The University of Nottingham

UNITED KINGDOM · CHINA · MALAYSIA

Physics and Astronomy @Nottingham

School of Physics and Astronomy Newsletter 2014

Welcome to your future

Fourth-year MSci Physics student Jorge Ferreras working in the cold atoms research lab.

Student satisfaction
Our students rate us highly

Exciting research opportunities
Summer placements and project opportunities abroad

PhysSoc
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I'm a scientist – get me out of here

Welcome to the School of Physics and Astronomy

Studying physics at The University of Nottingham offers many life-changing and career-building opportunities. These can be academic within the School of Physics and Astronomy or extra-curricular, taking advantage of the many excellent facilities available to our students across campus.

In this newsletter we emphasise some of the opportunities for our undergraduates to participate in the research activities of the school, either in the form of paid summer placements in our laboratories or research work abroad as part of a final-year project. Our exciting new final-year project scheme with the National Observatory in Rio de Janeiro is highlighted on page 4 and is likely to prove very popular.

Of course university offers many opportunities. The University's Physics Society, PhysSoc, is featured on page 8, summarising some of the social and physics-related activities that are organised. Also, many of our students have strong passions for sport and on page 6 we feature second-year student Natalie Wilson who has represented the UK internationally in canoe slalom.

We are very proud of our undergraduate students and the quality of the teaching we offer to them. Therefore we are especially pleased that our students have rated us so highly in the National Student Survey.

We very much appreciate your interest in our school and we hope to welcome you as a visitor to one of our open days or as a student.

Professor Richard Bowtell
Head of the School of Physics and Astronomy

News

Our students rate us highly

The School of Physics and Astronomy was rated highly by our final year students in the latest National Student Survey, recording a figure of 93% for 'overall satisfaction' with their physics degree course. With our MSci Physics course receiving a 100% rating.

The school also ranked second out of 42 university physics departments in the UK in the last Research Assessment Exercise which looks at research quality.

These high teaching and research ratings jointly contribute to the school being ranked in the top five physics departments, according to *The Times Good University Guide 2014*.

