Careers

28 DAYS 28 PHYSICISTS

IOP | Institute of Physics in Ireland

28 DAYS 28 PHYSICISTS

A day in the life of an Astronomer

My day usually begins early, so I can be in the office ahead of the traffic. I check the latest papers which have been published on the astro-ph web listings and download the ones of most interest to me. My research area is in gamma-ray bursts, which is a very hot topic in astrophysics. There are reports of new discoveries almost every day. The bursts are tremendous explosions which we can detect even to the edge of the visible universe.

A career as an astronomer is not for someone who likes the same routine every day (or night). This morning, I need to finalise a proposal I am writing with colleagues, to get observing time on an orbiting telescope, which can detect gamma-ray bursts. There is tough competition to get such data, so I need to make a strong scientific case, backed up by plenty of painstaking research and detailed calculations to show that the instrument has the capability to make the measurements we need.

Although most of my data comes from orbiting satellites, I also make observations from the ground using optical telescopes. A trip to a telescope is fun but exhausting since it involves staying up all night every night for about a week. A plentiful supply of sugary snacks is essential to keep the brain alert at 3am. With large telescopes there are often technical problems, which need to be dealt with on the fly, since there are usually intense time pressures to make as many observations as possible during the observing run.

After working on my proposal for a couple of hours, I need a break and go up to the research lab to see how the postgraduate students are getting on. Two of my students are building a robotic telescope, called Watcher, in South Africa. This will be able to operate automatically and move very quickly around the sky to detect gamma-ray bursts at visible wavelengths. It is a very exciting, but demanding, project and there are always unforeseen issues to be discussed and solved within the team. Today, we are planning our upcoming trip to South Africa to get the system fully operational.

After lunch with colleagues, I look over my lecture notes for my 1st year astronomy class in the afternoon. Preparing course materials takes a long time and I have already prepared this lecture well in advance. Today's topics are neutron stars and black holes. It's wonderful to teach the subject which is closest to my research interests. This course is open to all students and we usually end up having discussions about life, the universe and everything.

After class, I bump into a colleague on the corridor and we end up having a lengthy conversation about how to ensure that our 1st year students really understand the difficult concepts they encounter in physics. Then it's time to put the finishing touches to my proposal before heading home, thinking about clear skies and maybe setting up my telescope in the back garden for some star-gazing. But not before watching the Simpsons with the family!

Lorraine Hanlon

'My research area is in gamma-ray bursts, tremendous explosions, which we can detect even to the edge of the universe.'

Lorraine Hanlon at the 1 metre reflector telescope in Calar Alto, Southern Spain. Lorraine graduated in experimental physics and did her PhD research in astrophysics at the European Space Agency in the Netherlands. She is the Head of the School of Physics at University College Dublin.

A day in the life of a Community Engagement Manager

I work as a Community Engagement Manager with the Inspire Ireland Foundation (www.inspireireland.ie), which uses technology to help young people lead happier lives. A far cry from the lab I hear you say, and you would be right! My work revolves around promoting our new online service ReachOut.com (www.reachout.com) and getting young people involved in improving the service.

My job is pretty varied, but my day usually starts with me coming to the office and checking my emails to see if anyone from our youth advisory network has been in touch. I then go out to meet people on college campuses or youth centres across Ireland. I am usually trying to plan events or workshops with people which we then deliver in partnership with Students' Unions or youth centres. Our events help to promote our work and our workshops focus on storytelling to help young people create interesting personal stories for the site. My day ends when I come back to the office and I send some more emails, maybe write a blog for ReachOut.com or catch up with other staff members and plan the next few days.

I was recently invited to join RTÉ's show Two Tube (http://www.rte.ie/trte/twotube/) as their Science and Technology contributor. I have a regular slot where I talk about the latest news in the world of science and technology. It is great to weave science into TV programmes and inspire people to see science as something useful in everyday life, like in helping people understand the best way to tackle problems or finding out about science events in which they can become involved.

While both of these roles mainly involve marketing and communications, physics has been a great help to me and provided some valuable skills that I regularly use. My physics background helps me to critically and objectively assess what's working best and also helps me to plan ahead in a structured manner. While doing my degree I learned to communicate complex and interesting topics to various audiences, which means that I can communicate our ideas to people easily and effectively. Having a physics degree in my line of work also makes for an interesting talking point at meetings, which is always a good thing!

I never would have guessed my physics degree would have taken me to college campuses where I speak in front of large groups of people about the importance of taking care of their mental health and wellbeing, or working with young people in youth centres on interesting storylines and short films. The skills I learned from physics have been invaluable and allow me to make a real positive impact in our society...it's hard to ask anything more from a degree!.

Vincent McCarthy

'The skills I learned from physics have been invaluable and allow me to make a real positive impact in our society...it's hard to ask anything more from a degree!'

Vincent McCarthy has a BSc in Physics and Maths from University College Cork and MA in International Relations from Dublin City University.

A day in the life of a Computational Physicist

My work day begins around 9:00, depending on the number 10 bus. Sometimes there isn't one for a half an hour and then they come all at once. I always wonder if five 10s come in a row is that the same as one big 50?

As a physicist, I always think about systems and how they work, whether I am at work or, as usual at 8:45 in the morning, waiting for a bus. For example, when the buses get bunched together, should the drivers wait for the lead bus to get ahead before continuing? But, by waiting, no one goes anywhere. And how does the system work when affected by outside influences (traffic, rain, an accident) or, in the language of physics, perturbed by external forces?

Thinking about how things work, from buses to quantum physics, to laser-produced plasmas, are the hallmarks of all physicists.

Having arrived at my office, I start as almost everyone does by turning on my computer. As a computational physicist who specialises in modelling laser-produced plasmas, I couldn't work without an extremely fast computer, capable of performing more calculations than imaginable. If I am developing a model, I spend the day 'running' and testing my program. All the equations get coded into the program. I have to check for bugs, removing anything from typos to correctly coding an algorithm which is the exact 'recipe' for how to calculate a solution.

Then the program is ready for field testing, comparing the theoretical to experimental results. In the Spectroscopy lab, there are experimental physicists, who record spectra, a picture of the light radiation given off at different frequencies. By comparing theory to experiment, we can understand more about the system, in this case the interaction of light and matter. Today, models are at the core of computational physics.

Modelling physical systems is great fun. It's like a computer game, but instead of warding off evil trolls or jumping plumbers with a joystick, I get to create the game, the physics, to help see how the real world works. What could be more interesting and challenging than trying to predict the outcome of an experiment before the experiment?

At the end of my day, I walk the three miles home. It's nice to give atoms and buses a break. Alas, as I walk, I wonder how the traffic button at a pedestrian crosswalk works. That system I may never understand.

John White

'... but instead of warding off evil trolls, I get to create the game.'

John White, a Research Fellow at the School of Physics, University College Dublin.

A day in the life of a Development Aid Researcher

A typical day? I don't think I've had a typical day in a long time. My working life is split into two almost parallel existences. For the past 4 years, in addition to being a physics lecturer in an Irish medical college, I've also been running a multi-country study of solar disinfection (SODIS) of drinking water for use in developing countries. SODIS is a household water treatment where contaminated water is stored in ordinary plastic bottles which are placed in direct sunlight for a minimum of 6 hours. The action of solar heating and solar ultraviolet light combines to inactivate the microbial pathogens in the water. My research involves health impact assessments (HIAs) of SODIS in Cambodia, S. Africa, Kenya and Zimbabwe as well as lab-based research in Ireland, the U.K., Spain and Switzerland (see www.rcsi.ie/sodis) My development aid work in the past has included activities as diverse as chasing baboons away from water holes so that I can take water quality samples, to advising the Minister of Health of the Mexican State of Yucatan on how to use SODIS to provide clean water in a post-hurricane disaster situation.

Last week when I was on an inspection visit of the health impact assessment in Cambodia, my day started at 6.30am. I'd get up, take my anti-malaria pill, check for overnight bites (mosquitoes and bed-bugs seem to love me more than the locals), check my boots for lizards or scorpions before getting dressed, and then meeting the rest of team for a briefing over breakfast. The team consists of Cambodian field officers and data collectors who work with CARE-Cambodia, a collaborating aid agency.

We pile into the SUV and head out. After an hour we arrive in the first hamlet. These are part of the test group so they have been given plastic bottles for SODIS. I check how many participating children are in this hamlet, how many bottles there are and the location where bottles are exposed to sunlight. Through an interpreter I ask if they have any problems or questions. The villagers don't let us leave until after we had a cup of hot tea (it's getting up to 36°C and very humid). CARE have already conducted background tests on the pump water and water stored in the houses. In other countries I've also had to collect samples of the childrens' faeces for analysis of parasite burden, but luckily it's not needed here.

We visit about 8 or 9 hamlets in total. We also must pay our respects to the village commune leaders in each location so that they can tell us how many households are participating and what problems they might be having.

After returning to the "hotel" - I use that phrase loosely since there is no running water, air conditioner, mosquito nets or locks on the door - we have a debrief meeting with the team over a communal meal that evening in a local eating establishment and plan tomorrow's activities. Back in the hotel I drag the bed away from the wall since I've learned from cruel experience that there are few things more unnerving than a lizard falling onto your head in the middle of the night. I'm in bed by 9pm and drift off to the sound of a male gecko telling the local females that he's somewhere in my room but I'm happy in the knowledge that he's feasting on the mozzies that otherwise would be feasting on me!

