

Kian A. Rahnejat

Capturing complex reaction pathways step by step: organic molecules on the Si(001) surface (Dr S. R. Schofield)

Amy Ronksley

Optical remote sensing of mesoscale thermospheric dynamics above Svalbard and Kiruna (Dr A. L. Aruliah)

Sally Shaw

Dark matter searches with the LUX and LZ experiments (Dr C. Ghag)

Michael R. Shipman

Production of positronium and its scattering by atoms and molecules (*Prof G. Laricchia*)

Richard C. A. Tunnard

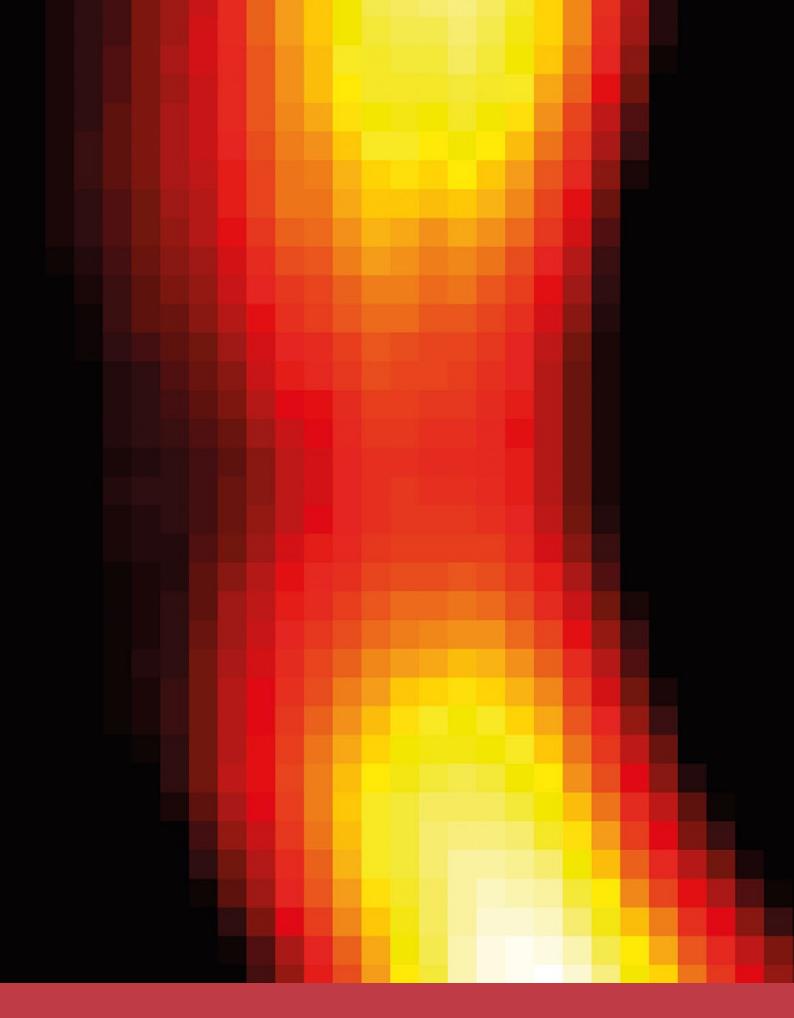
Characterising the dense molecular gas in exceptional local galaxies (Dr T. Greve)

Ryan J. Varley

Exoplanet spectroscopy with current and future instruments (Dr G. Tinetti)

Hsing Wu

Robotic processes to accelerate large optics fabrication (Dr D. Walker)



Research Spotlight

Astrophysics

Astrophysics is a very broad church, having emerged over the last century largely from the observation and analysis of those objects that could be studied with astronomical telescopes – pretty much everything in the universe. In the 21st century, it has developed and diversified into a range of specialised themes ranging from planetary science to cosmology. It is a feature of UCL's thriving astrophysics group that it encompasses investigations into an exceptionally broad array of these topics: planets, both in our own solar system and around the distant stars; the stars, gas, and dust that make up galaxies, along with the mysterious dark matter whose gravity helps bind them together; the structure, distribution, and evolution of those galaxies; and cosmology, the study of the birth and development of the entire universe.

Astrophysics starts close to home, and the group's Atmospheric Physics Lab has been operating a network of Fabry-Perot interferometers in Svalbard for over 35 years. Measurements of airglow and auroral activity with these instruments are used together with radar, magnetometer, and satellite observations to monitor and study 'space weather' near the north pole, where the solar wind is able to penetrate the Earth's atmosphere. Observations have to be made during the long hours of winter darkness; the Svalbard night is continuous from the beginning of November to the end of January, and temperatures can be as low as -40 celsius. Figure 1 shows the

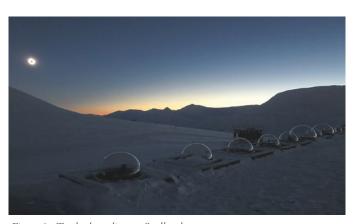


Figure 1. Total solar eclipse at Svalbard Credit: Drs Noora Partamies/Anasuay Aruliah

domes of the Kjell Henriksen Observatory, where our equipment is housed, taken at the 2015 total solar eclipse; the solar corona, normally invisible but glowing white in this image, is the base of the outflowing solar wind. This wind interacts not only with the Earth's magnetosphere, but also those of the other planets. Using data from spacecraft such as Galileo and Cassini (visitors to the Jovian and Saturnian systems, respectively), UCL scientists have studied these interactions in great detail, and a surprising discovery, uncovered by recent PhD graduate Nathan Pilkington, is that the size of Saturn's magnetosphere is controlled not only by the solar wind, but also by the pressure exerted by an 'internal' energetic-particle population (Fig. 2).

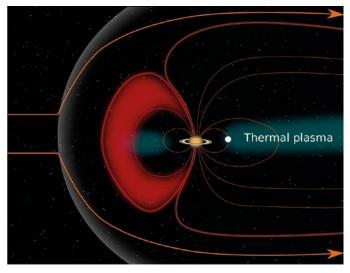


Figure 2. High-energy particles (shaded red), together with the solar wind (orange lines), sculpt Saturn's magnetic field (red lines).

Credit: Drs Nathan Pilkington/Nicholas Achilleos.

"Studies of planets around the distant stars – so-called exoplanets – are disclosing exciting new results."

Studies of planets around the distant stars – so-called exoplanets – are also disclosing exciting new results. The observations are extremely challenging, but researchers in the astrophysics group have developed two techniques for studying chemical and physical conditions in these remote bodies. The first is the analysis of starlight that passes through the atmosphere of a planet as it transits across the face of its parent star. This transmitted light encodes information on the characteristics of the atmosphere (just the colours of the Earth's sky encode information on our atmosphere). Using



Figure 3. The hot 'super-Earth' 55 Cnc e. Credit: NASA/ESA Hubble Space Telescope

sophisticated new processing techniques on data from the Hubble Space Telescope, PhD student Angelos Tsiaras and UCL colleagues have been able to study the atmosphere 55 Cnc e, a `super-Earth' more than twice the diameter and eight times the mass of our own planet, in unprecedented detail – the first time such an analysis has been possible. Although the planet orbits very close to its sun (in less time than it takes the Earth to rotate on its axis), and is consequently extremely hot (Fig. 3), the atmosphere still retains unexpectedly large amounts of the light elements hydrogen and helium.

Further evidence for rocky planets comes from observations of debris 'polluting' the atmospheres of white-dwarf stars (the descendants of stars like our own Sun). An asteroid-like body only a few kilometres in diameter can leave detectable traces if it falls

into this type of host star. Astronomer Jay Farihi studies these rare events to gain a better understanding of how rocky planets form, and he has recently discovered the remains of just such a shattered asteroid in a double-star system called SDSS 1557 (Fig. 4). This first clear evidence of the processes of rocky-planet assembly in a binary-star system is especially important because isolated stars. like our own Sun, are in a minority.



Figure 4. Artist's impression of rocky worlds in the SDSS 1557 binary-star system. Credit: Mark Garlick, UCL, University of Warwick, University of Sheffield.

"Although stars like the Sun will end their lives in a sedate manner, as slowly cooling white dwarfs, those that are born with masses greater than about eight solar masses are destined to die explosively, as supernovae."

Although stars like the Sun will end their lives in a sedate manner, as slowly cooling white dwarfs, those that are born with masses greater than about eight solar masses are destined to die explosively, as supernovae. Supernovae play a crucial role in galactic ecology; they are believed to be the source of all the heavier elements (and many of the lighter ones) that exist in the universe, including those that make up the Earth and all things on it. It has long been suspected that these massive stars may be important as efficient dust producers, potentially accounting for most of the dust production in the early Universe, but compelling observational evidence has been elusive. A new study, led by research fellow Ilse De Looze and utilizing observations from the Spitzer and Herschel satellites, has investigated the dust present in the supernova remnant Cas A (Fig. 5). They showed that the remnant contains dust with a total mass around half that of the Sun, about twice as much as previously known, supporting the scenario of supernova-dominated dust production in the early universe.

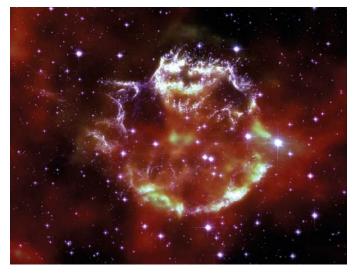


Figure 5. The Cas A supernova remnant, home to glowing dust (shown in green in this false-colour image). Credit: Dr. Ilse De Looze

The very earliest signal from the early universe that we can now observe directly is the Cosmic Microwave Background (CMB), remnant light from the Big Bang, created when the universe was around 0.003% of its present age. The CMB contains important clues to the formation and evolution of the universe, and postgraduate student Daniella Saadeh has performed detailed modelling to explore the possibility that it provides evidence of some large-scale distortion; for example, if space has different properties in different directions, this could be detectable as hot or cold spots, or even spiral patterns. Previous studies had considered the possibility that the whole universe might be rotating, but this new research examined the widest possible range of geometries (Fig. 6). The conclusion is that the universe is highly symmetrical – a reassuring outcome for cosmologists.