School of Physics and Astronomy

93%

overall satisfaction

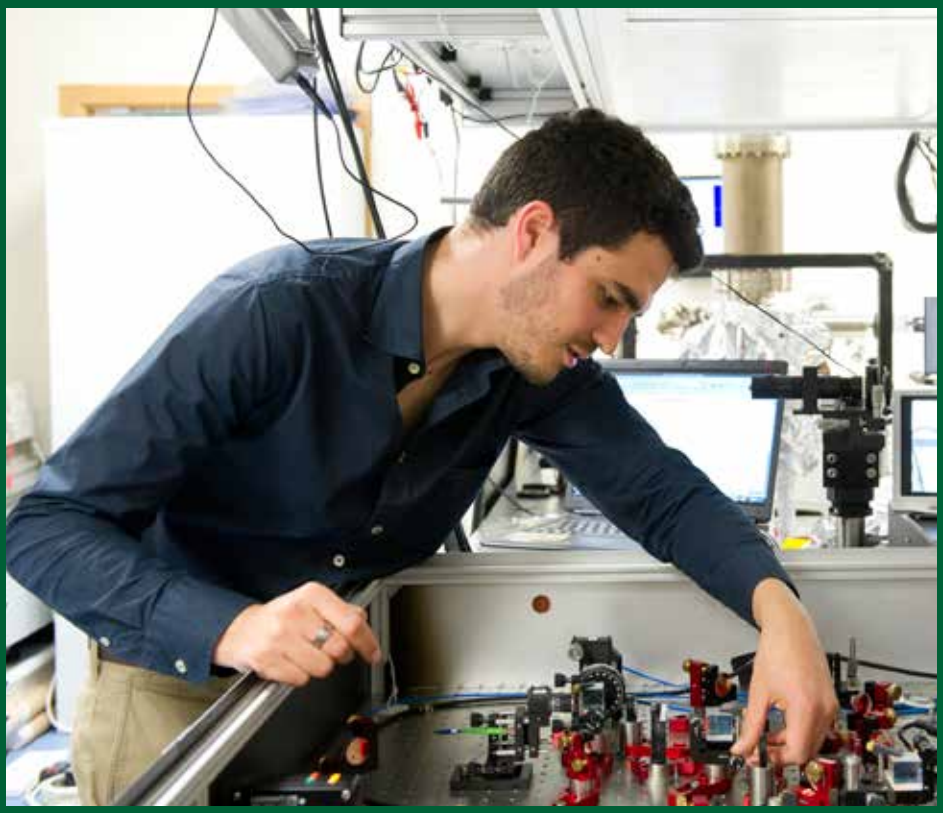
MSci Physics

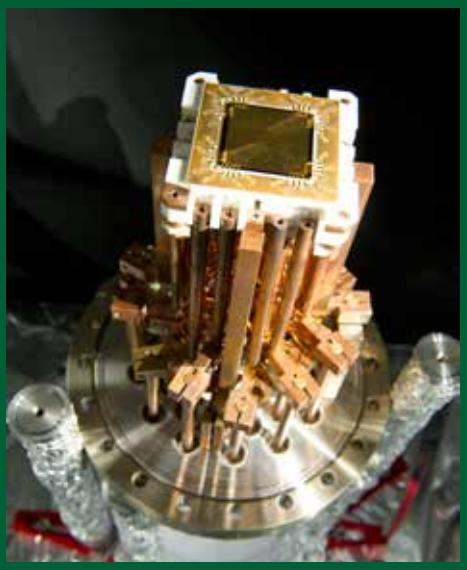
100%

overall satisfaction

Professor Merrifield lecturing on astrophysics.

A cold atom summer internship





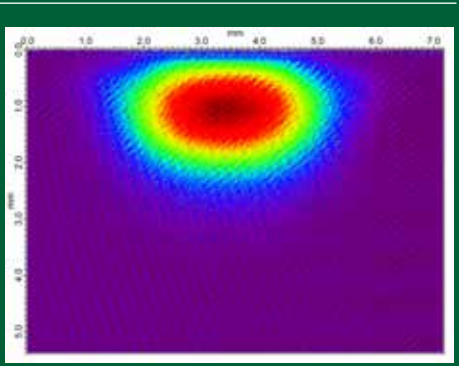
Left: Jorge in the cold atoms lab.

Above: The heart of the cold atom apparatus: an atom chip where the quantum atom clouds (Bose-Einstein Condensate) are manipulated and experimented upon.

Every year the School of Physics and Astronomy offers paid summer internships for our undergraduate students to gain experience of working in our research laboratories.

On the front cover is MSci Physics student Jorge Ferreras, who has widened his horizons by working in Professor Krüger's Cold Atom Research Group during the summer vacation. The team researches how beams from intense lasers, combined with some clever tricks involving radiofrequency irradiation and 'magnetic traps', cool the atom clouds down to temperatures of just 100nK, where they reveal their exquisite quantum properties. With dimensions measured in millimeters, the atom cloud exists as a single, macroscopic quantum object. These are called Bose-Einstein Condensates, the subject of two Nobel Prizes and featuring big in current physics research worldwide. Given that 1nK is just 10^{-9}K, Jorge rightly claims that the laboratory environment he worked in is one the coldest places in the universe!

Reflecting on his time in the lab, Jorge said: "My work involved the design and development of a polarimeter which analyses the polarization of the intense laser beams. This project gave me the opportunity to work in cutting-edge labs with high-level research projects. Working alongside the cold atoms experiments, combined with the friendly environment in the labs, made me feel very interested in the research carried out in there and has led me to apply for a PhD in the cold atoms research area."



An image of $7x10^7$ atoms of Rubidium in a magnetic trap of the Bose-Einstein apparatus.

See you in Rio...

As well as opportunities for studying at overseas universities as part of your degree, The School of Physics and Astronomy has inaugurated a new link with the National Observatory in Brazil.

In the spring of 2013, pioneering student Ashley Smith blazed a trail by becoming Nottingham's first physics student to undertake our new research project exchange programme with the National Observatory in Rio de Janeiro. Ashley recounts some impressions of his cherished, life-changing experience:

"When I first arrived in Rio I was knocked over by the warmth, and I'm not talking just about the temperature, but about the fellow students and researchers at the observatory; I felt comfortable and at home. Despite knowing just a few words of Portuguese, I was soon socialising and playing cards with my housemates, who were also students at the observatory.