It's hard but rewarding work that has enabled me to work with some of the most impressive and dedicated people I have ever met. None of this would have been possible were it not for the fact that I was a physicist in the right place at the right time.

Kevin McGuigan

'advising the Minister of Health of the Mexican State of Yucatan on how to use SODIS to provide clean water in a post-hurricane disaster situation.'

Me (on left) with Cambodian villagers whose families are participating in the SODIS study

Kevin McGuigan (on left) with Cambodian villagers whose families are participating in the SODIS study. Kevin has a BSc (Hons) in Experimental Physics NUI Maynooth and a PhD in Infra-Red Semiconductor Spectroscopy from Dublin City University.

A day in the life of an Econophysicist

Arrive at the office, not so early in the morning. I prefer to work during the evenings, it is more inspiring. The first thing that I do is to check the new articles related to my field on the Physics arXiv, an online archive with many of the most recent articles published in a wide range of branches of physics.

I spend some time preparing everything (registration and travel) for a conference that will take place in two months. It is always very important to present our work at international conferences. However, in an interdisciplinary field like mine the comments of researchers from different backgrounds have even more importance.

Because of this, I leave my office to meet a collaborator at the School of Business Studies. Some progress in our work is made when I present him with the new results about the existence (or not) of a real estate bubble in Ireland.

After lunch, I have my Econophysics group meeting. The first topic that we discuss is the future of our work on correlations of stocks on the London Stock Exchange. This work was based on nuclear physics techniques applied to a time series of stocks. A network of stocks, whose connections meant strong correlations, was built to study the cluster of stocks in industrial sectors.

The second topic is about our study on wealth distributions in societies. We compute models and compare it with real data from U.K., Ireland and Portugal. Some of these results are in a chapter that we are writing for an econophysics book.

After the meeting, I return to my office. Back to business on my computer! My work is divided in computational and analytical studies. In the computational one, I construct programs to simulate models or to analyse data. In the analytical study, I work on some maths and physics together to find the underlying nature of theory. Right now I'm developing new routines to one of my programs in order to obtain better results.

Time for a hot cappuccino break. I pick one of the many articles piled on my desk. It is amazing how many different subject areas econophysics is now divided into, and how much work has been done by econophysicists during the last decade.

Around 9 p.m. I leave the office. Stop for some shopping and go home.

Tomorrow, I'm sure that I will meet someone surprised with this word econophysics. After all, that happens every day!

Ricardo Coelho

'We discuss the future of our work on correlations of stocks on the London Stock Exchange which is based on nuclear physics techniques'

Ricardo Coelho studying for his PhD at the office of the Econophysics' group, School of Physics, Trinity College Dublin. Ricardo has a BSc. in Physics from Universidade do Porto, Portugal (2003), a MSc. in Computational Methods in Science and Engineering from Universidade do Porto, Portugal (2004).

A day in the life of a Failure Analysis Engineer

Arrive at the office at 8.30am and log on to my email account. I check to see if there are any important emails from my sales colleagues in Germany. The company manufactures computing chips. As my job mainly involves failure analysis of customer returns it is important that I keep in contact with the sales engineers to prioritise claims. This morning there are no urgent emails so I have the freedom of prioritising my own claims.

I begin analysis on one particular claim which is for an important customer. The first step is visual inspection using a microscope. The device has been in application and is in poor condition so I remove excess flux and solder using a soldering iron.

The next step is IV Curve Trace. This method checks the diode characteristics of each pin on the device. This technique will tell me if excessive voltage or current has damaged any pins. This time, all the pins have passed. Next I x-ray the device to see if there is any internal damage such as broken bond wires or a cracked chip. The device is in good condition and passes x-ray. The next step in analysis is the most important step – the device is tested using a mass production test program. This will test the functionality of the device and from the customers point of view is the main test. The device is tested on a special mass production test board. If it passes this test this usually means that the customer has experienced a problem with their application which is not due to our device. However in this case the device has failed.

1pm – and time for dinner! Now that my most important claim is tested I have time for other issues. Part of my job involves QT testing. These are qualification tests for new devices. Today, one of the QT's needs special analysis. This will tell me if there is any delamination inside the device package. On inspection of the devices, all are ok. This is good news and the people in charge of this device in Japan are informed of our results. They are very pleased.

I now return to my claim from earlier in the day. I examine the datalog and discuss it with my supervisor. We determine the root cause of the fail and I begin writing the report. When the report is finished I send it to the Sales and Marketing representatives in Germany and close it off on our database.

3.30pm – tea break. When I return to the office there are a couple of emails with reports from Japan. It is also my job to check failure analysis reports from Japan and send them to the sales people in Germany.

Every day is different. I get to use complex analysis equipment from locations all around the plant. Some days are very hectic, depending on customer demands. Also, every day brings challenges – a new problem or a new opportunity to learn. Other days involve teleconferences, audits, phone calls with sales engineers, new projects – the list goes on. I finish work at 5pm. I am happy that I have completed an important claim today but I know that no sooner has one important claim finished than a new one arrives in the door.

Paul Noonan

'I x-ray the device to see if there is any internal damage such as broken bond wires or a cracked chip.'

Paul Noonan at work using IV Curve Tracer for analysis. Paul graduated in Photonics from the IT Tralee, then gained a BSc in Physics with Lasers and Photonics from The University of Hull in England.

A day in the life of a Forensic Physicist

Working as a consulting forensic physicist much of my time is spent between the lab and the courts, giving expert testimony with a well balanced practice of defence and plaintiff work.

8.00am. – Meet at a quarry. Examine exploded excavator battery which caused serious injuries to the operator. Dispute on liability between machine operator, quarry operators, excavator manufacturers, excavator maintainers and battery manufacturers. Debate about hydrogen build-up, ventilation, gas sealing, use of conducting tools, previous attempted repairs and training. Photograph and measure anything potentially relevant. Remove battery and hold for laboratory examination.

10:00am. – Attend High Court consultation on eye injury accident from flying staple on a factory production line. Dispute about whether the injured party was wearing his safety spectacles. A trajectory from the staple gun to the eye appears impossible with the glasses on. Could it have tumbled or deflected? My tests say no line of sight, too much aerodynamic drag and too little momentum for injurious bounce or deflection. Injured party was not wearing his glasses. Trial goes on. Plaintiff reviews situation. Case settles for fraction of its value. Physics wins!

11:30am. – Meet Counsel in a road traffic accident. Report already submitted and exchanged with defendants. No agreement.

12:10pm. – Testify at Court on findings of report. Lines of sight, skid marks, vehicular distortion, vault and throw distances and final positions of vehicles confirm plaintiff's version of events. Rigorous cross-examination. Defendants do not call their expert. Plaintiff succeeds. Feeling smug.

1:15pm. – Lunch at the desk. Deal with post and e-mails. Plan some golf.

2:00pm. – Meeting at office with builder who believes his footwear allowed an ankle over-articulation injury. Boots examined. Very poor ankle support. Made to European Certification standard in China but standard does not address ankle support. Should the builder's employers have addressed this themselves? Dispute looming.

3:00pm. – Correct drafted reports. Collate photographs and maps. Pursue solicitors for fees payment. Consult with costs accountants. Most difficult part of the job is getting paid.

4:30pm – Factory meeting. Electric fork-lift truck crushed driver who was standing beside it and switched it on from the outside. Should not have been possible. Dead man's switch should have prevented activation. Used in cold room. Controls frozen? Transpired that ice build up on dead man's lever arm under foot pedal was keeping it depressed and effectively bypassing it. Maintenance issue, but should truck manufacturers not have anticipated it so that it locked out and would not start with the dead man's switch bypassed? Machineries Directive. Was it certified for cold room use? Suppliers run for cover.

7:00pm. – Dictate report on the way home.

Pat Culleton

'Case settles for fraction of its value. Physics wins!'

Pat graduated from Trinity College Dublin with an MA in Experimental Physics and continued his studies with postgraduate engineering, geotechnology, computing and environmental engineering qualifications from University College Dublin and TCD. He founded PLC Engineering, Consulting Forensic Engineers and Scientists in 1989.

A day in the life of a Games Developer

Working as a producer with IO Interactive, creator of such computer games as *Hitman* and *Kane & Lynch: Dead Men* brings me into contact with all the varied aspects of the company from programming, art and animation to PR, brand and marketing and, best of all, playing. Game development always seems to be in a state of flux and I find that the analytical and problem solving skills provided by my background in experimental physics helps me control this continually changing environment.

9:30 – Start the day by collecting some coffee and a croissant from the canteen on my way into to a meeting with our outsourcing manager. We are planning on producing seventy percent of our graphic assets for this new game in Shanghai. Luckily our company's line art director in China was the art director on *Kane & Lynch* – a game we finished last year so I know him well.

10:45 – Straight from the last meeting into another one – this time about staffing. We have 4 projects running here at IO all at various stages of production and a limited number of elite staff. This translates into 4 producers fighting tooth and nail for the best people. My team is at a very early stage in production and we have 3 of the best people in the company on a team of 6, so no stress at this meeting for me.

11:30 – Finally get up to my team – things seem to be going great – the feature set for our next company demo is nearly complete and our art direction is finally heading in a direction we all agree on.

11:45 – Time to deal with mail. There are lots of externals that need looking after as that's my job too – dealing with brand, marketing, PR etc.

12:00 – On the way up to lunch I notice people crowding round the many 50" screens scattered through the building – I had forgotten that the latest version of one of the most popular games of all time has been released today – well that puts paid to any real work getting done today.