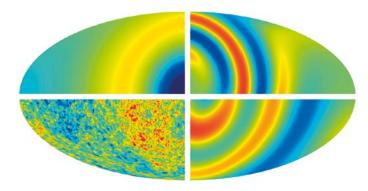


Figure 6. A projection of the entire sky showing the Cosmic Microwave Background. The bottom-left quadrant shows observations (from the Plank satellite); other panels show trials models for different spatial distortions. Red (blue) shows relatively hot (cool) regions. Credit: Dr. Daniella Saadeh.

The foregoing notes mention no more than a brief selection of the observational, modelling, and theoretical studies reported by UCL scientists in 2016, chosen to illustrate the wide scope of research conducted under the aegis of the astrophysics group. With exploitation of new facilities such as ALMA, the Atacama Large Millimeter Array; ongoing projects like the Dark Energy Survey, and involvement in the forthcoming Twinkle mission and the Dark Energy Spectroscopic Instrument (both described elsewhere in this Report), the next few years should be even more exciting.

Atomic, Molecular, Optical and Positron Physics (AMOPP)

Project in focus

Exploring the Universe at the energy frontier

Aim

Searching for new particles and interactions by colliding protons at the highest energies ever reached.

Results

The ATLAS experiment at the LHC has published hundreds of scientific articles with detailed studies on the properties of strong and electroweak interactions, and of heavy particles like top quarks, or W and Z bosons, as well on searches for new physics. Its most famous result is arguably the discovery of the Higgs boson, responsible for the mechanism that gives particles a mass, and the study of its properties.

UCL Involvement

The UCL group is active in data analysis (measurement of Standard Model processes, Higgs production, search for new physics), on the trigger system that selects in real time the interesting events to send to the permanent storage, and on the detector upgrade.

In 2016 the AMOPP group consolidated its diverse range of research while also developing new research directions. We welcomed ten new PhD students and eight postdoctoral research associates over the year. Below is a summary of major directions and results of some of the AMOPP research groups over the year.



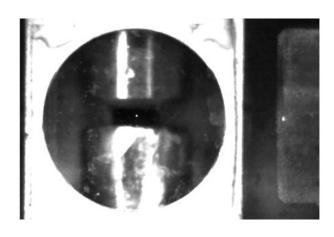
Dr Alexandra Olaya-Castro, who is part of both the AMOPP and biological physics research groups won the prestigious Institute of Physics Maxwell medal and prize for her contributions to the theory of quantum effects in biomolecular systems. This was awarded to her for the understanding of exciton-vibration interactions and the emergence of nontrivial quantum behaviour in photosynthetic complexes.

Dr Dan Browne became the director of the EPSRC Centre for Doctoral Training in Delivering Quantum Technologies. Quantum technologies involve the control and manipulation of quantum states to achieve results not possible with classical matter promising a transformation of measurement, communication and computation. Many of these students become part of the AMOPP group when they begin the research phase of their programme.

A very successful collaboration between the groups of Dr David Cassidy and Dr Stephen Hogan reported on electric field guiding of positronium (Ps) atoms for the first time along electrostatic quadrupole guide. Positronium is an atom consisting of a positron and an electron. This control of the external motion of the Ps atoms is an important step in exploring how gravity affects this hybrid matter-antimatter system. Dr Hogan also received a prestigious ERC Consolidator grant to carry out laboratory studies of collisions and decay processes involving atoms and molecules in highly excited Rydberg states that are present in the upper atmosphere of the Earth.

A few years ago, the Positron and Positronium Collision group discovered that positronium scatters in a manner similar to a bare electron (despite Ps being a neutral atom, twice the electron mass). This year, Prof Laricchia and her group were awarded an EPSRC grant to advance their studies. This includes the realization of a positronium beam that is now tuneable down to energies five times lower than previously obtained, and the development of a new high-resolution positron-beamline. Already, the total cross section of positrons scattering from H₂0 has been measured with a high angular discrimination providing the first direct comparison with ab initio theoretical predictions.

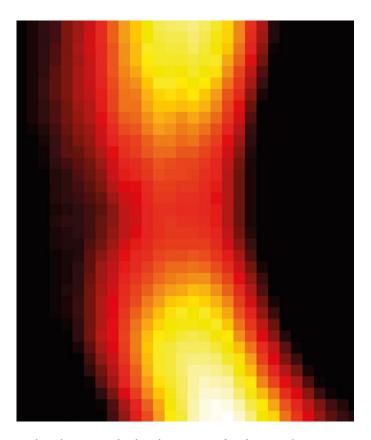
The groups of Professor Tania Montiero and Professor Peter Barker reported on a new, quantum optomechanical system, comprising a nanosphere levitated in a hybrid electro-optical trap. Cooling of the nanosphere by the light inside the optical cavity to sub-milkelvin temperatures was observed. This work is as an important milestone in their research programme as it paves the way for future experiments which aim observe the non-classical, quantum motion of macroscopic objects. Funding for this work was renewed by the EPSRC in 2016 for another 4 years.



Levitated nanosphere cooled to mK temperatures in a hybrid electro-optical trap.

The newest member of the AMOPP group, Dr Isabel Llorente-Garcia, has developed an advanced microscopy platform that combines two-colour light-sheet fluorescence imaging with optical tweezers for single molecule force spectroscopy. This is being used to investigate the molecular interactions relevant to virus entry into living cells in collaboration with Prof. Mark Marsh (UCL MRC Laboratory for Molecular Cell Biology). The group has recently developed the capability of measuring pN-level, bond-rupture forces at the surface of living cells with optical tweezers.

Professor Renzoni's group obtained several important results in different areas, from fundamental theoretical physics to exploiting quantum technologies. His group developed a general framework for the understanding the generation of directed motion in driven systems. They also developed a new technique, based on electromagnetic induction imaging with atomic magnetometers, to perform tomography of the human heart, with specific application in the diagnostic of atrial fibrillation.



High-resolution normalized conductivity map of a sub-mm crack in an Al ring using electromagnetic induction imaging in the Renzoni group.

Dr Marzena Szymanska's theory group, in collaboration with an experimental team led by Dr Daniele Sanvitto (Lecce), have created and explored the dynamics of topological defects such as skyrmions and spin vortices in quantum fluids of light.

They realised the first macroscopically extended equilibrium polariton condensate (published in Physical Review Letters) which has enabled subsequent observation of Berezinskii-Kosterlitz-Thouless (BKT) phase transition in a system of interacting photons.

The third law of thermodynamics has a controversial past and has had formulations by Planck, Einstein, and Nernst. Although formulated in 1912, there has been no general proof of the principle, and the only evidence for it is that particular cooling methods become less efficient as the temperature lowers.

Prof Oppenheim and Dr Masanes have provided the first derivation of a general unattainability principle, which applies to arbitrary cooling processes, even those exploiting the laws of quantum mechanics. Their work helped to clarify the connection between two famous versions of the third law, the Unattainability Principle, and the Heat Theorem.

A team led by Alessio Serafini illustrated the possibility of improving, through continuous monitoring, the empirical discrimination between standard quantum mechanics and variants where the collapse of the wave-functions that describes the act of measuring is generated by a stochastic noise field. This is an endeavour of interest in foundational studies, but might also have technological implications since similar techniques might be applied to sensing devices.

The quantity and behaviour of carbon dioxide in our atmosphere is of the utmost importance as the world tries to cope with the climatic consequences of human activity."

Dr. Agapi Emmanouilidou's group reported on the theoretical formulation and computation of the formation of high Rydberg states and of double ionization in two-electron triatomic molecules driven by intense and ultra-short long-wavelength laser fields. These highly challenging studies were performed with state-of-the-art semi-classical models that are being developed in the group. This is a stepping stone for unravelling the physical mechanisms of electron motion and magnetic field effects on the attosecond time-scale. EPSRC has renewed funding of this work in 2016 for the next three years.

How much light does the carbon dioxide molecule absorb? The quantity and behaviour of carbon dioxide in our atmosphere is of the utmost important as the world tries to cope with the climatic consequences of human activity. Very precise data on the probability of this molecule absorbing light of different wavelengths is needed and traditionally this has been determined experimentally. Jonathan Tennyson and group members have shown that very precise quantum mechanical calculations can be used to provide the best solution to this problem by performing elaborate electronic structure calculations. As a result, the 2016 release of the HITRAN spectroscopic database used for climate models, and much else, has adopted these calculated intensities in preference to the many measurements they had to choose from.

High Energy Physics (HEP)

High Energy Physics (HEP, also known as Particle Physics) is perhaps the most fundamental branch of science as it studies the smallest building blocks of matter and energy and the way these particles interact with each other. It has changed the way we look at the Universe and produced a major impact on other fields of physics, chemistry, biology, medicine and even philosophy.

At the time of writing the UCL HEP group has 46 academic, research and technical staff and 32 PhD students. We are one of the largest particle physics groups in the country with research areas spanning experiment and theory, software development and applications outside academia.

"A large part of the group is involved in the ATLAS experiment at the Large Hadron Collider (LHC) in CERN."

A large part of the group is involved in the ATLAS experiment at the Large Hadron Collider (LHC) in CERN. The larger article in this issue is dedicated to this major activity of the UCL HEP group.