When I found out about the opportunity to travel to Brazil for the research project I knew I had to go for it. I was apprehensive about moving to a country with a culture so different to Britain's, and dealing with language difficulties, but I knew the experience would be life-changing and unforgettable.

Rio de Janeiro is known in Portuguese as "Cidade Maravilhosa" – the marvellous city – and it's easy to see why. The physical geography of the harbour with its jungles and mountains make up one of the seven natural wonders of the world, which is blended together with one of the most vibrant cities in the world.

While settling in and discovering the city, I was also getting up to speed with my project. I was studying data from the Chandra X-ray space telescope to investigate the megaparsec-scale bodies of hot gas that permeate the intergalactic space within galaxy clusters. This involved making spectroscopic measurements to determine the amounts of different elements that are present, a novel approach to studying dynamical structures within the gas, which are known as cold fronts. Having weekly meetings to share our knowledge, I felt very much a valued member of the research group within the observatory using data from X-ray telescopes to study fields varying from the stellar to galactic to cosmological scales.

Aside from studying, there was a great day when I went hiking up the 842m high Pedra da Gávea (accessible only by climbing), and sat at the top with Rio at my feet. The end of my time in Rio arrived all too quickly, but with my work completed and the report posted back to Nottingham, I was free to see more of Brazil for two weeks. I chose to visit a remote beach called Jericoacoara – from the nearest airport, it takes five hours by bus plus one hour by off-road truck across dunes – here I think I came close to the true meaning of paradise.

I was sad to leave, but I then continued on to Brasilia, a city with a unique origin and even stranger modernist buildings containing the heart of the government of Brazil. I concluded my journey at the Iguaçu Falls, probably the most beautiful of the great waterfalls of the world, and Itaipu Dam."

The exchange programme with the National Observatory in Brazil is now firmly established, and this year Adam Parsons and Sofia Palazzo-Corner are the lucky fourth-year physics students who will be setting off for Rio.

Ashley on top of the Pedra da Gávea high above Rio de Janeiro.

The National Observatory in Rio.

Jasmine and Charlie on the Great Wall, but hopefully for UK science the change of allegiance is only temporary!

Taking time out from their project.

With the research group outside the physics lab.

Adventure of a lifetime

In 2013, undergraduate physics students Jasmine Rivett and Charlie Patrickson spent three months working as members of a research group at the prestigious Fudan University in Shanghai, China, as part of their fourth-year MSci project.

Nottingham's School of Physics and Astronomy has long established links with the Physics Department at Fudan University. For more than fourteen years, fourth-year undergraduate physics students have set off for Shanghai, eager to have their first opportunity to conduct original research as well as experience the culture of this fast-changing and exciting country.

Jasmine and Charlie's project involved an investigation of the new wonder material graphene, a one-atom thick honeycomb lattice of carbon atoms for which the 2010 Nobel Prize in Physics was awarded to former Nottingham researcher, Professor Andrei Geim.

Writing their final report, Jasmine and Charlie found that the exotic electron transport properties arising from the unique two-dimensional structure of graphene have the potential to be exploited in a wide range of applications including high speed microelectronics devices and highly sensitive chemical detectors. The particular aim of their project was to investigate new methods of laying down a one-atom thick graphene film onto a substrate of hexagonal boron nitride. This idea is potentially important to the future manufacture of electronic devices based on graphene, but at the same time is of enormous fundamental interest to a physicist.

Reflecting on her time in China, Jasmine said: "It was an excellent opportunity to gain experience working in a different cultural environment and to see how research is carried out in other countries. The lab was a very social environment and we often took breaks to play badminton (a very popular sport with the people in the group!) and we went for meals and karaoke after work. We also visited the homes of the people we worked with in the lab and got to make dumplings.