13:00 – On the way down from lunch I can see that the new game has penetrated nearly every office I should really do something about this, get them all back to work – but on reaching my office I find some serious research has arrived on my desk and I sit back with the controller in my hand and get to work checking out the latest from our competition.

17:00 – Is it that time already? Woops ☺

Hugh Grimley

'...our art direction is finally heading in a direction we all agree on.'

Hugh Grimley graduated from University College Dublin with a BSc Hons in Physics in 1989.

A day in the life of a Geophysicist

Today's a day for data acquisition. I will be collecting broadband magnetotelluric data throughout Botswana.

7am, the team of 12 meets for breakfast to discuss the plan of action. Decide to split into 3 groups, each group pulling one recording unit out of the ground and putting a new one in further down the line. After packing up the landcruiser with all the necessary equipment and fuelling up, my group of 4 hits the road. When we get to our first site, the first thing I do is ensure that the unit is still recording and that the site has not been disturbed. There is a lot of local wildlife that enjoys chewing on wires nosing around the instruments! If all is well, I download the data and have a quick look at the time series to be sure that the equipment was working correctly before removing the equipment.

Magnetotellurics (MT) is a method that provides information on the electrical conductivity of the Earth by measuring the natural time-varying electric and magnetic fields at its surface. These fields are generated from electric currents that are produced from natural variations in the Earth's magnetic field. The project in Botswana is part of a larger effort to understand the conductivity structure of the deep crust and upper mantle beneath Southern Africa. This involves putting in stations every 20 km along a profile, or highway, and allowing them to record for 3 days with the hope of obtaining information from depths of 150 – 200 km. Today we are working on the profile between Francistown and Kasane.

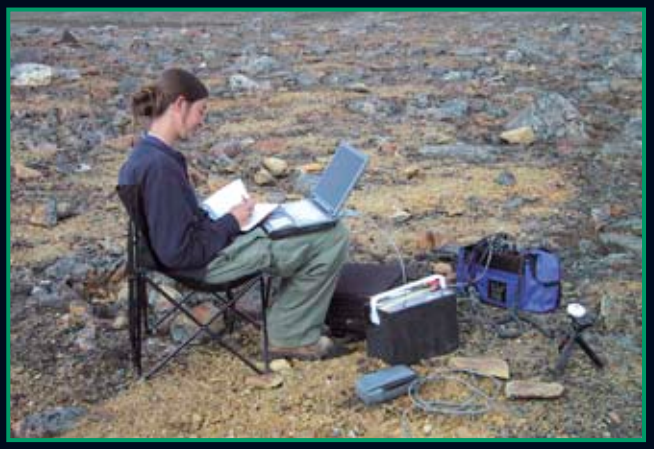
Setting up a new site is not quite as easy. After driving over 60 km down the highway to the next location, we drive around the area to find someone who works locally on the land. Good thing we have a local Setswana speaker with us, the farmer is able to find us a great spot under a large shady mopane tree where we can keep the recording box out of the sun. Installing the site takes about 2.5 hours, and most of that time is spent digging holes for each of the sensors. I then attach all the sensors to the recording box and set it to record data for the next 3 days.

On return to the lodge, there are a few chores to be done. The batteries that power the instruments need to be charged, the trucks tidied, equipment problems need to be tested and fixed, and accommodation needs to be booked for the following night. If we are going to be camping we will need to do some grocery shopping.

After a quick clean up, I then sit at the computer and back up the data from the three sites collected that day. The data is quickly processed giving us an indication of any changes to the site installation that are necessary the following day. If I have time, I will run more complex processing and edit the response curves so that each site will be ready for 2-dimensional modelling when we return to Dublin. But for today, I will enjoy the fantastic African sunset before the group meets again to discuss the day's events, and plan for tomorrow.

Jessica Spratt

'There is a lot of local wildlife in Botswana that enjoys chewing on wires nosing around the instruments!'



Jessica Spratt, Geophysical Research Technician from Dublin Institute for Advanced Studies, setting up a recording box on central Baffin Island, Canada. Jessica has a BSc in geology and an MSc in geophysics

A day in the life of an Imaging Processing Researcher

As an imaging processing researcher, I work with colleagues to uncover and develop exciting new technology for digital still camera (DSC) image enhancement. Image enhancement technologies (such as red eye removal and face detection) are the brain child of researchers and engineers in Ireland. These and other innovative software solutions can be found in an estimated 80 million digital cameras worldwide. Tessera, the company behind this innovation through its FotoNation technology, has headquarters in the USA and a significant R&D office in Ireland in Galway.

The world of digital cameras is rapidly evolving as expectations and the use of images change. With the increasing inclusion of cameras in mobile phones, the type, and the very way, images are being taken is shifting. Manufacturers in the highly competitive digital camera market face continuous pressure to reduce the cost of cameras without compromising the quality of the images. This is where my colleagues and I come in. It is apparent that, traditionally, the dominant factor in determining image quality is the optics, that is, if you want a good image use good optics. However, size constraints and the ever-decreasing footprint of imaging devices are compromising the quality of imaging lenses. We recognise that, at a certain level, imaging imperfections that were traditionally met with a correction at the optical source, can now be corrected or compensated in the digital domain - offering a smart solution which unburdens the optical designer. These solutions also are designed to not only correct imperfections, but to enhance the imaging capabilities of the camera modules.

On an average day I begin by checking my emails, deal with current business and then sift through any email alerts from the main optics journals. This helps me keep abreast of new optical research findings. At some point during the day I consult with my colleagues on recent progress or to discuss new strategies for techniques which may lead to a unique and worthwhile solution. I say unique because in industry intellectual property is protected and we all have to be sure that any correction solution does not infringe on the work of others, and that it can itself be protected. I work closely on projects with one colleague in particular for which we have regular meetings and discussions with the research manager. This is where progress on a specific project is charted and the next step in research direction determined.

I am periodically assigned a new project. It could be an entirely new area of research seeking to overcome an imaging problem or it might overlap a previous project that needs integration of a new solution. Evolving and changing projects ensures that research is kept fresh and current. In fact this keeps it more that current, because, after all, research in this field determines and creates the technology of the future... whatever it may be.

Larry Murray

'Manufacturers face continuous pressure to reduce the cost of cameras without compromising the quality of the images. This is where my colleagues and I come in.'

Larry Murray graduated with a BSc in Physics with Astrophysics from Queen's University, Belfast, in 1999 and MSc in Opto-electronics and Information Processing Theory, also from Queen's, in 2000. He then spent a year at New Jersey Institute of Technology (NJIT), New Jersey taking graduate courses, and spent 6 months in Sunspot, New Mexico, at the National Solar Observatory doing research. All of which was part of a Ph. D. in Solar Physics. However, on his return to Ireland he began another Ph. D. in 2002 in the Applied Optics Group at NUI Galway and graduated with a Ph. D. in Applied Optics in 2007.

A day in the life of a **Laser Physicist**

I work as a Senior Laser Engineer in a company that designs and builds laser machining tools.

9.00am – My typical day starts with a project planning meeting to ensure that my team and I are clear on what we need to do for the day. We discuss problems or issues encountered in the previous day and talk about the work plan for the current day.

My job is to investigate new laser processes for our existing and potential customers. This involves determining what type of laser, and laser conditions, to use on different types of customer wafers. Our customers typically manufacture computer chips and memory devices. Amongst other work we machine small features such as holes, trenches and slots on such device wafers.

10.00am, the engineers working for me start processing work in the lab. It involves a series of experimental tests to determine the optimum laser conditions for machining a particular customer sample. We change parameters such as laser beam size, laser focus, laser repetition frequency, laser wavelength and laser pulse energy in order to determine the optimum machining conditions. After machining we conduct tests using an optical microscope in order to assess the quality of the laser machined features.

Throughout the day I pop in and out of the lab to see how things are going, discuss progress and analyse samples that have been machined. Once we have decided on a suitable process I will write a report for our customer that details our experimental results and provides a detailed analysis of the features we have machined.

Other aspects of my job include visiting customers to see how their laser tool is performing and assist in their process development work on-site if required. This involves travelling within Europe, the US and Asia for a short visit, or sometimes several weeks, depending on the customer requirements.

A few times a year I visit laser vendors to perform sample testing with some of their new prototype systems to assess if we can expand our customer base by integrating a new laser with different performance characteristics onto a new version of our machine.

The day draws to a close with most problems ironed out and I start to think about tomorrow, which includes a visit to a potential customer to assess their application. I'll have to decide if technically our machines can perform to their conditions or if we need to alter our tool/laser process in order to meet their requirements.

Oonagh Meighan

'This involves travelling within Europe, the US and Asia for a short visit, or sometimes several weeks.'

Oonagh Meighan (seated) at an optical microscope, analysing laser machined samples. Oonagh graduated with a degree in Applied Physics and a PhD in Experimental Physics from Dublin City University.

A day in the life of a Low Yield Analyst

My work as a Low Yield Analysis Engineer is based at the Intel FAB 24 site in Leixlip, Co. Kildare. The company is the leading semiconductor manufacturer and produces microprocessors and chip sets used in desktops, laptops, servers, home entertainment systems, mobile phones, digital cameras and mp3 players. Microprocessors, referred to as 'die', are manufactured on circular silicon wafers and are transported to each manufacturing step in groups of 25, known as a 'lot'.

The Low Yield Analysis group (LYA) is one of six sub-groups within the Yield Department. LYA engineers and technicians operate as 'forensic' scientists in the plant, investigating why and how the yield on any 'lot' is below target.