After ATLAS, the largest UCL experimental effort is on the NEMO3/SuperNEMO projects. These experiments located under the Frejus mountain (on the French/Italian border) are dedicated to the search for nuclear double beta decay without emission of neutrinos. This process would demonstrate that the neutrino has a unique property of being its own antiparticle, something that is only possible for neutrinos as the only fundamental neutral fermion. The analysis of data from the NEMO3 experiment, that has now stopped running, is basically complete, and currently a larger and improved follow-up, SuperNEMO, is being built.

Another way to look at neutrino properties is to study neutrino oscillations, the property of these particles to spontaneously change between one type (or "flavour") to another. Since this oscillation takes some time to happen with a measurable probability, and neutrinos being so light travel basically at the speed of light, oscillation experiments have the neutrino detector placed hundreds of kilometres away from the neutrino production point. UCL has had a long-standing involvement in the MINOS experiment on the Fermilab-Minnesota beam line, and a new UCL-lead proposal has been made to build new large neutrino detectors inside water-filled pits along the same beam line.

The group is planning for a future experiment where neutrinos will be sent, still from Fermilab near Chicago, to an old underground mine in South Dakota. Since the planned detectors

in the far site will measure neutrino interactions in huge containers filled with Liquid Argon, a small Liquid Argon setup was built at UCL to study detector properties in this environment, and participation in prototypes being built at CERN is under way.

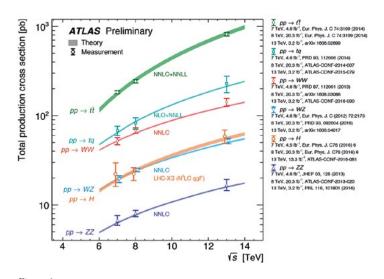
Other group activities include participation to a balloon experiment that recently (January 2017) completed its flight over Antarctica to study cosmic rays, the study of new particle acceleration technologies based on plasma excitations, dark matter searches in underground laboratories, detector development for cancer therapy with proton beams. We are also involved in theoretical and phenomenological studies of strong interactions and in building models that look beyond the successful but certainly incomplete standard model of particle physics.

Even such a long list does not cover all research areas the HEP group is involved in. For more information please follow: www.hep.ucl.ac.uk/research.shtml

ATLAS and LHC

Switching on the most powerful particle accelerator in the world is not a simple business. It was therefore decided to have a staged ramp-up of the accelerator: the LHC was run with a total collision energy of 7 TeV in 2010 and 2011, and of 8 TeV in 2012. This period, called Run 1, was a big success: an enormous amount of measurements, and the discovery of a Higgs-like particle was announced by the ATLAS and CMS collaborations in 2012.

In order to safely raise the beam energy to the design value, some changes were needed to the accelerator. Thousands of resistive



Cross-section for the production of some known processes as a function of the total collision energy of the LHC. The lines represent theory predictions, the points with error bars are the experimental measurements.

connections between the superconducting cables were supplied with superconducting bridges, to prevent any possible warming up resulting in loss of superconductivity. This operation was quite lengthy, so an extended shutdown of the accelerator was performed between spring 2013 and 2015, with data taking resumed at the energy of 13 TeV, very close to the design value of 14 TeV.

Another very important parameter of a particle accelerator is the luminosity, proportional to the number of produced collisions. In 2015, the first year with the new energy, the luminosity collected was relatively small, for a total of about 4.5 fb-1 per experiment (compared to over 20 in 2012), but last year the amount of data collected exceeded all expectations, and an integrated luminosity of over 40 fb-1 was collected per experiment. The LHC has finally reached its design performance.

As usual, the physics goals of the LHC Run 2 are twofold: the measurement of the properties of known particles at new energies, and the search for new phenomena.

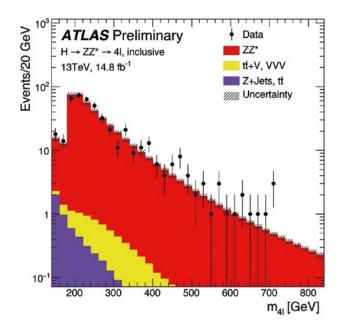
Production probabilities for many particles (including the Higgs boson) have been measured for the new beam energy, and are in very good agreement with the state-of-the-art theory predictions, as shown in figure 1.

Measuring production and decay angles of heavy objects such as W, Z and Higgs bosons and top quarks give important information on their properties and couplings; any deviation from the expected behaviour would be an indirect indication of new physics. Once again a very good agreement with expectations from the Standard Model has been observed, allowing us for instance to demonstrate that the Higgs-like particle observed in 2012 has all properties predicted for the Standard Model Higgs boson. Still, a possibility remains that this particle is only the lightest of a series of Higgs bosons, as predicted by many models of new physics. Searches for higher-mass partners of the Higgs boson, as well as any yet unknown new particle, occupy

the daily work of hundreds of physicists from the LHC experiments, including many from the UCL ATLAS group. The plots in figure 2 show two examples of analyses performed by UCL physicists. The first plot shows the invariant mass distribution of four leptons that are pairwise compatible with being the decay products of two Z bosons. A heavy partner of the Higgs boson would show up in a peak in the invariant mass distribution, on top of the red histogram, that represents the expected background. In a similar way, the second plot shows the invariant mass distribution of two hadronic jets (collimated "sprays" of particles), each being compatible with a decay product of a W boson (using jet substructure techniques developed partly in our group). A new particle (either a heavy Higgs, or a heavy Z boson) would appear as a peak on top of the red line, obtained as a fit to the data. In both cases, even if locally some points are above the predictions, the excess is compatible with the uncertainties, and a sophisticated statistical analysis of the data confirms that no significant excess is present on top of the expected background.

Even if in other search channels some small deviations with respect to the Standard Model have been observed, they are still compatible with being just statistical fluctuations. However, no new physics search so far managed to analyse the whole 2016 data. The first results using the full luminosity will be presented at the 2016/17 winter conferences, and hopes for surprises, or confirmation of the current anomalies, are running high.

In parallel to the analysis of current data, our group is heavily involved in the upgrade of the ATLAS trigger and data acquisition system in view of the High-Luminosity LHC, when the luminosity of the accelerator will be increased by a further factor of 10 with respect to the current performance. In this very busy environment it will be very difficult to select the important collisions from the most common ones, so more information will be needed. The Level-1 track trigger, to which UCL is a major contributor, will improve trigger performance in this very hostile environment.



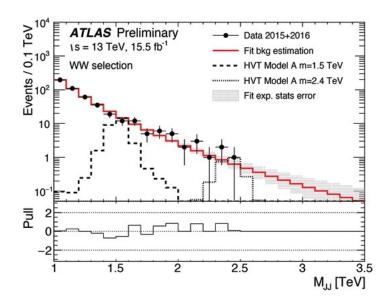


Figure 2
Left: invariant mass distribution of four leptons, pairwise compatible with coming from decays of Z bosons. Right: invariant mass distribution of two jets, each compatible with being a product of hadronic decays of W bosons. In both cases the black points represent data, the background is the red histogram on the left plot, the red line on the right plot.

Condensed Matter and Materials Physics (CMMP)

Every gramme of solid or liquid comprises perhaps a trillion trillion atoms. Such a huge assembly of particles can exist in diverse forms and the particles can move collectively in complex ways. In some cases, these arrangements and motions come as a surprise and go far beyond what might reasonably be anticipated from a study of the microscopic laws of physics. It is said that "more is different" and it is this diversity and mystery – reflecting the complexity of the many-body interaction – that gives condensed matter physics its particular vibrancy as a research field.

From the processes of the earth and of life, to plastic electronics, levitating superconductors and exotic quantum states, the subjects of condensed matter physics research have roots in, and relevance to, many fields of science and technology. All of these are of fundamental interest and potential practical importance: for example, the technology of the computer age is very much built on the rock of understanding and application that condensed matter physics provides.

"...condensed matter physics research have roots in, and relevance to, many fields of science and technology"

The research interests of the CMMP (condensed matter and materials physics) section reflect the diversity of subject matter that is inherent to the field. The section comprises over twenty independent research groups who conduct research in many different areas. The following describe only a few out of many highlights of CMMP research in 2016.

Ice physics

Water is arguably the most important chemical substance, and its solid phase – ice – is a most enigmatic material, of both practical importance and theoretical interest. In terms of conventional pictures, ice lies somewhere between a molecular solid and a protonic semiconductor, but it has always defied any simple classification. The strange properties of ice must be revealed through experiment, theory and advanced numerical simulation. A good example is afforded by the problem of ice formation in clouds – a very subtle process that relies on a extremely dilute concentration of suitable particles, one of which is dust of the mineral feldspar. This year, a combination of quantum mechanical calculations and scanning electron microscopy, involving the CMMP's Angelos Michaelides and his group, has identified exactly how ice starts to crystallise on edges, cracks and depressions in the surface of feldspar crystals. This has given a crucial insight into

the origin of over ninety per cent of the rain, snow and hail that falls over land, and it explains how precipitation might change with differing composition of the atmosphere.



Figure 1
Quantum mechanical calculations and scanning electron microscopy
experiments have revealed the mechanism of how ice crystals form in clouds.