Staying so close to the centre of Shanghai was great, and the metro system (which was luckily also signed in English!) made it very easy to get around and visit the famous Shanghai skyline and the beautiful parks in the city. After the project was finished we had the opportunity for a few weeks of travelling and got to see the beautiful Chinese countryside, including watching the sunrise over rice terraces and walking along the Great Wall, which was stunning! Overall, even though I was worried about being in a foreign country where I didn't speak the language for almost three months, we had an amazing time and we are very lucky that the school provided us with such a fantastic opportunity!"

"It was an excellent opportunity to gain experience working in a different cultural environment."

Natalie in physics mode working with an X-ray diffractometer.

Intense concentration on the white water.

Physics with international canoe slalom

"There is nothing as exhilarating as a morning of training on the white water at the National Water Sports Centre before physics lectures."

In one sentence, second-year physics student Natalie Wilson eloquently conveys her enthusiasm for her two passions; canoe slalom and physics. And Natalie is really quite single-minded in fully exploiting the opportunities that both present to her. Realising she had a natural flair for the sport (and enormously supportive parents!), at the age of 17 her whole family moved house from Staffordshire to Nottingham to enable her to be closer to the world-leading training facilities at the National Water Sports Centre at Holme Pierrepont in Nottingham.

For three years, Natalie studied A levels part-time at sixth form, during which time her canoe slalom career really began to blossom. She represented the UK in the U23 World Championships in the USA, winning a silver medal in the team canoe slalom event, and also gained representative honours at the U23 European Championships in Slovenia. Although she was in close contention for a place on the UK team at the London Olympics in 2012, Natalie was still a little young for the senior squad.

As part of the 'Olympic Ambitions' programme, however, she still played her part at London 2012; in the immediate lead-up to the main competitions, Natalie's canoe was fitted with a BBC camera and she was given the role of tackling the Olympic white water course at Lee Valley in front of 13,000 spectators to provide action shots for the TV broadcast.

The University supported her training by providing her with a sport's bursary and access to a specialised weights room for elite athletes. She also finds the green parkland environment of University Park Campus and nearby Wollaton Park excellent for running, and enjoys the bike friendly environment of our local area. In fact, living in Lenton she is able to cycle on traffic-free routes all the way to the canoe slalom training course at Holme Pierrepont.

Natalie is keen to give something back to the community, and as part of the 'Sporting Champions' programme she has taken on the rewarding role of coaching young people, acting as a role model and encouraging them to get as much from their abilities as they can.

Natalie is enjoying her physics degree enormously, and for the immediate future is balancing the demands of her work and her sport, concentrating on national level competitions in canoe slalom. Beyond that? A big push to be in a position to compete for the UK team at the World and Olympic Championships after she graduates.

Natalie hopes to follow in the footsteps of David Florence, who in his first year after graduating with a physics degree from Nottingham won his first Olympic medal.

"Nottingham is one of the best places in the country to study physics as well as one of the best places to train as a national canoe slalom athlete."

Our students impress at International Physics Tournament

Above: Olympic-style voting at the International Physics Tournament.

Right: Members of the Nottingham team: James Robinson, Sofia Palazzo-Corner, Joe Farrow and Arani Navaneethakrishnan.

The International Physics Tournament invites teams of up to six university students from different countries to compete in challenging, interactive 'physics fights'. Participants solve tricky scientific problems, present them to opposing teams, and dispute and discuss each other's solutions, all set against the backdrop of the Lake Geneva region of Switzerland.

Did you know that if you point a green laser into a cola bottle the beam inside changes colour depending on height; green near the surface of the cola and red at a greater depth? Do you think you could work out why?

In 2013, a team of four Nottingham physics students represented the UK in the International Physics Tournament based at the Ecole Polytechnique Fédérale de Lausanne (EPFL), which is a top-ranked research and teaching institution located in an idyllic spot overlooking Lake Geneva and facing the Alps.

In a competition involving 10 countries, the Nottingham team, comprising Sofia Palazzo-Corner, Joe Farrow, Arani Navaneethakrishnan and James Robinson, tackled a variety of tasks from a list of physics problems designed to be both challenging and fun. Examples included optimising the design of a dart gun, and finding out how tall you can build a sandcastle before it collapses on itself.