My day starts at 8am with ergonomic stretching exercises with others from the Yield department in Intel. At 8.15am The LYA engineers meet the Failure Analysis (FA) technicians for task up-dates.

All wafers undergo a series of electrical tests and are categorised according to their failure mode. My job involves analysing the pass/fail trends in this data (called sort data) along with other parameters and statistics to ascertain if and why something went wrong in the manufacturing process flow. The job also involves examining lots that are held at end-of-line, due to any variation in standard processing. Such lots cannot be released until reviewed by LYA. Another aspect of our work involves split lot analysis whereby some of a lot purposely receive non-standard processing – experiments carried out in a bid to qualify the introduction of a modified process step with a view to improving yield trends.

11am – our group meet for a daily huddle (or cuddle as it is often referred to!). During this time we categorise all lots that have reached end-of-line and delegate work appropriately.

12 noon – lunch time: today we have a lunch time party to celebrate a key milestone on Intel's new factory FAB 24-2 road map – we have a mini-Olympic games. The music is blaring, popcorn and candy floss are flowing.

1pm – The yield department meeting with all Group Leaders present. I am presenting on behalf of LYA today and am sort of nervous as I am still relatively new to this job. The yield model needs to be run before the meeting – hope it matches or runs close to the actual yield. If not there will be some explaining to be done. The meeting goes according to plan. I also have to make this presentation at our 'virtual factory' meeting (phone conference) this evening with our colleagues in Portland, Oregon and New Mexico.

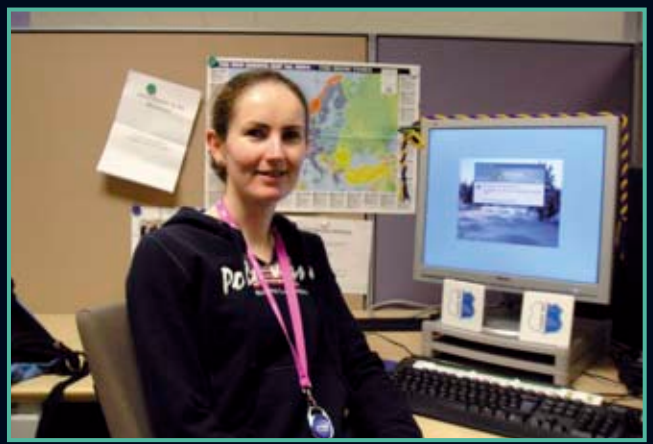
There are thousands of instructor-taught and web-based training courses at Intel. I schedule myself for at least one course a week – this week I will complete a course on effective meetings.

In addition to my engineering chores I also take part in a number of community projects such as teaching internet skills to students with learning disabilities, and involvement in promoting science and technology in schools.

5pm sees the end of the working day…. time for a 10 km run to recharge my batteries.

Emily Gleeson

'Low yield analysts operate as the 'forensic' scientists in the plant'



Emily Gleeson followed her double honours degree in Experimental Physics and Chemistry with a PhD in Far Infrared Space Applications (NUI Maynooth).

A day in the life of a Mathematical Modeller

For me there is no such thing as a typical working day; no two industrial mathematics problems are the same, but one thing is common – they always include maths and physics in one way or another.

I walk to work, rain or shine, wellies or sandals, it is a good start to the day for a non-morning person! I usually arrive at the University of Limerick around half nine, and begin the day by replying to any pressing emails, and checking the results of any simulations that I have left running overnight.

In 2008 I completed my PhD in the mathematical modelling of noise and vibration problems in geared systems, such as car gearboxes, wind turbines, and vacuum pumps. Currently I am applying similar techniques to cam-shaft follower systems found in car engines, and magnetic bearings used in kinetic energy storage release.

I usually spend my mornings analysing any new results, looking up and reading relevant papers, and sometimes making a phone call to my collaborator in the National University of Ireland Galway if I find something intriguing to discuss. This morning, with the help of Google Translate, I am reading a German MSc thesis on the dynamics of a cathedral bell that won't ring reliably. I make notes as I read, and highlight the key equations.

After an essential coffee around 11, I meet an internship student whom I have been supervising this summer. She has to give a presentation on her project later this week, on the dynamics of the double pendulum, and she is understandably a bit nervous. I listen and comment on a couple of practice runs, until she feels more confident.

Lunchtime arrives quickly, and it's time to get some fresh air. At least a couple of times a week and weather permitting, I try to go for a walk or a run along the tow path next to the river Shannon. It's a good way to catch up with friends, and make the most of working at such a beautiful campus.

Back at my desk I write a couple of emails to check that the volunteer team I am leading are up to date with the interactive physics tricks we'll be performing at this year's Taste Northern Ireland festival in Belfast next month. Outreach activities are a way in which I can share my passion for my subject, and try to enthuse others about science. I should really dedicate some time to start planning some activities for Maths week in October...

Often my day involves preparing for teaching undergraduate tutorials, teaching is a constant challenge and helps keep me on my toes! This year I have taught first-year calculus, third-year engineering maths, and fourth-year mathematical modelling, with sizes of tutorial groups ranging from 3 to 40. The students are still on summer holiday, so today I can postpone any preparation until the start of the semester in a few weeks' time.

4pm, time now for the weekly seminar run by my research group, the Mathematics Applications Consortium for Science and Industry (MACSI), who were established in 2006 to act as a mathematical modelling consultancy to Irish companies. Today's problem involves investigating cheaper alternatives to a widget in a can of Guinness. Previous problems have ranged from resolving discrepancies in measurements of milk before and after transportation from farm to dairy, to discovering the causes of defects in contact lenses. In each case, a mathematical modelling approach is used to capture the essential phenomena in the simplest possible way, and to provide practical solutions to industry.

By 6:30 I'm ready to leave the office. At least one evening a week I go into town to use the pottery studio that I share with six others. I find making large, abstract, and non-functional sculptures a refreshing change from maths! Although one of these days I plan to make some colourful Penrose tiles...

Joanna Mason

'In each case, a mathematical modelling approach is used to capture the essential phenomena in the simplest possible way, and to provide practical solutions to industry.'

Joanna Mason, postdoctoral researcher, maths busking in the Limerick milk market during Maths Week. Joanna has a BA in Mathematical Sciences from Oxford University, an MSc in Mathematical Modelling from University of Bristol and a PhD in Engineering Mathematics from the University of Bristol

A day in the life of a Medical Physicist

It's only 8:00am but in one hour patients will be arriving for their Nuclear Medicine scans, so need to get those injections prepared. This is my first task of the day, combining pharmaceuticals with radioactive tracers to make up all the different patient injections.

When injected, this radiopharmaceutical will travel to certain parts of the patients' anatomy. Then we can use a Gamma Camera to image that part of the anatomy. The images are used for diagnostic information and to help make clinical decisions.

I work at a specially designed cabinet in the Radiopharmacy. The cabinet is shielded with lead, which will attenuate almost all the radiation that I'm working with. I have to manipulate vials and syringes of radioactive material but it is all contained in lead pots and lead syringe shields so I am very well protected from the radiation. Some of the radioactive material needed for today's clinic comes ready-prepared in capsules from the manufacturer, in which case I don't have to prepare the injection. Instead, I measure the activity of each capsule in a dose calibrator and make sure it is the correct dose for the patient. I know it has decayed since the manufacturer measured it, so I calculate the expected activity and this matches well to what I measured in the dose calibrator, so I'm happy with my results.

I'm finished in time for a 9.30am meeting with a consultant dermatologist to review our progress on a research project we're undertaking in Ultraviolet Phototherapy. UV radiation is used very successfully in hospitals to treat skin conditions, but the dose has to be very carefully controlled. We are investigating the different methods for testing the patients' skin before treatment starts – there's always room for improvement and new devices coming on the market all the time. The project is progressing well so we decide to submit our results for presentation at an upcoming scientific conference…. it will be good to share the results from our study and hopefully get some feedback from other physicists.

After lunch, it's over to the university part of the hospital to give a lecture to a group of doctors and nurses about laser safety and the hazards they might encounter in the course of their work. The group is full of questions and we have a good discussion afterwards about their practical experiences with lasers. I drop into the library after the lecture to download a new report on X-ray image quality as I'm testing a new digital X-ray room next week - no more films! Will have a read of it for any new recommendations, but I'll have to leave that task until tomorrow.

Una O'Connor

'My first task of the day is combining pharmaceuticals with radioactive tracers to make up all the different patient injections.'

Una O'Connor at work in St. James's Hospital Dublin processing Nuclear Medicine images taken with a Gamma Camera. Una graduated with a BSc in Applied Science from Dublin Institute of Technology and then gained an MSc in Physical Sciences in Medicine from Trinity College Dublin.

A day in the life of a Meteorologist

My night duty as weather forecaster in Met Éireann's forecast office begins at 10pm. On arrival in the forecast office I am briefed by the evening duty meteorologist. They will give a run down of the current weather situation and walk me through the forecast for the next week or so, highlighting any severe weather expected.

Once the evening forecaster departs I have a few busy hours ahead of me. I must prepare for the live radio broadcast scheduled just before midnight. I will need to analyse the forecast charts produced by computer forecasting models. These computer models predict atmospheric conditions like air pressure, temperature and precipitation. It is my job to assess this information and convert it into a format that can be easily used by our customers, the public.

Using the new model data and taking into account the current weather conditions I will update Met Éireann's national forecast, a concise text describing the weather for Ireland for the next 24 to 36 hours. This national forecast is posted on our web page (www.met.ie) and on RTÉ teletext. At 11pm a second forecaster comes on duty for the night I take some time to brief him fully.