Topology and exotic quasiparticles

Ever since Loenhard Euler solved the problem of the 'Seven Bridges of Königsberg' in 1736, topology has held a deep appeal to mathematicians, yet it is only relatively recently that it has found mainstream applictaions in physics. Pioneers include Weyl and Dirac in the 1920's and 1930's while more recently, the ingenuity of the 2016 Nobel Laureates Kosterlitz, Thouless and Haldane has established the topological basis of condensed matter. This year the CMMP's Des McMorrow and his group have been searching for an elusive and mysterious topological quasiparticle: the Weyl fermion. This is a particle-like state, with a particular 'handedness', that is thought to emerge from the many-body interaction of electrons if the conditions are right. However, no Weyl quasiparticles have yet been observed, possibly reflecting the lack of a suitable substance to host these strange entities. McMorrow and colleagues investigated a class of materials known as pyrochlore iridates that contain the very heavy iridium atom. In these materials the electron spin interacts with its orbital motion to potentially produce the right electronic and magnetic conditions to host the Weyl fermion. Using resonant X-ray scattering techniques, the researchers confirmed that pyrochlore iridates do indeed adopt the required type of magnetic order to host Weyl fermions, and hence they have made it more likely that this elusive quasiparticle will be found in the near future.

Another condensed matter 'host' for strange topological quasiparticles is 'spin ice', discovered in UCL in 1997. In recent years it has become clear that these materials contain atomsize packets of effective magnetic charge, known as magnetic monopoles. This year Steve Bramwell of the CMMP has been involved in broader collaboration that has succeeded in unequivocally demonstrating the Coulomb interaction between

magnetic monopoles in spin ice. This is the first time the Coulomb law has been directly observed in experiment for atom-sized magnetic charges, although Coulomb himself in 1785 showed that the north and south poles of bar magnets interact in the same way. It has taken two and a half centuries to translate this classic experiment from the human scale to the atomic scale.

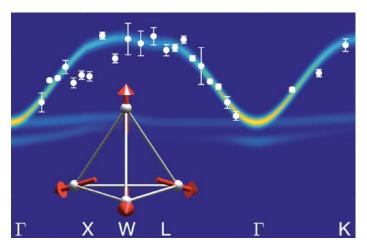


Figure 2
Magnetic excitations in a pyrochlore iridate measured by esonant x-ray scattering.

Negative Capacitance

The number of transistors per computer chip has been doubling roughly every couple of years for several decades, such that today, there are billions of transistors on every chip, all consuming power. There is therefore a need to find more efficient transistors and one approach involves so-called 'negative capacitance'. This year Pavlo Zubko (CMMP) and his colleagues have engineered negative capacitance in crystals that consist of alternating layers of materials with different properties, each only a few nanometers thick. These behave as negative capacitors connected in series and could give rise to transistors that consume less power.

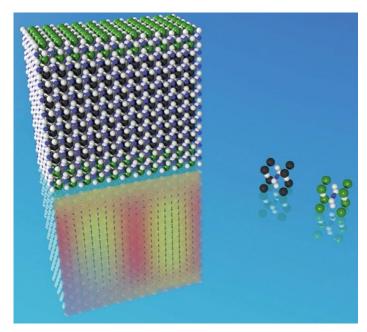


Figure 3

Atomic structure of superlattices that show negative capacitance.

"Two-dimensional materials, such as graphene, are expected to revolutionise technology"

One-atom thick layers

Two-dimensional materials, such as graphene (a form of carbon), are expected to revolutionise technology, but progress has been slowed by the difficult challenge of making and manipulating these materials on an industrial scale. This year Chris Howad (CMMP) and colleagues have revealed a way of producing single layers of many two-dimensional nanomaterials in ways that could be scaled up for industrial application. In particular the group inserted lithium and potassium ions between the layers of different materials including bismuth telluride, molybdenum disulphide and titanium disulphide. Dissolving the resulting substances in selected solvents gave solutions of isolated single atomic layers, which could potentially be used, for example, in electroplating processes. UCL Business has patented this research and will be supporting the commercialisation process.

"...there are billions of transistors on every chip, all consuming power. There is therefore a need to find more efficient transistors"

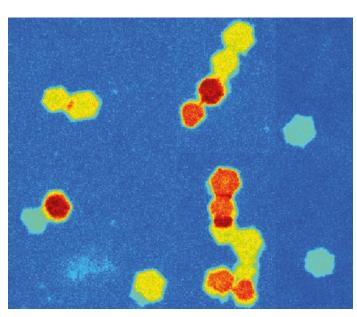


Figure 4
A laser illuminates few-atom thick platelets in solution: a single layer nanosheet is blue, a two layer one is yellow, a three layer one is orange and a four layer one is red.

Biological Physics (BioP)

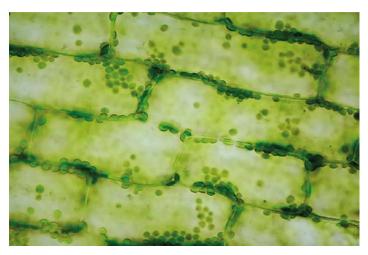
The Biological Physics group focuses on solving key intellectual and practical problems in the physics of biological systems and the underlying properties of soft matter, from molecular to cellular length scales, by using experimental, computational and theoretical methods. It overlaps with the cross-faculty UCL Institute for the Physics of Living Systems (IPLS), which promotes interdisciplinary approaches that combine physics and biology to understand fundamental properties of living systems. Here we provide a brief selection of recent activities and highlights in the BioP group.

Research achievements of BioP Group members have been recognized with several recent prestigious awards

New staff and awards

The BioP group was initiated in 2009 and formally established as a departmental research group in the autumn of 2014. It started by bringing together academics from the Atomic, Molecular, Optical and Positron Physics and the Condensed Matter and Materials Physics groups. Since then, it has grown with two appointments related to the Francis Crick Institute (see also below). In addition, in 2016, we have welcomed two new IPLS fellows, Anđela Šarić and Shiladitya Banerjee, as group leaders in theoretical biological physics.

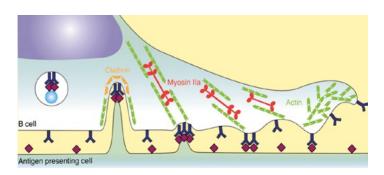
Research achievements of BioP Group members have been recognized with several recent prestigious awards: Bart Hoogenboom was awarded the Scanning Probe Microscopy Medal by the Royal Microscopical Society for his development and application of atomic force microscopy in the life sciences; Alexandra Olaya-Castro was invited to show her work on the quantum secrets of photosynthesis to the general public at the Royal Society Summer Science Exhibition 2016, and was awarded the Maxwell Medal by the Institute of Physics for her contributions to the theory of quantum effects in biomolecular system; and Ewa Paluch (MRC Laboratory for Molecular Cell Biology, affiliate BioP member and director of the IPLS) was awarded the Hooke Medal by the British Society of Cell Biology in recognition of her contributions to cellular biophysics.



Alexandra Olaya-Castro displayed her work on photosynthesis at the Royal Society Summer Science Exhibition.

Physical forces at the Francis Crick Institute

Over the course of 2016, researchers from the MRC National Institute for Medical Research and Cancer Research UK's London Research Institute (formerly located at Lincoln's Inn Fields and Clare Hall) moved into the new Francis Crick Institute near London St Pancras station. There, they were joined by new recruits such as Guillaume Salbreux, a theoretical biophysicist who works on mechanics and shape generation in cells and tissues and who has joined the BioP group. BioP researchers Isabel Llorente-Garcia and Ewa Paluch were awarded Crick secondments which provide the opportunity to carry out part of their research activities at the Institute in close interaction with Crick Institute scientists.



Schematic of a B cell binding to the surface of a pathogen. Reproduced from P. Tolar, K. M. Spillane, Adv. Immunol. 123, 69 (2014).

Llorente-Garcia's work aims at understanding the molecular interactions, dynamics, forces and mechanical properties that drive biological processes such as, for instance, cell growth, immune response, pathogen infection, etc. For this she uses biophysical tools such as optical tweezers and fluorescence microscopy that enable experiments at the nanometre scale, measure dynamics at millisecond time scales and detect forces at the single molecule level. One of the exciting perspectives of her work with the Crick (with Crick scientist Pavel Tolar) is the possibility of investigating the role of physical forces in antigen extraction by B cells, a type of white blood cell that helps our body to eliminate pathogens.

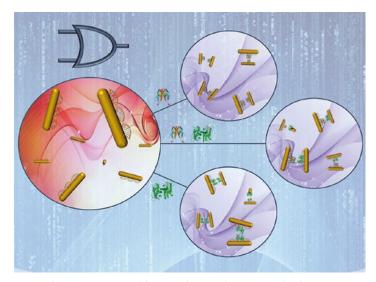
"...equipping physicists with the required skills and knowledge to make an impact in the life sciences"

Logic, plasmonic sensing by gold nanorods

One of the promising applications of nanotechnology is the construction of molecular-scale logic gates, producing for example OR and NOT operations similar to the semiconductor based logic gates that form the building blocks for electronic devices such as smart phones. A possible implementation is by adsorbing DNA on gold nanorods of the order of tens of nanometres long, and detecting variations in the absorption of light by the nanorods as a function of proteins that bind to the DNA. This makes use of the high dependence of this absorption on surface (plasmonic) properties of the nanorods. Proteins bind to DNA, changing these surface properties and thus changing the optical absorption, which can easily be detected.

Interestingly, this makes use of the same type of protein binding that restricts or promotes the expression of genes in our cells, the mechanism that allows our cells to differentiate from each other and adapt their protein contents with time. Nguyen Thanh and her group have optimised nanorod fabrication methods for such applications, resulting in uniformly sized gold nanorods, and currently achieve six logical operations based on an input of two proteins that in the human body are activated by oestrogen

(the hormone that, among other things, controls a woman's period). In the future, such systems may be used to sense and directly interpret a more complicated combination of biological markers.