The 'physics fights' involved not only presenting the solution to the physics problem, but also opposing or reviewing the solution of another team. Doing this effectively demanded a high level of understanding as well as excellent communication skills, and time was spent before the tournament coaching these aspects.

The Nottingham team were delighted to win three out of four of their fights but didn't quite make the top four. The organisers commented that the first two days of the competition proved the level of all teams was very high, but style differences could be noticed, with each team showing a particular character. The Polish team, for example, impressed with its very structured approach while the British team seduced with a relaxed attitude.

The visit was organised by physics PhD student David Farmer who said: "This tournament was an amazing opportunity and it was great to watch our students get stuck in. I think they all got a lot out of representing their country, not just a free trip to Switzerland!"

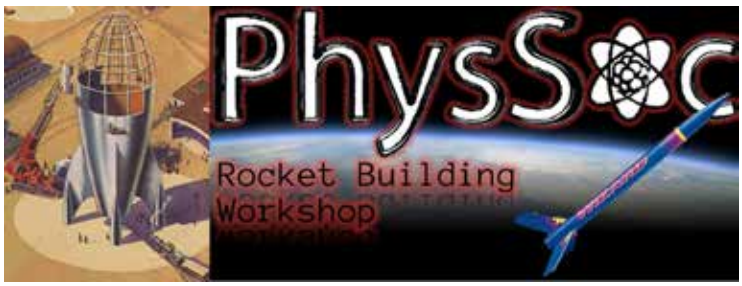
The 'relaxed and confident attitude' of the Nottingham students was exemplified by Sofia who said, "There was lots of physics and fun. That's all people need! My brain also feels bigger". On a more serious note, Arani said, "I've developed my skills in analysing problems, especially in terms of learning how to approach a new problem. My presentation skills have improved, and I think I'm more confident in my abilities".

PhysSoc

Has Wallace and Gromit inspired you to one day build that rocket for a trip to the moon? Or do you fancy some observational astronomy using a high quality telescope?

The University's physics society, PhysSoc, is run by our undergraduate students and organises a wide range of social and physics-related activities.

Whether it's social, physics-related or sporting events, PhysSoc has something for you. This year the events have included a rocket building workshop, training to qualify students to use the school's astronomical telescopes, and masterclass lectures by expert researchers from Nottingham and outside (with free drinks and doughnuts!).



Additionally, social events have included visits to CERN (voted best trip by the Students' Union) and the National Space Centre, as well as slightly lighter activities such as Laser Quest, bowling, a River Trent boat trip and a Christmas party. Each year the range of activities continues to expand.

A particularly successful innovation this year was a 'Meet the lecturers' evening, a sort of academic speed dating event giving students the chance to quiz physics lecturers and professors about their research interests in an informal atmosphere (with appropriate beverages and snacks…). And the year usually ends with a massive summer BBQ to celebrate the examination results.

I'm a scientist – get me out of here

Latest winner of the 'Quantum Zone' in the 'I'm a scientist – get me out of here' online competition is Nottingham physics PhD student, Dave Farmer.

Dave survived an X Factor-style process of elimination over a fortnight in June, voted by students as the best scientist in the Quantum Zone. The competition, which is sponsored by the Wellcome Trust, is designed to get year 8 and 9 students engaged in science through meeting and interacting with scientists. Competitors took part in challenging live online chats, answering questions on physics as well as more general areas of science, such as 'what is the speed of gravity?'

After his victory Dave said: "I came into the event just wanting to have fun and to see how far I got. I'm honestly amazed at the standard of questions we were asked. Quantum physics is not an easy topic to wrap your head around."

Dave was clearly being modest, as a short time later he scooped another science communication award, this time winning the Institute of Physics East Midlands '3 Minute Wonder' competition, where local scientists had just three minutes to amaze and dazzle the audience by explaining their research. In the national finals of the event, Dave will present his talk in the famous lecture theatre of the Royal Institution in London.

You will also have seen previously in this newsletter how Dave has inspired a team of our undergraduates to participate in the International Physics Tournament. For Dave's next project, he has his eye on working with our students to beat a world record; for the biggest potato battery!


Dave Farmer

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