My next task is to prepare a sea area forecast for the waters around Ireland focusing on the winds at sea over the coming 24 hours. Also, before midnight I need to prepare a radio script covering the expected weather over the next few days. Just before midnight I go into our small radio studio, just beside the forecast office. I phone up the sound desk in RTÉ Radio 1 and we do a sound level test. Shortly after I will go out live on air broadcasting the 1 minute general forecast script and the sea area forecast.

Between midnight and 3am the forecast office is rather quiet. I need to continue to analyse the weather, each hour we get reports in from Met Éireann's stations about the country. I need to ensure that the forecast is on track and make any amendments if necessary.

At 3am things get busy again and stay that way until my duty ends at 8.15am. New output from computer models will become available. Both forecasters on duty will analyse this data and will finalise the forecast for the day ahead as well as the outlook for the coming week. I will focus on the next 24 to 36 hours and if any severe weather is expected I will issue warnings. My colleague on night duty will concentrate on the longer range forecast and will write and record the forecasts used on our Weatherdial service. I will update Met Éireann's national forecast and produce an updated sea area forecast which I then broadcast just after 6am on RTÉ Radio 1.

My final task is to prepare a radio script covering the general forecast for the coming week and deliver this forecast on Morning Ireland, just before the 8 o'clock news headlines. After this broadcast my relief forecaster will have arrived and after briefing them I can head home to bed!

Sarah O'Reilly

'..and if any severe weather is expected I will issue warnings.'

Sarah O'Reilly, at work in Met Éireann, has a degree in Theoretical Physics from Trinity College, Dublin and a PhD in Atmospheric Physics from NUI Galway.

A day in the life of a Nanotechnology Researcher

8.45am – a rushed start this morning with a 9.00am lecture followed by a teaching lab session at Dublin City University.

My job description is a university physics lecturer. However, I am involved in an active research group in studying nanostructured semiconductors. Certainly that is a mouthful, and not a good thing to try to rhyme off the cuff on Monday morning! Nanostructures are materials systems, which have structured features on the scale of 100nm or less (less than 1000 times the width of a human hair!).

After lunch I meet with my research group (one postgraduate student and one postdoctoral fellow). At present we are trying to understand how we can tailor the structure of zinc oxide nanorods so that we get nanorods growing on top of a network of nanowalls, as shown in the left hand panel of the figure below, rather than simply growing as separate little pillars (shown in right hand panel). The width of these little pillars is less than 100nm. The problem is; none of us know how to do it so that it works every time. We discuss the possible options, what might be going on and how we can control it. Actually this is the key to our research, trying to develop control of the growth processes so that we are confident in our methods. We need to understand the physics, some chemistry and some engineering to do this: we are at the interface of a number of disciplines.

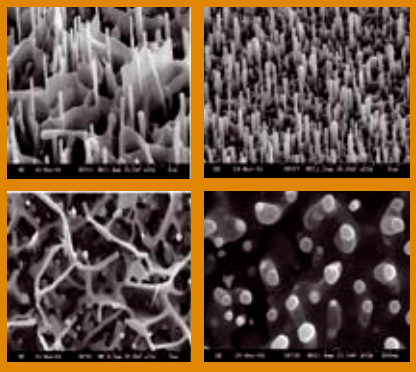
Zinc oxide (yes, the stuff in skin creams) has great potential for use in next generation UV and white light sources for data storage, energy efficient lighting and displays. Nanostructures based on zinc oxide may produce exceptionally efficient device structures. Hence the large mouthful used earlier in describing my research work.

By 4.00pm I'm ready to have a cup of coffee and a chat with my friend and colleague, Paul van Kampen, whose research is concerned with the best ways to teach physics. We talk about everything, physics, research grants, families and football and everything in between. Paul often has useful insights about my work, and occasionally I can repay the favour.

At the end of the day, when things have quietened down I will do the usual things, answering emails, clearing forms on my desk, trying to finish off writing a research paper for a journal on some previous results from our lab, and prepare for the next day's challenges!

Enda McGlynn

'We need to understand the physics, some chemistry and some engineering to do this'



Tilted (top) and perpendicular (bottom) views of ZnO nanostructures on sapphire, with nanorods & nanowalls (left hand side) and just nanorods (right).

Second level teacher and visitor to the group, Ms. Claire Kelly (front right), R.T. Kumar (back) and Enda McGlynn in the nanostructure growth laboratory. Enda graduated from Dublin City University with a BSc in Applied Physics followed by a PhD in Solid State Physics.

A day in the life of an Onboard Geophysicist

11pm – time to get up and make the short commute from my cabin to the instrument room on a seismic research vessel operating in the North Sea. I am working the night shift as an onboard geophysicist for a marine geophysical data acquisition company. The data we acquire is used by our client oil & gas companies in their exploration for hydrocarbons deep within the earth's crust.

A seismic survey is a 24/7 operation therefore we spend an extended period (typically 4-5 weeks at a time) in the field both living and working aboard the vessel. With around 15 different nationalities onboard it certainly makes for an interesting work environment!

There are only four geophysicists onboard so two of us are relieving the guys who have been on-duty for the previous 12 hours. Hand-over takes place and we discuss the previous and upcoming shifts. Tonight operations are shut down due to rough seas we've being having over the last few days. With terabytes of raw data being acquired during the survey we have plenty of keep us occupied though!

The technique used to get our data is called "reflection seismology". We specialise in a type of seismic called OBC (Ocean Bottom Cable). Sound energy is sent into the earth where it undergoes a complex series of reflections through the various rock layers comprising the earth's crust. Sensors embedded in arrays of cables stretching several kilometres along the sea-floor detect and measure this reflected energy as it returns to the earth's surface. The data we acquire will be used to build a detailed 3D image of the subsurface which will aid in the recovery of oil or gas from the targeted reservoir.

Tonight I'm spending most of my shift analysing data quality. Among other things this involves checking for irregularities due to issues such as faulty equipment or seismic interference (i.e. noise). Highly significant issues may require data to be reacquired so it's important that those found are thoroughly investigated and detailed records are kept.

Breakfast at 05:30 means it's time for a break and a chance to watch the sun rise over the north sea....then it's back to work.

We can use the seismic data to supply us with some valuable information, for example we determine the positions of the sensors on the seafloor to an accuracy of about +/- 1m...no mean feat considering they're covered by 100m of sea! An analysis tool being set up will also use the data to help us determine a sound velocity model for the rock layers in the subsurface. It's amazing what you can decipher from a few squiggles on a computer screen.

Apart from analysing data other tasks that need to be taken care of include maintenance, repair of equipment and safety monitoring. If something breaks out here you don't have much option but to fix it yourself.

Shift ends with hand-over at 11:45. After shift I usually unwind by going to the gym, we have a 1.5 hour safety meeting later though so maybe not today...the joys of working the night shift!

Mark Connolly

'If something breaks out here you don't have much option but to fix it yourself.'

Mark Connolly on deck in the North Sea, about 75km off the Shetland Islands. Mark has a BSc in Applied Physics from Dublin City University

A day in the life of a Particle Physicist

12 o'clock – My day starts at the Fermi National Accelerator Laboratory near Chicago. That's 12 midnight, not noon!

The proton and anti-proton beams of the Tevatron collider circulate 24 hours a day, smashing together 10 million times a second. Each time they interact, they produce a miniature fireball, recreating conditions that last existed less than one billionth of a second after the Big Bang.

Tonight I'm part of the team operating the 'camera' that photographs the explosions. Our 'camera' is a specialised detector that took 500 physicists ten years to build. About the size of a two-storey house, we can take pictures with a precision of one hundredth of a millimetre, allowing us to obtain remarkable images of the decays of subatomic particles.

There are three of us in the control room tonight. One person co-ordinates our activities, another is responsible for storing the data, while my job is to monitor detector conditions and data quality. In front of me are eight monitors, each displaying a series of plots which so far suggest everything is proceeding smoothly.

Suddenly one of the screens flashes red – all is not well. Investigating further I discover that the voltages on one sub-detector have gone to zero. I follow the recovery instructions, but without success. After a brief discussion, we agree that to solve this we need expert intervention. We make a phone-call to the relevant expert (about 20 people are on-call 24 hours a day to solve specialist problems) and at 3:30am, a rather tired but obliging physicist arrives and after half an hour succeeds in fixing it.

The rest of the shift is uneventful. I complete my report and hand over to the next crew that arrive in at 8am. Time for me to get some sleep!

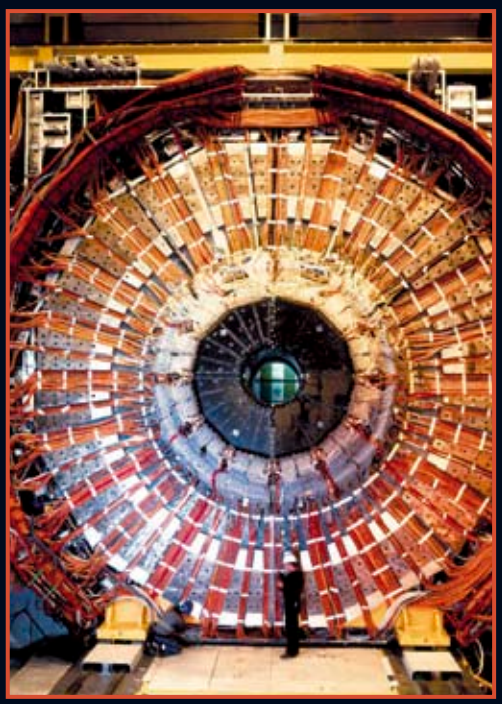
At 3pm I come back to the laboratory for an important meeting. In analysing data taken over the last two years, one of the physicists thinks they may have discovered a new particle that suggests that we all live in a super-symmetric world where each everyday particle like the proton and electron has a rare super-world partner. If correct, this could be a Nobel prize-winning discovery!