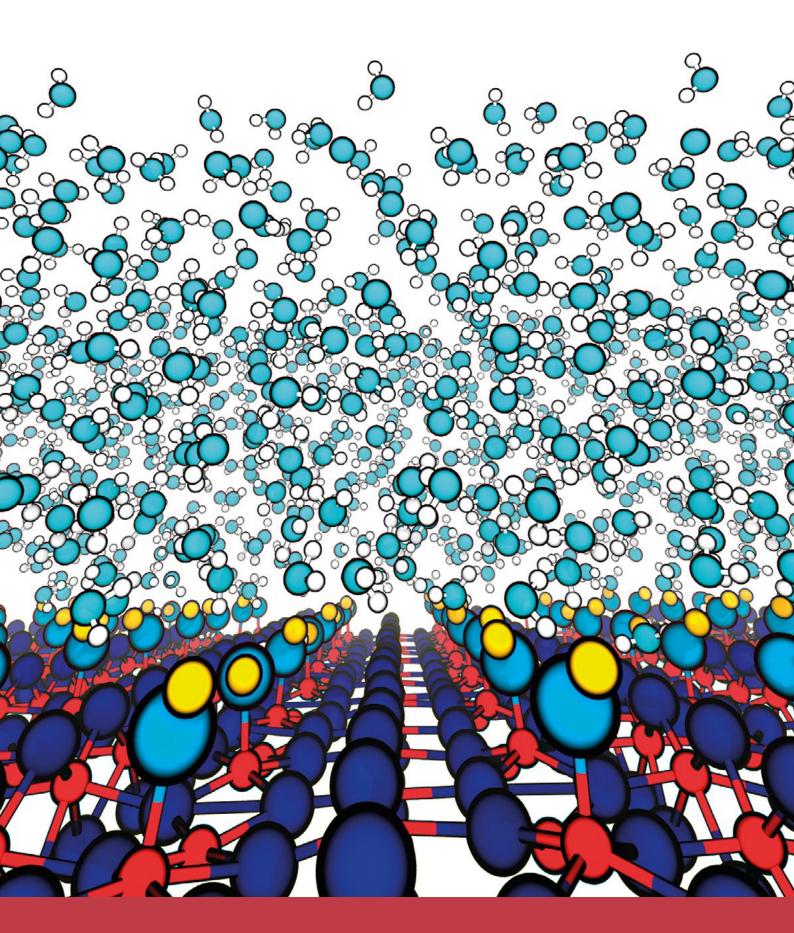


Logical operations on a gold nanorod sensor, by Nguyen Thanh's group.

An MSc in biological physics

Given the wide scope of opportunities for physicists in biology and biomedicine, the BioP group is committed to equipping physicists with the required skills and knowledge to make an impact in the life sciences. On a smaller scale, this is achieved by the inclusion of relevant experiments in the teaching labs (e.g., a new Brownian motion experiment set up by Daven Armoogun) and of the 4th year optional module in Molecular Biophysics (currently taught by BioP member Shiladitya Banerjee).

On a graduate level, we are preparing the launch of an MSc course in Biological Physics, which will prepare students to enter the fields of biological physics and quantitative biology, and their applications in industrial research or academic settings. The first cohort of students will start in Autumn 2017. Together with the current IPLS PhD programme, we anticipate that this will help directing bright minds towards an even brighter future in biological physics.



Research Statistics

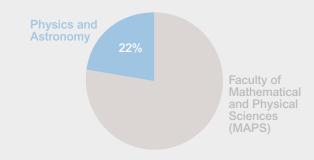
Research Statistics

Publication Summary

Research Group	Number of publications in refereed journals
Astro	199
AMOPP	148
CMMP	132
HEP	732
BioP	45

Active Grants and Contracts

In the last financial year (Aug 2015 – Jul 2016), the MAPS faculty as a whole yielded £35.4 million, with the Department of Physics and Astronomy contributing £7.9 million (22%) of the total research income for the MAPS faculty.



Astrophysics

University Research Fellowship Renewal (Royal Society) PI: Dr Filipe Abdalla, £318,537

SKA preconstruction phase at UCL (STFC) PI: Dr Filipe Abdalla, £281,909

SKA preconstruction phase continuation at UCL (STFC) PI: Dr Filipe Abdalla, £274,814

UCL Astrophysics consolidated grant 2015-2018 (STFC) PI: Dr Filipe Abdalla, £252,696

EUCLID Implementation Phase 2015-2020 (STFC) PI: Dr Filipe Abdalla, £654,666

DEDALE Data learning on manifolds and future challenges (European Commission H2020) PI: Dr Filipe Abdalla, £315,508

MSSL Solar and Planetary Physics Consolidated Grant 2016-2019 (STFC) PI: Dr Nick Achilleos, £392,682

Observations of thermospheric winds in the presence of TIDs (Royal Society) PI: Dr Anasuya Aruliah, £67,940

An observational and modelling study of upwelling in the auroral thermosphere (Air Force Office for Scientific Research) PI: Dr Anasuya Aruliah, £33,475

Variability of Neutral Temperature in the High-Latitude Upper Atmosphere (NERC) Pl: Dr Anasuya Aruliah, £32,933

ESPAS: Near-Earth space data infrastructures for e-science (European Commission FP7) PI: Prof Alan Aylward, £199,537

UCL Astrophysics consolidated grant 2015-2018 (STFC) PI: Prof Michael Barlow, £540,456

SNDUST: Supernova Dust: Production and Survival Rates (European Commission H2020) PI: Prof Michael Barlow, £1,624,047

An ongoing study of dwarf carbon stars (STFC) PI: Dr Carolina Bergfors, £2,369

Centre for earth observation instrumentation and space technology (UK Space Agency) Pl: Dr David Brooks, £14.640

Think Universe! Fundamental science master classes for school teachers at KS2 (STFC) PI: Dr Francisco Diego, £9,481

The dark energy spectroscopic instrument (STFC) PI: Prof Peter Doel, £742,939

UCL Astrophysics consolidated grant 2015-2018 (STFC) PI: Prof Peter Doel, £351,112

Archaeology of exo-terrestrial planetary systems and a search for water (STFC) PI: Dr Jay Farihi, £318,089

Kinematics galactic age chemistry and water fraction of asteroid polluted white dwarfs from the Sloan Digital Sky Survey (STFC) PI: Dr Jay Farihi, £180,237

An ongoing study of dwarf carbon stars (STFC) PI: Dr Jay Farihi, £1,764

A Chemical Inventory of Planetary Debris in the First Known Polluted White Dwarf (STFC) PI: Dr Jay Farihi, £2,178

IOSPOT: Monitoring the IO plasma torus (RAS) PI: Dr Stephen Fossey, £2,000

Career Acceleration Fellowship (CAF): Star formation and the ism evolution of galaxies across cosmic time (STFC) PI: Dr Thomas Greve, £471,898

Tracing large-scale structure growth with SCUBA-2 (STFC) PI: Dr Thomas Greve, £1.514

Fellowship: Massive star formation with new generation interferometers (STFC) PI: Dr Izaksun Jimenez-Serra, £451,297

Chemical pathways to life: amino acids and their precursors in the ISM (STFC) PI: Dr Izaksun Jimenez-Serra, £241,742

Ernest Rutherford Fellowship: Advancing weak lensing and intrinsic galaxy alignment studies to the era of precision cosmology (STFC)
PI: Dr Benjamin Joachimi, £351,642

A multi-probe strategy to pin down the nature of gravity and dark energy (STFC) PI: Dr Benjamin Joachimi, £218,171

TESTDE: Testing the dark energy paradigm and measuring neutrino mass with the dark energy survey (European Commission FP7) PI: Prof Ofer Lahav, £1,844,558

UCL Astrophysics consolidated grant 2015-2018 (STFC) PI: Prof Ofer Lahav, £122,431

Fellowship: Glimpse – Understanding the dark universe through 3D weak lensing reconstructions (European Commission FP7) PI: Dr Adrienne Leonard, £166,205

Daphne Jackson Fellowship (Daphne Jackson Fellowship Trust) PI: Dr Maria Mendes Marcha, £77,401

Europlanet 2020 research infrastructure – EPN2020-RI (European Commission H2020) PI: Prof Steve Miller, £247,980

Cosmic Dawn – understanding the origins of cosmic structure (EU FP7)
PI: Dr Hiranya Peiris, £1,119,800

UK Involvement in LSST: PHASE A (STFC) PI: Prof Hiranya Peiris, £92,666

UCL Astrophysics consolidated grant: 2015-2018 (STFC) PI: Prof Raman Prinja, £393,273

UCL Astrophysics consolidated grant: 2015-2018 (STFC) PI: Prof Jonathan Rawlings, £355,311

University Research Fellowship (Royal Society) PI: Dr Amelie Saintonge, £467,973

Cold gas and the chemical evolution of galaxies (Royal Society) PI: Dr Amelie Saintonge, £69,577

Self-consistent modelling of the interstellar medium of galactic scales (Royal Society) PI: Dr Amelie Saintonge, £14,205

FISICA – far infra-red space interferometer critical assessment: scientific definition and technology development for the next generation THZ space interferometer (EU FP7) PI: Dr Giorgio Savini, £270,117

Critical technology advancement of the locus mission: toward future space light (UK Space Agency) PI: Dr Giorgio Savini, £669,241

University Research Fellowship Renewal: The exoplanet revolution (Royal Society) PI: Prof Giovanna Tinetti, £311,958

ExoLights – Decoding lights from exotic worlds (European Research Council)
Pl: Prof Giovanna Tinetti, £1,385,754.95

ESA M4 Mission Candidate Ariel Phase A Study Sep 2015–Jul 2016 (STFC) PI: Prof Giovanna Tinetti, £24,448