'If correct, this could be a Nobel prize-winning discovery!'

Not unsurprisingly, many people are sceptical of the claim so the meeting is quite lively. The proponent of the signal makes a detailed presentation. Immediately he is presented with a barrage of questions: how well is the energy resolution known? How were the calibrations determined? Can the precision quoted be justified? Like a skilled barrister in a courtroom he defends his position, but in our case, the final arbiter will be truth itself. For every claim or counter-claim, the data itself can be interrogated for an answer.

The meeting finishes at 6pm without a firm conclusion as to the veracity of the proposed signal but a clear programme of work has been defined that will let us decide the issue using rigorous scientific criteria. My student volunteers to perform an important crosscheck that will settle one of the arguments. The truth lies hidden in our data, and the job of the scientist is to liberate these truths.

Ronan McNulty



The DELPHI particle detector at CERN where Ronan worked for ten years. He graduated with a BSc Joint Honours in Experimental and Mathematical Physics from University College Dublin, and a PhD from Liverpool University.

A day in the life of a Physics Lecturer

First job of the day – ensure I am in the right place! I work both as a lecturer in the Physics Department at University College Cork and conduct research in the Photonics Centre at Tyndall National Institute - juggling two locations takes a lot of forward planning.

Most days, I concentrate on teaching activities in the morning and then head to Tyndall in the afternoon to meet with my team of researchers that makes up the Quantum Optics Group. This morning I am with a large group of budding engineers giving a lecture on mechanics.

All our final year students conduct research projects as part of their degree programme. Today, after the lectures, I spend a couple of hours helping to bring together compatible students, projects and supervisors. The match is important to make sure that the student has an enjoyable experience, learning new skills that he or she will use in the workplace or if they choose to study for a higher degree such as an MSc or PhD.

Once teaching is over, I head to the research laboratory to see how things are going there.

The lab is a hive of activity with a number of experiments running. In one experiment we have a really complex optical and vacuum setup where we cool rubidium atoms down to 50 microKelvin using a technique known as laser cooling. This allows us to study the quantum nature of atoms - a very hot topic in physics as a quantum revolution is taking place. Tried and tested theories are now being used to realise a host of quantum-based technologies such as computing, sensing and information security. There's so much instrumentation being used for the laser-cooling setup that it is quite daunting and a real challenge to master. We use a very expensive and delicate infra-red laser system for this experiment: the laser beam consists of a stream of light particles known as photons. We shine the laser onto rubidium atoms and, on collision, each photon removes some energy from each atom. This slows each atom down, thereby reducing the average temperature of the atoms.

In another experiment we explore novel types of laser systems, known as microlasers due to their size. The microlasers we use are about the size of a speck of dust and can often be confused with just that! When working, they emit bright green light because of the materials they are made of (glass doped with erbium ions). These microlasers can be used for a lot of different purposes and need to be pumped optically in order to emit the green light. One exciting use of these lasers is as miniature mechanical systems for switching devices in optical circuits. To make the microlasers we shine light from a very powerful CO_2 laser onto some glass powder to melt it – when the CO_2 laser is on we have to be very careful since it could immediately burn a hole in human flesh or cause blindness.

I need to organise a trip for myself and one of my research students to visit our collaborators in Germany and Austria next month. The research group meet to discuss who should travel and the benefits to the people involved- there are usually more volunteers than places so this is a tough decision to make.

At 4pm I'm off to meet a visiting US professor who is giving a talk on "50 Years of the LASER" to celebrate the laser's historic birthday since it first come into operation in 1960. This is part of a series of seminars for all the staff and students, which I organise, so I'm delighted to see a good turn out.

7pm and time to leave. I list all the jobs to be tackled tomorrow and send e-mails to the researchers to make sure they know what to do. Another work day is over and I'm off to the gym to relax.

Síle Nic Chormaic

'we cool rubidium atoms down to 50 microKelvin using a technique known as laser cooling.'

Physicist Síle Nic Chormaic attending an atomic physics conference in Australia. Síle has a BSc in Experimental and Mathematical Physics from NUI Maynooth. She then gained an MSc in atomic physics from Maynooth and a PhD in atom optics from Université Paris-Nord.

A day in the life of a Physics Student

Thursday is our longest day in college, but it's also our most varied: a three-hour lab session, followed by three lectures. We kick off at 10am, with General Labs. Today, my lab partner and I are measuring the radioactive decay of the Barium-137 isotope in real-time – it takes about half an hour to decay fully, so we can measure it in the lab, which is pretty remarkable. Our data fits an exponential decay curve nicely, so we're very pleased.

1pm: We have an hour for lunch. We eat in different places on campus every day but today we head to the restaurant. There are ten or twelve of us, and we have a great time chatting about last night's TV, funny stuff people came across on the Internet, and the Physics night out in town that's planned for next week, among other things.

2pm: The first of our lectures is Quantum Physics. The course covers topics we're familiar with from the Leaving Cert., like the Photoelectric Effect, and goes all the way through to concepts like Heisenberg's Uncertainty Principle and the Schrödinger Wave Equation. It's a very interesting and popular module.

3pm: Maths. This semester, we're studying Calculus of Several Variables, which is basically differentiation in three dimensions. While the concepts are new, the actual calculus is pretty much Leaving Cert. standard.

4pm: Last lecture of the day, Relativity and Nuclear Physics. We've been looking at Einstein's theory of Special Relativity; $E=mc^2$, time dilation, length contraction, relativistic momentum and energy, the twin paradox… there are a lot of strange and fascinating effects that occur at velocities close to the speed of light.

5pm: Lectures are finished, but a student's day is never complete without some hanging around, so we go to Zero One, the café underneath the library. One of the nice things about Physics is that it's a niche subject, so the people who study it tend to have a lot in common. Because of this, the class get along really well, and we can talk, literally, for hours on end. After one of our exams last January, we sat down in Zero One at 11:30am, and didn't leave till after 4:30pm!

'the class get along really well, and we can talk, literally, for hours on end.'

Tonight, though, it's been a long day, and most people have gone by 6pm. We're off at 1pm tomorrow, so we'll have more time for hanging out, and hopefully a few games of pool as well.

Catherine Doyle

Catherine Doyle in the Physics computer lab in Dublin City University during her second year of a four-year Applied Physics degree.

A day in the life of a Physics Teacher

Just because you have a timetable for the day doesn't guarantee that all will go as planned. I'm in my lab early, intent on getting a projectile experiment set up. However, pupils and colleagues drop by to say hello, another Physics teacher asks me about the best way to introduce potential difference and before I know it, it's time to register my tutor group. Achieving time dilation would certainly make my job easier! In my first class, Year 11 pupils hand in their homework on "Waves and Sound". Flicking through their work, I stop – "Sarah, why do you have "Henry the Hoover" on your poster?" "That's easy – it's because sound can't travel in a vacuum". I smile to myself as adverts for revolutionary "silent" vacuum cleaners scroll through my mind. I'm struck again by the conflict for pupils between everyday vocabulary and the language of science.

"Hey miss – guess what?" Jemma announces as she explodes through the door after break. "When I was in Tesco's yesterday with my mum, she got a shock off her trolley. I said to her, "We were learning about that in Physics. It's to do with friction and the electrons moving." A volley of contributions from the class follows about their "static" experiences. Inwardly, I'm jumping for joy – it's encouraging to see pupils realising that Physics really is relevant. The Van de Graaf generator lesson today will provide a few shocks – none greater than the sight earlier of our technician brushing Barbie's hair to ensure a truly hair-raising experience.

A-level classes are one of the highlights of my day. The teacher-pupil relationship is different from that with younger classes, and I feel more like a "facilitator" of learning. I love being challenged by a brilliant question. It's exciting to look at the potential in front of me and I wonder where some of these inquisitive minds will end up. Today, Ben is questioning the viability of a floating power station…

It's 4 o'clock, and we're having an impromptu staff "Look what I've discovered" session. That's so important for us as teachers – retaining our sense of wonder and inquiry. Colleagues make a huge difference in that regard – people who are keen to keep learning and who really love their job. We're all in one of the labs, playing with horseshoe magnets and a signal generator, as we combine Fleming's left hand rule and standing waves theory to produce dancing foil strips that can be strobed. I leave happy that day, looking forward to showing my Year 14 class our "new invention" tomorrow. I just hope they are as excited as their teacher. The daily task of marking tests, sorting out homeworks and lesson preparation still awaits me at home – just part and parcel of a teacher's lot!

Catherine Donnelly

'I'm struck again by the conflict for pupils between everyday vocabulary and the language of science.'

Catherine Donnelly studied at Queen's University, Belfast, where she completed her primary degree in Applied Mathematics and Physics in 1994, before gaining a PhD in Atomic and Molecular Physics in 1997. She is currently Senior teacher and Head of Physics in Ballymena Academy, N. Ireland, where the team of 7 enthusiastic Physics teachers ensures that Physics is thriving.

A day in the life of a Radiological Protection Officer

Today it's 9am when I arrive at my office in Trinity College where I have been working on a part time basis for just over 13 years as the College Radiological Protection Officer (RPO). My chief role is to oversee the use of ionising radiation in the College and ensure that such work is undertaken in a safe manner. Just have time to check my emails before heading to a meeting regarding plans for a new building which will contain X-ray equipment and advise on compliance with regulatory requirements.

11.00am: Time for a quick coffee before heading over to the Biochemistry School to monitor a batch of radioactive waste and sign clearance forms for disposal. One of the best parts of my work is that many staff and postgraduate students work with sources of ionising radiation so my work brings me into contact with people right across the university involved in areas as diverse as medical equipment and pharmaceuticals to geological specimens such as radioactive ores.

At 12.30pm I finish up at Biochemistry and make my way to the Physics School to oversee the installation of a new sealed radioactive Cobalt 57 source. I need to monitor the radiation dose rate, check the shielding and perform a leak test on the source.

By 2.30pm, having squeezed in a quick lunch, I'm on my way to a laboratory where an unknown and unlabelled flask of liquid has been found in a fridge with a radiation trefoil sticker on it. I have this liquid analysed to determine if any radionuclide is present, establish the activity levels and advise on its safe disposal.

3.30pm – I'm back in the office, preparing for tomorrow's College Radiological Safety Committee meeting. Some of the issues, which are coming up, include the safety aspects of liquid sources of radiation generally used as tracers or markers in experimental procedures. In addition we will be considering 'Sealed sources', i.e. solid, encapsulated, mainly gamma sources of radiation used to irradiate other materials, and 'X-ray equipment' which range from bone densitometers for assessing diseases such as osteoporosis to X-ray diffraction equipment for analysis of materials.

4.00pm I meet an academic staff member regarding a new project involving the importation and use of uranium and thorium compounds. I assess his laboratory facilities and enquire about activity levels to ensure that regulatory requirements can be complied with. I write a risk assessment and justification case for submission to the Radiological Protection Institute of Ireland.

5.15pm Phew – time to get home! Apart from my work as College RPO for Trinity College, I am also a Chartered Radiation Protection Professional with my own private business 'Radiation Safety Ireland' providing consultancy, training and advice services to industry (www.radiationsafety.ie). On the train I use this time to answer an e-mail enquiry from one of my clients sorting out a site visit to a pharmaceutical plant later this week. My clients are many and varied and include major pharmaceutical companies, research and education facilities, gamma irradiator facilities, government agencies and waste management companies throughout Ireland.

There being no 'typical day' my work can vary from contributing to EU platforms on radiological protection in foreign countries to less glamorous days out in the wind and rain monitoring radioactive waste in Ireland, but without a doubt there has rarely been a dull moment.

Elaine Doorly

'An unknown and unlabelled flask of liquid has been found in a fridge with a radiation trefoil sticker on it. Analysis and safe disposal definitely needed.'

Dr Elaine Doorly, College Radiological Protection Officer, Trinity College Dublin and Dr. Eric Finch, School of Physics, Trinity College Dublin at an International Conference on Education and Training in Radiological Protection in Lisbon, Portugal. Elaine has a B.Sc. (Hons) in Environmental Health from the University of Dublin, Trinity College, an M.Sc. in Occupational Health, Safety & Ergonomics from National University of Ireland Galway and a PhD in Physics in the field of Environmental Radioactivity from the University of Dublin, Trinity College.

A day in the life of a **Rocket Scientist**

OK let me start with a confession. I don't actually build rockets. Rather I develop magnetometer experiments for satellites that sit on top of rockets! But I've been called a rocket scientist too many times to remember and I've seen plenty of spacecraft up close and personal over the years.

My job is a mixture of mission specific hardware builds and research into new magnetic sensing technologies. The magnetic field is a fundamental parameter in outer space. It tells us, for example, how the plasma streaming from the sun in the form of the solar wind interacts with the Earth's magnetic field, resulting in the Northern Lights.

Usually the morning will start with a review of the overnight emails reporting the status of our instruments in-flight. These reports are critical because if there are problems we need to engage with the Operations Centre to address them via telecommand. Fortunately this is a fairly rare occurrence even though the space environment is tough – low pressure vacuum, thermal extremes, ionising radiation. It's one of the reasons why project cycles can be of the order of twenty years – you design, build and test, test, test.

Following this we will have a range of meetings or tele-conferences on active hardware developments. Many days are spent on mission either at industrial sites, space agencies or other universities. This business is definitely for you if you like to travel. Although with strict launch deadlines it can sometimes mean some very long hours. But it's a very satisfying feeling to see the rocket on a launch pad, knowing your kit is about to be blasted into space.

In the early afternoon I'll spend some time in the lab. One current area of interest is tiny magnetometers based on magneto-resistance. The 2007 Nobel prize for Physics was awarded for work in this field and applications are a hot topic. In the late afternoon it's back to the PC, usually a proposal, paper or interface deadline has appeared in my calendar.

We even hope to launch or own spacecraft in the near future. A small CubeSat, only 1kg and so small you can hold it in the palm of your hand. We have several MSci students working on this project and it represents a perfect opportunity for test flight of our new magneto-resistive sensors. Our own spacecraft in outer space - then I could call myself a real rocket scientist.

Patrick Brown

'...it's a very satisfying feeling to see the rocket on a launch pad, knowing your kit is about to be blasted into space.'

Patrick Brown (third from left) and colleagues checking the Double Star spacecraft flight path during magnetometer commissioning.

Patrick Brown (facing camera) on mission during magnetometer commissioning on the Double Star spacecraft at CSSAR, Beijing. Patrick graduated from Trinity College Dublin with a B.A. (Mod) in Experimental Physics followed by a M.Sc. in permanent magnetism.

A day in the life of a Solar Physicist

A typical day? Well that depends! My job consists of several aspects. The first and main one is research. For that I make use of spacecraft and ground-based observatory datasets to try and understand explosions on the Sun. This involves a lot of computing work, and also much collaboration internationally.

All of our space missions are international collaborations. Our main hardware partners are in Japan and the US.

Ground-based observatories are all over the world from Poland to China to Argentina. We make use of the internet to get access to many of these datasets, but also have opportunities to meet with people from around the world, design observing campaigns, and help design new spacecraft in the future.

Another aspect in my job is teaching. I lecture to first year undergraduates in astronomy. This is a lot of fun, as it is an interesting subject to teach, and many students have already tried their hand at astronomy to some level. I also supervise PhD students and am the graduate tutor for our department. Graduate level teaching is very different as the aim is for each student to leave as an independent and confident researcher. The interaction between 'teacher' and student is different from that at undergraduate level as it concerns research: the answers are never known in advance so new territory is always being explored.

The final part of my job involves space mission work. I am the project scientist for the UK/Japan/US mission, Solar-B. This involves ensuring that the instrument design will fulfil the science goals.

As with many other parts of my job, there is travelling involved to meet with collaborators in Japan and the US – and following the launch I hope to spend an extended period in Japan where the spacecraft operations will take place.

The other project with which I'm involved is Solar Orbiter. It is in its infancy, but is expected to be launched by ESA in 2015 and is a mission to orbit the Sun. There are a lot of technical challenges for a mission such as this, and I am working with top-class engineers to ensure that we have a suitable instrument design and safe technology to successfully carry out this mission.

This work is being done in collaboration with other European colleagues from Belgium, France, and Germany.

Louise Harra

'The other project with which I'm involved is Solar Orbiter. It is in its infancy, but is expected to be launched by ESA in 2015'

Louise Harra at work analysing solar data at her computer. She graduated with a PhD in physics in 1993 from Queen's University, Belfast. She is now a professor of solar physics at University College London.

A day in the life of a Solar Thermal Research Physicist

I usually arrive into work around 8am; check my emails and then it's down to work proper. I should explain I work in the R&D department of Thermomax Limited, a manufacturer of evacuated solar collectors. Today I've got a new prototype collector to test under the solar simulator. The simulator allows me to measure a collector's performance relatively quickly, which is very useful as the weather conditions in Northern Ireland are not always favourable for outside testing. As the collector was mounted onto the test rig the previous day, it's just a matter of switching on the test lights and analysing the data. This test takes approximately two hours during which time I check on material specifications relating to the prototype.

In general, though, my day-to-day duties are somewhat varied. Some days I'll be modelling the performance of a solar thermal collector, presenting a paper at a conference or even fabricating some components in the workshop.

For the rest of the morning I'm in correspondence with a partner at Athens agricultural university. For this project we designed a 240m^2 collector field for driving a Rankine cycle system for saltwater desalination by reverse osmosis. I'm really just checking in, getting an update on the project and answering any technical queries they may have. The objective is to provide farming quality/drinking water to communities on the remote Greek islands where freshwater is an expensive and limited commodity. The system is about to go live shortly and it should be quite exciting when the results start coming in. You can check out the site at http://rosolar.aua.gr/

In the afternoon a colleague and I drive up to the Centre for Sustainable Technologies at the University of Ulster's Jordanstown Campus. We're interviewing potential students of a joint PhD studentship position between Thermomax and UUJ characterising the performance of collectors with optimised solar exposure. Initially we discuss with the project head what form the interview will take and what questions will be asked of the candidate. This process takes around two hours before we return to the factory.

Back at my desk I prepare for a meeting I have tomorrow with a company that develops thin-film technologies. I read the report they provided and prepare some questions and comments about their process.

And that's the end of another day, I tidy up any loose ends I may have and head home.

Tommy Williamson

'The objective is to provide drinking water to communities on the remote Greek islands where freshwater is an expensive and limited commodity.'