ESA M4 Mission Candidate Ariel Phase A Study May 2016–Mar 2017 (STFC) PI: Prof Giovanna Tinetti, £26,498

Mapping CS in starburst galaxies: Disentangling and characterising dense gas (STFC) PI: Prof Serena Viti, £2,349

Linking solid-state astronomical observations and gas-grain models to laboratory data (STFC) PI: Prof Serena Viti, £41,305

Novel mathematical techniques for advanced tool-paths to transform high value optical fabrication (STFC) PI: Prof David Walker, £281,780

Market and supply chain study (UK Space Agency) PI: Prof David Walker, £10,000

STFC DiRAC Project Office 2014-2017 (STFC) PI: Dr Jeremy Yates, £377,026

A Pathfinder Project for a National AAAI (STFC) PI: Dr Jeremy Yates, £155,625

AMOPP

In situ quantification of metabolic function using florescence lifetime imaging (BBSRC) PI: Dr Angus Bain, £218,061

Cavity optomechanics: Towards sensing at the quantum limit (EPSRC) PI: Prof Peter Barker, £814,269

Quantum cavity optomechanics of levitated nanoparticles (EPSRC) PI: Prof Peter Barker, £869,905

Nonclassicalities and quantum control at the nanoscale (EPSRC) PI: Prof Sougato Bose, £1,166,350

Nanoelectronic based quantum physics – technology and applications (EPSRC) PI: Prof Sougato Bose, £441,672

PACOMANEDIA: Partially coherent many-body non-equilibrium dynamics for information applications (European Commission FP7) PI: Prof Sougato Bose, £947,605

Gravitational free fall experiments with positronium (Leverhulme Trust) PI: Dr David Cassidy, £147,622

Production and manipulation of Rydberg positronium for a matter-antimatter gravitational freefall measurement (EPSRC) PI: Dr David Cassidy, £693,517

Spectroscopy of Positronium: Atom control and gravity measurments (European Commission) PI: Dr David Cassidy, £75,000

Semi classical models for ultra-fast multi electron phenomena in intense electromagnetic laser fields (EPSRC) PI: Dr Agapi Emmanouilidou, £336,665

Control and imaging of processes triggered by x-ray pulses in multi-centre molecules (EPSRC) PI: Dr Agapi Emmanouilidou, £309.665

Orbit-based methods for multi-electron systems in strong fields (EPSRC) PI: Dr Carla Figueira De Morisson Faria, £313,960

Hybrid cavity-QED with Rydberg atoms and microwave circuits (EPSRC) PI: Dr Stephen Hogan, £524,578

CATLOMCHIP: Cold atmospheric molecules on a chip (European Commission H2020) PI: Dr Stephen Hogan, £1,290,609

Doctoral Prize Fellowship (EPSRC) Fellow: Dr Ciarán Lee, £97,177 A fast fluorescence and photonic force microscope with nanometre and femtonewton resolution (MRC) PI: Dr Isabel Llorente Garcia, £50,000

Fellowship: Luca Marmugi – Gammalas towards gamma-ray lasers via super-radiance in a Bose-Einstein condesate of 135mCs isomers (European Commission H2020) PI: Prof Ferruccio Renzoni, £128,418

Fellowship: RMAT3 theoretical study of cold and ultracold collisions intriatomic systems using inner-Region nuclear motions wave functions and outer-region R-matrix propagation (European Commission)
Fellow: Dr Laura McKemmish £127,046

Phonon-assisted processes for energy transfer and sensing (EU FP7) PI: Dr Alexandra Olaya-Castro, £184,320

Quantum secrets of photosynthesis at the Royal Society Summer Science Exhibition (EPSRC) PI: Dr Alexandra Olaya-Castro, £2,500

Fellowship: Quantum information science: Tools and applications for fundamental physics (EPSRC) PI: Prof Jonathan Oppenheim, £984,329

Wolfson Research Merit Award (Royal Society) PI: Prof Jonathan Oppenheim, £60,000

Studentship: What are the laws of quantum thermodynamics? (FQXi) PI: Prof Jonathan Oppenheim, £40,360

IT from QUBIT: quantum fields, gravity and information (Simons Foundation) PI: Prof Jonathan Oppenheim, £251,429

Control of atomic motion with AC fields (Royal Society) PI: Prof Ferruccio Renzoni, £12,000

Exploring stochastic thermodynamics with optical traps (Leverhulme Trust) PI: Prof Ferruccio Renzoni, £149,040

Studentship: Identifying and characterising materials using magnetic field interrogation (AWE) PI: Prof Ferruccio Renzoni, £66,035

COSMA – coherent optics sensors for medical applications (European Commission FP7)
PI: Prof Ferruccio Renzoni, £23,550

Impact Studentship: Atomic magnetometers for medical applications (NPL Management Ltd) PI: Prof Ferruccio Renzoni, £32,583

Studentship: Application of quantum magnetometers to security and defence screening (Defence Science and Technology Laboratory) PI: Prof Ferruccio Renzoni, £124,662

Studentship: Cylindrical magnetic imaging tomography (AWE) PI: Prof Ferruccio Renzoni, £61,500

Studentship: Magnetic sensor systems for the detection of metallic objects (AWE) PI: Prof Ferruccio Renzoni, £75,035

Localisation of arrythmogenic foci with a radio-frequency atomic magnetometer (Wellcome Trust) PI: Prof Ferruccio Renzoni, £44,688 Ultra-low frequency magnetic induction tomography with atomic magnetometers for security and defence applications (EPSRC) PI: Prof Ferruccio Renzoni, £76,135

What's Inside The Building Challenge 1: Detection – detection and identification using electromagnetic induction with atomic magnetometers (Thales) PI: Prof Ferruccio Renzoni, £28,123

Gamma-Ray nuclear super-radiance in a Bose-Einstein condensate (Royal Society) PI: Prof Ferruccio Renzoni, £12,000

Threat detection fast parcels (Home Office) PI: Prof Ferruccio Renzoni, £13,358

Coherent quantum matter out of equilibrium from fundamental physics towards applications (EPSRC Fellowship) Fellow: Dr Marzena Szymanska, £1,222,168

Novel superfluid phenomena in semiconductor microcavities (EPSRC) PI: Dr Marzena Szymanska, £295,981

The UK theory of condensed matter summer school (EPSRC) PI: Dr Marzena Szymanska, £170.029

ExoMol - molecular line lists for exoplanet atmospheres (European Commission FP7) PI: Prof Jonathan Tennyson FRS, £1,878,425

Wolfson Research Merit Award: Molecular line lists for extra solar planet and other hot bodies (Royal Society) PI: Prof Jonathan Tennyson FRS, £72,000

Studentship: James Hamilton – Electronic impact vibrational excitation of water molecules (Quanternol Ltd.)
PI: Prof Jonathan Tennyson FRS, £12,900

Studentship: Modelling of spectra of hot molecules (Servomex Ltd.) PI: Prof Jonathan Tennyson FRS, £18,150

Atomic and molecular data services for astrophysics (STFC) PI: Prof Jonathan Tennyson FRS, £47,110

Studentship: Emma Burton – Line lists for hot chlorine containing molecules (Danish Technical University) PI: Prof Jonathan Tennyson FRS, £32,583

High accuracy transition intensities for ozone (NERC) PI: Prof Jonathan Tennyson FRS, £347,048

ExoData: a commercially supported space telescope (European Commission H2020) PI: Prof Jonathan Tennyson FRS, £90,645

Commercial space science service provision (EPSRC) PI: Prof Jonathan Tennyson FRS, \$7,800

Support for theoretical molecular physics research at the University of Douala Cameroon (Institute of Physics) PI: Prof Jonathan Tennyson FRS, £1,936

Studentship: Daniel Darby: r-matrix calculation of electron collisional excitation rates of jet and iter relevant molecules (UK Atomic Energy) PI: Prof Jonathan Tennyson FRS, £23,000

Fellowship: RichMol – Optical activity of molecules with rotational chirality (European Commission) PI: Dr Sergey Yurchenko, £173,462

UCL Astrophysics Consolidated Grant 2015-2018 (STFC) PI: Dr Sergey Yurchenko, £234.536

CMMP

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

Impact Studentship: A computational investigation of charge transfer in organic semiconducting materials (PNNL) PI: Prof Jochen Blumberger, £34,167

Characterisation of electron transport in bacterial nano-wire proteins through high performance computing and experimentation (EPSRC) PI: Prof Jochen Blumberger, £321,327

Impact Studentship: Exploration of the performance of a CDFT for the calculation of parameters that govern the thermodynamics and kinetics of interfacial ET reactions (PNNL) PI: Prof Jochen Blumberger, £27,168

SOFTCHARGE: charge carrier transport in soft matter: from fundamentals to highperformance materials (European Commission H2020) PI: Prof Jochen Blumberger, £1,492,491

Studentship: O(N) density functional theory for dye sensitised solar cells (Jiangsu Kuga Digital Group Co.) PI: Prof David Bowler, £29,257

Complementary Zinc-oxide optoelectronics (Leverhulme Trust) PI: Prof Franco Cacialli, £245.618

CONTEST: Collaborative network for training in electronic skin technology (European Commission FP7) PI: Prof Franco Cacialli, £480,418

Impact Studentship: Giuseppe Maria Paterno – nanoscale characterisation and radiation damage testing of organic solar cells using neutron scattering techniques (STFC) PI: Prof Franco Cacialli, £42,676

SYNCHRONICS: Supramolecularly engineered architectures for optoelectrics and photonics: a multi-site initial training action (European Commission H2020) PI: Prof Franco Cacialli, £781.498