Tommy graduated with a BSc (Hons) in Applied Physics 1996, gained a MSc in Opto-electronics 1997 and a PhD in 2001. He is pictured in front of the direct-flow solar thermal collector by Thermomax.

A day in the life of a Strategic Planner in Physics

9.15am – Phone rings as I come through the office door – a call from an environmental journalist. This is on foot of a press release which I sent out yesterday in relation to climate change and global warming. He is firing questions at me about the rate of increase in greenhouse gas emissions in Ireland and whether this is meeting European targets. Luckily, I had recently been in contact with the Environmental Protection Agency and had the up-to-date figures to hand or at least buried under only a moderate layer of paperwork on my desk. Although my background is in Astrophysics, in my job as policy officer for the Institute of Physics in Ireland I find myself tapping into many broad areas of the subject and enjoy keeping myself aware, at least at a surface level of what is happening in physics.

By 10.00am I have dealt with most of the multitude of emails which have come in overnight and I'm starting to put together a newsletter article about a recent meeting of the heads of physics departments in Ireland with the government chief Science adviser. Policy work is about formulating ideas on physics issues and then attempting to influence education/academia/government/industry in these areas. So this meeting allowed the Institute to find out at first hand the issues affecting third level teaching and research and to ensure that this is heard at a senior government level.

11.30am – while having a quick cup of coffee, I scan through a recent report on UK salaries which shows that graduates in physics and chemistry have significantly higher lifetime earnings than graduates in most other areas including psychology, biological sciences, business and arts. Make some phone calls to the authors of the report to see if the findings can be extended to Ireland – the good news is Yes!

1.00pm – Intend to go to gym, but have a sandwich instead with colleagues in the physics department at Dublin City University and catch up on lots of gossip. Afterwards get to work on arrangements for an upcoming medical physics conference, calling potential speakers and checking the venue's lunch facilities. No matter how good the talks are people always want a decent meal – or is that just me? Part of my work is to think strategically about how the Institute can work with other organisations to promote Physics. So have decided to work closely with the Irish Medical Devices Association in promoting this meeting. This should help enhance links between academics and industry.

4.00pm – start to put together some figures on numbers of physics teachers in N. Ireland for tomorrow's meeting with the Institution of Engineering and Technology in Belfast. We share a similar concern about resources for teaching science in schools and together we might be able to push through some initiatives on this.

By 5.30pm I'm ready to leave – tomorrow will be a totally different day, combining travel, meetings and some work at home to ensure all is ready for the following day. For now – it's home to dinner and the family.

Shiela Gilheany

'graduates in physics and chemistry have significantly higher lifetime earnings'

Sheila Gilheany at work. Sheila has a BSc in Pure and Applied Physics and a PhD in Astrophysics from Queen's University Belfast.

A day in the life of a Video Producer

As Producer/Director at media company Agtel, I'm involved in some major science communication projects that enable me to combine my physics background with my interest in television production.

Today is going to be very busy as Science Week Ireland is in full swing and we're filming the launch of a telescope project for schools on behalf of our client, Discover Science and Engineering. I meet the crew at our offices at 8am and we transfer all the filming equipment to one of our crew vehicles before heading to our first location of the day. As Producer/Director, it's my job to lead the whole production and make sure that we film the right material to make a strong story when we edit the final video together. I've already spent the best part of a week planning the logistics of this shoot and what the finished story will look like – discussing things with the client at every stage to make sure that we give them maximum value.

Producing video projects is all about communicating sometimes complex concepts in a way that engages and even entertains the target audience. I find that the research skills I learned while studying physics at Trinity College Dublin really help me understand complicated scientific ideas quickly and convey them clearly. My experience of problem-solving with technical equipment during my Masters degree in nanotechnology also helps when I'm using our sophisticated camera and editing equipment.

We move quickly when we arrive on location to set up all the equipment in the best position. Once we've filmed all the speeches, we interview some of the key participants and then travel to our next location. This afternoon the Dublin Institute of Technology has invited a lot of young people from schools all over the city to have a go at dozens of colourful science demonstrations. After we've filmed a wide variety of experiments, we head back to the office and I move on to one of my other science projects.

'we're filming the launch of a telescope project for schools'

One of the projects I'm producing is a series of educational DVDs for schools all over Europe by the European Space Agency. Today we're working on instructions for the astronauts – for every DVD in the series an ESA astronaut films experiments on board the International Space Station, and we also film the students in four schools around Europe doing similar experiments. It's very exciting to watch the footage from space of the astronauts floating around following your instructions!

With the crew procedures for the astronauts e-mailed to the clients for their feedback, it's time to head home at around six o'clock and relax in front of the television – although watching tv can sometimes feel like work…

Diarmaid Mac Mathúna

Diarmaid Mac Mathúna. Diarmaid has a BA degree in Physics and an MSc in Physics by research from Trinity College Dublin.

A day in the life of a Wind Analyst

Each morning, I arrive in the Airtricity office, greet my colleagues and switch on my indispensable laptop. First task of the day is an important one: I check that all of Airtricity's wind monitoring masts around the world have sent in their data overnight. If one hasn't, I analyse the problem, come up with the solution and arrange for it be fixed straight away. Sometimes, I must make the trip to the mast and fix the problem. In summer, this can mean an enjoyable day-trip from the office to one of the many hills throughout the island, each with its own spectacular view. On winter days, well, let's just say you really appreciate the power of wind!

Next I turn my attention to the data that has arrived and perform some quick statistical checks to ensure the data is reliable using some software I've developed. Good computer skills are a great advantage for the modern physicist and allow me to accomplish so much more.

Why do we need this data? Surely, a hill in Ireland is windy enough? Well, the real question is how windy? We want to produce as much clean renewable electricity as possible from these graceful wind turbines, so we must find the best places to put them and know as accurately as possible how much electricity we can generate over the next 20 years. Coincidentally, the next item on my list requires me to estimate the potential 20 year energy production from what is now just a hill. I process several years of wind data and after several steps reduce it to a probability distribution representing the expected long-term wind climate. This process simplifies the next analysis, where I use sophisticated flow modeling to model the wind-flow across the hills, lakes, trees – pretty much anything really.

Once I have produced a 'digital wind map' for the site, the next step is to locate the turbines. There are many turbine models to choose from, so I select the most suitable model for this site and then maximise their future electricity production by programming our fast workstation to optimise the wind farm layout under the constraints.

This computation can take many hours, so in the meantime, I prepare my report and methodically take account of uncertainties in each step of the analysis. At the end of it all, I present a nice round 20 year energy production figure to our finance people. If the site is 'a runner', the wind farm layout goes off to the men in hard hats for construction.

When this essential work is done, I turn my attention to my various sideline projects, sometimes working with our trading, finance and engineering departments. The quantitative skills of a physicist are often called upon to solve their problems. Today, I will work on the wind power forecasting project where we want to accurately forecast our wind power several days ahead. Given the relative infancy of the industry, these projects involve a new piece of research that I can later adapt into a research paper. In the past, I have been invited to present such work at conferences in Europe where I have met many interesting people from across the world working in wind energy.

As a physicist, I enjoy the interesting and challenging opportunities in this new and growing industry. Knowing that I am part of a larger movement, to use smarter and less polluting forms of energy and help fight climate change, makes it so much more rewarding.

Paul Hughes

'On winter days, well, let's just say you really appreciate the power of wind!'

Wind turbines on the Arklow banks off the coast of Co. Wicklow.

Paul Hughes earned a joint honours degree in Experimental Physics and Biology at NUI Maynooth before researching a Master's degree in Computational Astrophysics at University College Dublin.

JOBS FOR PHYSICISTS

ENERGY

Bio-fuels researcher
Nuclear Physicist
Oil Rig Engineer
Geothermal Expert
Wind Analyst
WAVE ENERGY EXPERT
Solar Power Advisor

Health & Medicine

MEDICAL DEVICE DESIGNER
Perfusionist
Biomechanical Engineer
Radiation Technologist
NUCLEAR MEDICINE SPECIALIST
MEDICAL PHYSICIST
Image Processing Researcher

EDUCATION & RESEARCH

PARTICLE PHYSICIST
SPORTS MATERIALS
LAB TECHNICIAN
SCIENTIST
RESEARCH TEAM LEADER/MANAGER
PHYSICS TEACHER/LECTURER
LASER PHYSICIST
NANOTECHNOLOGIST
Quantitative Analyst

Space

Science Advisor

IT & Telecommunications

Games Developer
Software Designer
Media
Antenna Designer
SEMICONDUCTOR ENGINEER
Photonics Researcher
Encryption Expert
Manufacturing Technician
Electrician
Lithographer
Soil Physicist

ENVIRONMENT

Geophysicist
Hydrologist
Oceanographer
Environmental Analyst
VOLCANOLOGIST
Archaeologist
Seismologist
Meteorologist
Food Quality Controller
Diagnostic Controller

astronomer
radiation effects engineer
PLASMA MODELLER
SOLAR PHYSICIST
remote sensing researcher
Satellite designer

Finance & Legal

optometrist
Entrepreneur
Patent Examiner
Risk Analyst
Sales and Marketing Rep
Econophysicist
Intellectual Property Lawyer
Forensic Physicist
Insurance Broker

TRANSPORT
AIR TRAFFIC CONTROLLER
Metallurgist
Engineer
Aeronautical
Fuel-Cell Researcher
Radar System Designer
Music Technologist
Sound Engineer
Web Designer
SCIENCE CURATOR
Exhibit Designer
Video Producer
Science Journalist/ Communicator

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