Fellowship: Semiconducting Nanostructures (Royal Society) PI: Prof Franco Cacialli, £62,500

Impact Studentship: Directing crystal growth with functional surfaces (PNNL) PI: Prof Dorothy Duffy, £37,515

Modelling nano-ferroelectrics (NPL Management Ltd) PI: Prof Dorothy Duffy, £30,000

Studies of domain dynamics in nano-ferroelectrics (NPL Management Ltd) PI: Prof Dorothy Duffy, £31,505

Consequence analysis postdoctoral research associate (Ministry of Defence) PI: Prof lan Ford, £227,288

Graphenecore1 - graphene-based disruptive technologies (European Commission H2020) PI: Dr Chris Howard, £68,933

MIIA – driving the 2D materials revolution: A scalable method for dissolving layered materials (EPSRC) PI: Dr Chris Howard, £17,752

Graphene based revolutions in ICT and beyond (European Commission) PI: Dr Chris Howard, £9,559

Quantum feedback control of levitating opto-mechanics (EPSRC) PI: Dr Alessio Serafini, £579.937

EngD Studentship: Advanced gate stack and dielectric in resistive memory material (International Sematech) PI: Prof Alexander Shluger, £48.047

EngD Studentship: Jonathan Cottom – ab-initio simulations in bulk and interface defects (Infineon Technologies Austria AG) PI: Prof Alexander Shluger, £30,000

EngD Studentship: Oliver Dicks – Tuning electronic properties of thin films and interfaces using defects (Argonne National Laboratory) PI: Prof Alexander Shluger, \$58,412

Impact Studentship: Ashley Garvin – laser materials interaction (PNNL) PI: Prof Alexander Shluger, £45,400

Studentship: Atomistic modelling of reliability limiting point defects in silicon carbide and near the interface to silicon dioxide or contacting metals (Infineon Technologies Austria AG)
Pl: Prof Alexander Shluger, £35,000

Exploring polaronic effects in oxides using range-separated hybrid density functional theory (Weizman Institute of Science)
PI: Prof Alexander Shluger, £7,059

Studentship: David Ingram – Regeneration of H2 storage materials (CELLA Acquisition Ltd) PI: Prof Neal Skipper, £36,000

University Research Fellowship Renewal: Charge donors and traps in complex oxides (Royal Society) PI: Dr Peter Sushko, £322,387

Effect of framework modification on the electronic structure of 12CaO.7Al203 (Lockheed Martin Corporation)
PI: Dr Peter Sushko, £85,635

OPTIMAX – Optimal imaging with present and future coherent x-ray sources (European Research Council) PI: Dr Pierre Thibault, £901,675

Studentship: High resolution tomography of energy materials with hard x-rays (Diamond Light Source Ltd) PI: Dr Pierre Thibault, \$2.100

Studentship: Development and application of ptycho-tomography at 113 (Diamond Light Source Ltd) PI: Dr Pierre Thibault, £34,707

Studentship: Speckle-based x-ray phase contrast imaging (Diamond Light Source Ltd) PI: Dr Pierre Thibault, £44,791

UCL cross-disciplinary advanced x-ray imaging centre (EPSRC) PI: Dr Pierre Thibault, £317,189

HFP

Development and maintenance of ATLAS run time tester (STFC) PI: Prof Jonathan Butterworth, £327,246

Fellowship: Event simulation for the Large Hadron Collider at high precision (STFC) PI: Prof Jonathan Butterworth/Dr Rikkert Hendrik Frederix, £428,325

Giving Physics a boost at RUN-II of the LHC (Durham University) PI: Prof Jonathan Butterworth. £5.000

UK Involvement in direct dark matter searches (STFC) PI: Dr Chamkaur Ghag, £93,748

Meeting radioactivity requirements for the discovery of dark matter (Royal Society) PI: Dr Chamkaur Ghag, £11,029

The LUX-ZEPLIN (LZ) dark matter search (STFC) PI: Dr Chamkaur Ghag, £346,111

IPPP Associateship 2013 -2015 (University of Durham) PI: Dr Keith Hamilton, £1,000

University Research Fellowship: Higgs physics and the mystery of particle masses (Royal Society) PI: Dr Gavin Hesketh, £532,834

Fellowship: Discovering the True Nature of the Higgs Boson at the LHC (Royal Society) PI: Dr Gavin Hesketh, £319,583

Modelling of Higgs backgrounds at the LHC (University of Durham) PI: Dr Gavin Hesketh, £3,000

Dorothy Hodgkin Fellowship: Investigating the neutrino with MINOS and liquid argon detector technology (Royal Society) PI: Dr Anna Holin, £466,676

Calorimetry for proton therapy (STFC) PI: Dr Simon Jolly, £49,531

Studentship: A calorimeter for proton therapy (NPL Management Ltd.) PI: Dr Simon Jolly, £34,107

OMA: optimization of medical accelerators (EU H2020) PI: Dr Simon Jolly, £177,637

ATLAS upgrade (Phase 1) (STFC) PI: Prof Nikos Konstantinidis, £245,246

ATLAS Phase II upgrades 2014-15 (STFC) PI: Prof Nikos Konstantinidis, £87,810

ATLAS Phase II upgrades 2015-16 (STFC) PI: Prof Nikos Konstantinidis, £123,290

ATLAS Upgrade R&D 2016 (STFC)
PI: Prof Nikos Konstantinidis, £164,003

Ernest Rutherford Fellowship: Heavy quarks a window into new physics at ATLAS (STFC) PI: Dr Andreas Korn, £363,285

Beam diagnostics for PETS and PXIE (STFC) PI: Prof Mark Lancaster, £128,859

Measurement of the anomalous magnetic moment of the muon to 0.14ppm using the FNAL G-2 experiment (STFC) PI: Prof Mark Lancaster, £246,429

MUSE: muon campus in US and Europe contribution (EU H2020) PI: Prof Mark Lancaster, £117.000

LBNE and the Fermilab liquid argon detector programme (STFC) PI: Prof Ryan Nichol, £4,058

Probing the ultra-high energy universe with ANITA and ARA (Leverhulme Trust) PI: Prof Ryan Nichol, £220,205

Investigating the nature of the neutrino with MINOS (+) and LAR detector development for DUNE (URA) PI: Prof Ryan Nichol, £12,914

UCL experimental particle physics consolidated grant: 2015-2019 (STFC) PI: Prof Ryan Nichol, £4,763,816

Training network for Monte Carlo event generators for LHC physics (EU FP7) PI: Dr Emily Nurse, £177,938

University Research Fellowship: Search for a vector boson fusion produced Higgs boson at ATLAS (Royal Society) Fellow: Dr Emily Nurse, £406,633

University Research Fellowship Renewal: Higgs studies and a search for dark matter at the ATLAS experiment (Royal Society) Fellow: Dr Emily Nurse, £274,703

A novel technique to search for dark matter at the Large Hadron Collider (Leverhulme Trust) PI: Dr Emily Nurse, £288,386

Determining the properties of the Higgs Boson (Royal Society) PI: Dr Andrew Pilkington, £71,371

Establishing the nature of electroweak symmetry breaking (Royal Society) Fellowship, PI: Dr Andrew Pilkington, £484,076

Low background techniques for particle physics and astrophysics (STFC) PI: Prof Ruben Saakyan, £33,310

High resolution fast detector for quality assurance in proton beam therapy (STFC) PI: Prof Ruben Saakyan, £118,042

University Research Fellowship: Determining the true nature of the Higgs-like particle (Royal Society) PI: Dr Tim Scanlon, £483,706

Determining the true nature of the Higgs-like particle (Royal Society), PI: Dr Tim Scanlon, £85,277

Feasibility studies for mega-tonne scale neutrino detectors (Royal Society) PI: Prof Jennifer Thomas CBE, £12,000

MINOS+ (STFC) PI: Prof Jennifer Thomas CBE, £239,618

The path to CP violation in the neutrino sector: mega-ton water detectors (Leverhulme Trust) PI: Prof Jennifer Thomas CBE, £383,431

Theory Consolidated Grant – Standard Model Phenomenology and beyond (STFC) PI: Prof Robert Thorne, £410,047

Particle physics phenomenology (STFC) PI: Prof Robert Thorne, £343,107

Terauniverse - Exploring the terauniverse with the LHC, astrophysics and cosmology (European Commission FP7)
PI: Prof Robert Thorne, £360,514

Experimental Particle Physics Consolidated Grant 2012 – 2016 (STFC) PI: Prof David Waters £4.340.016

Supernemo commissioning and sensitivity demonstration (STFC) PI: Prof David Waters, £420,768

Enhanced European coordination for accelerator research and development (EU FP7) PI: Prof Matthew Wing, £93,794

European XFEL clock and control system (European X-Ray Free-Electron Laser Facility GmbH) PI: Prof Matthew Wing, £686,926

Photon-driven plasma Wakefield acceleration – a new route to a TeV e+e- collider (STFC) PI: Prof Matthew Wing, £26,777

AIDA 2020: Advanced European structure for detectors and accelerators (European Commission H2020) PI: Prof Matthew Wing, £245,00

AWAKE: a proton-driven plasma Wakefield acceleration experiment at CERN STFC) PI: Prof Matthew Wing, £253,098

Biophysics

Manipulation and destruction of cancer cells using cavitation bubbles generated by optical and acoustic tweezers (British Council) PI: Dr Philip Jones, £99,415

Fellowship: Carbon nanotube-magnetic nanoparticle hybrid system for expansion of umbilical cord blood stem cells (Royal Society) Fellow: Dr Tan Kuan Boone £101,000

Nanoparticle probes carrying single DNA molecules for biomolecular detection (Royal Society) PI: Prof Thanh Nguyen, £12,000

Nanoscale magnetism in next generation magnetic nanoparticles (Air Force Office of Scientific Research) PI: Prof Thanh Nguyen, £46.397

Fellowship: Tan Kuan Boone – Carbon nanotube-magnetic nanoparticle hybrid system for expansion of umbilical cord blood stem cells (Royal Society) PI: Prof Thanh Nguyen, £99,000

Advanced flow technology for healthcare materials manufacturing (EPSRC) PI: Prof Thanh Nguyen, £324,223

Magnetic nanoparticle engineering via microreaction (EPSRC) PI: Prof Thanh Nguyen, £403,869

Engineering multi-functional magnetic nanoparticles for enhanced oil recovery (RAENG) PI: Prof Thanh Nguyen, £24,000

Staff Snapshot

Head of Department

Professor J. M. Butterworth

Deputy Head of Department

Professor R. K. Prinja

Astrophysics

Head of Group: Professor S. Viti

Professors:

M. J. Barlow, A. P. Doel, R. Ellis, I. D. Howarth, O. Lahav, S. Miller, H. Peiris, R. K. Prinja, J. M. C. Rawlings, G. Tinetti, S. Viti

Readers and Senior Lecturers:

F. Abdalla, N. Achilleos, A. L. Aruliah, G. Savini

J. Farihi, T. Greve, B. Joachimi, A. Pontzen, A. Saintonge

Senior Research Associates:

F. Diego, P. Guio, J. Yates

Research Associates:

H. Baghsiahi, S. Balan, J. Barstow, A. Bevan, J. Braden, A. Coutens, I. De Looze, D. Fenech, A Font-Ribera, W. Hartley, K. Kakiichi, F. Kirchschlager, D. Kirk, N. Laporte, M. Marcha, B. Moraes, G. Morello, M. Rivi, R. Schuhmann, M. Tessenyi, E. Van Uitert, I. Waldmann, C. Watkinson, R. Wesson, L. Whiteway

Support Staff:

M. Bibby, S. Betts, S. Boyle, D. Brooks, T. Catling, J. Deacon, E. Edmondson, J. Fabbri, S. Fossey, I McWhirter, M.Pearson, C. Jenner, K. Nakum, M. Rangrej, T. Schlichter, V. Shipley

Atomic, Molecular, Optical and Positron Physics

Head of Group: Professor P. Barker

Professors:

P. Barker, S. Bose, G. Laricchia, T. Monteiro, J. Oppenheim, F. Renzoni, J. Tennyson

Reader and Senior Lecturers:

A. Bain, D. Browne, D. Cassidy, A. Emmanouilidou, C. Figueira de Morisson Faria, S. Hogan, A. Olaya-Castro, A. Serafini, M. Szymanska, S. Yurchenko

I. Llorente Garcia

Research Fellow:

YI Ii

Research Associates:

L. Banchi, A. Bayat, T. Blacker, S. Brawley, Gentil Dias de Moraes Neto, O. Duarte, M. Genoni, L. Lodi, A. Loreti, B. Mant, L. Marmugi, L. Masanes, T. Mavrogordatos, L. McKemmish, T. Meltze, O. Polyansky, A. Pontin, A. Rahman, C. Zagoya Montiel, A. Zamora, D. Zaouris, V. Zhelyazkova

Support Staff:

K. Bouzgan, R. Jawad, S. Khan, S. Schmieschek

Biological Physics

Heads of Group:

Dr B. Hoogenboom, Dr P. Jones

Professors:

J. Blumberger (also CMMP), G. Charras (Cell & Developmental Biology), B. Hoogenboom, E. Paluch (MRC LMCB), Nguyen TK Thanh, I. Robinson (also CMMP)

Readers and Senior Lecturers:

A. Bain (also AMOPP), P. Jones, A. Olaya-Castro (also AMOPP)

Lecturer:

I. Llorente-Garcia (also AMOPP)

Senior Research Fellows:

S. Banerjee, G. Salbreux (Crick), A. Saric

Research Fellows:

E. Parsons, A. Pyne, D. L. Tung

Research Associates:

B. Chen, K. Kwakwa, A. Lagrow, S. Mourdikoudis, Y. Mohammed, G. Morrison, B. Ozkahraman, J. Schwenke, T. J. Smart, F. Zhang

Support Staff:

J. Gill-Thind

Condensed Matter and Materials Physics

Head of Group:

Professor S Bramwell

Professors:

J. Blumberger, D. Bowler, S. Bramwell, F. Cacialli, D. Duffy, A. Fisher, I. Ford, A. Green, G. Materlik, D. McMorrow, A. Michaelides, Nguyen TK Thanh, I. Robinson, A. Shluger, N. Skipper

Readers and Senior Lecturers:

J. Elzerman. C. Hirjibehedin, B. Hoogenboom, M. Szymanska, S. Zochowski

Lecturers:

M. Buitelaar C. Howard, F. Kruger, R. Perry, S. Schofield, P. Zubko

Research Associates:

L. Bovo, D. Buckley, A. Carof, J. Chen, J. Cottom, R. Darkins, A-M. El-Sayed, Z. Futera, D. Gao, T. Gill, T. Greenland, L. Ishibe Veiga, A. James, C. Kumarasinghe, K. Kwakwa, A. Minotto, D. Mora Fonz, E. Parsons, A. Pyne, G. Sosso, J. Vale, B. Villis, A. Zen, F. Zhang

Most Research staff are employed through the LCN

Support Staff:

J. Gane, A. Gormanly, D. Ottley, S. Patel, F. Sidoli, G. Tregnago, J. Walden

High Energy Physics

Head of Group: Professor R. Saakyan

Professors:

J. M. Butterworth, N. Konstantinidis, M. A. Lancaster, R. Nichol, R. Saakyan, J. A. Thomas, R. S. Thorne, D. Waters, M. Wing

Readers and Senior Lecturers:

M. Campanelli, E Nurse

Lecturers:

F. Deppisch, C. Ghag, K. Hamilton, G. Hesketh, S. Jolly, A. Korn

Royal Society Fellowship:

A. Holin (Dorothy Hodgkin), T. Scanlon

Principal and Senior Research Associates:

R. Flack, P. Sherwood, B. Waugh

Senior Research Fellows:

G. Facini

Research Fellows:

A. Pappa

Research Associates:

S. Amjad, J. Cesar, R. Chislett, L. Corpe, Cremonesi, L. Deacon, J. Dobson, A. Freshville, S. Germani, K. Gregersen, Z. Grout, C. Gutschow, L. Harland-Lang, K. Leney, L. Manenti, A. Martyniuk, J. McFayden, C. Patrick, P. Sherwood, D. Wardrope

Support Staff:

D. Attree, K. Bouzgan, M. Cascella, G. Crone, E Edmondson, T. Hoare, S. Kilani, M. Warren

Professional Services

AMOPP/HEP Research Groups & Goods Inwards Administrator: K Bouzgan

Teaching

Director of Teaching: Professor N. Skipper

Director of Postgraduate Studies:

T.S. Monteiro

Director of Laboratories:

D. Cassidy

Principle Teaching Fellow:

P. Bartlett

Teaching Fellows:

D. Armoogum, E. Bailey, J. Bhamrah, L. Dash, N. Nicolaou

Laboratory Superintendent:

D. Thomas

Laboratory Technicians:

B. T. Bristoll, M. A. Sterling, K. Vine

IT Systems Manager (Teaching & Learning):

Fahad Ihsan

Admissions Tutors:

A. Aruliah (MSc), J. C. Rawlings (Astronomy Certificate), J. Blumberger (Postgraduate Research), C. Faria (Undergraduate)

Programme Tutors:D. Duffy (MSc), J. C. Rawlings (Astronomy Certificate), S. W. Zochowski (Physics and Astronomy)

UCL Observatory

Director: G. Savini

Teaching Fellows:

S. J. Boyle, S. J. Fossey

Computing and Instrumentation Officer:

T. Schlichter

Technical Support:

T. Catling, M. Pearson

Maps Workshop

Superintendent: D. Cassidy

Technicians:

J. Benbow, J. F. Percival

Professional Services

Departmental Manager: J. Smith

Senior Staffing and Communications Officer:

B. Carboo

Grants Officer:

J. Barrett

Accounts Officer:

C. Nalty

Finance Officer:

J. Gane

Finance and Postgraduate

Administrator:

N. Waller

Senior Teaching and Learning

Administrator:

A. Keegan

Teaching Administrator:

S. Thanki

Astrophysics Research Group and Observatory Administrator:

K Nakum

AMOPP/HEP Research Groups & Goods Inwards Administrator:

K. Bouzgan

Biophysics Administrator:

J. Gill-Thind

IT Co-ordinator:

F Ihsan

Safety Officer and Estates Manager:

L. Bebbington

Outreach and Public Engagement

Outreach Coordinator and Ogden Science Officer: tbc

Science Centre Organiser:

S. Kadifachi

Visiting Professors and Emeritus Staff

A. Aylward, S. Bridle, R. Cohen, M. Coupland, D. H. Davis, M. M. Dworetsky, M. Duff, M. Ellerby, M. Esten, F. Fernandez-Alonso, J. L. Finney, T. Fountain, M. J. Gillan, W. Glencross, A. H. Harker, B. Hiley, C. Hilsum, P. Hobson, J. W. Humberston, T. W. Jones, B. R. Martin, K. A. McEwen,

J. McKenzie, D. J. Miller, S. Miller, D Moores, W. Newell, G. Peach, A. Slosar, A. C. Smith,

W. Sommerville, P. J. Storey, D. N. Tovee, C. Wilkin, D. A. Williams, A. J. Willis

