DCU School of Physics Degree Projects 2016

Ollscoil Chathair Bhaile Átha Cliath
Dublin City University

Introduction

It is a great pleasure to introduce this booklet which summarises the recent activities and achievements of the final year Physics students in the School of Physical Sciences from all three of our honours B.Sc. degree programmes (Applied Physics, Physics with Biomedical Sciences and Physics with Astronomy) in the academic year 2015/16, in both their Integrated TRAining (INTRA) placements in 3rd year, as well as their final year degree projects in 4th year. The material in this booklet has been prepared by the final year Physics students themselves, coordinated by Prof. Colette McDonagh. I would like to thank Ms. Sue O'Neill from the DCU Research and Enterprise Hubs and Ms. Katy Halpin from the DCU Communications and Marketing office for the production and design of the booklet. Thanks also to Mr. Pat Wogan of the School of Physical Sciences for his assistance.

The purpose of this booklet is to provide more information and detail as to the range and type of skills our Physics students acquire, including excellent problem solving skills in both the experimental and theoretical domains, based on their up-to-date and deep disciplinary knowledge and understanding linked with mathematical, coding and computing skills, as well as a range of key generic and transferable skills related to oral and written communications, project planning and management.

My colleagues and I in the School of Physical Sciences firmly believe that this range of skills make them the epitome of the modern "T"-shaped graduate and ideally position them for employment across a wide range of industrial and enterprise sectors, engaging in roles including research, development and translation.

If you have any enquiries, or if you would like to discuss ways in which your organisation could work with the School of Physical Sciences in the future, either in terms of INTRA placements or final year degree projects, please contact me using the email address below.

Yours sincerely
Head, School of Physical Sciences,

Prof. Enda McGlynn
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Programme Overviews

Overview of Applied Physics Programme

Year 1		**Year 2**		**Year 3**		**Year 4**	
Semester 1	*Semester 2*	*Semester 1*	*Semester 2*	*Semester 1*	*Semester 2*	*Semester 1*	*Semester 2*
Motion & Energy	The Universe	Quantum Mechanics	Linear Mathematics	Laboratory	INTRA	Degree Project	Degree Project
Light & Optics	Waves & Electricity	Relativity	Electro -magnetism	Quantum Physics		Solid State Physics	Plasma Science
Computing	Thermal Properties	Vibrations & Waves	Solid State Physics	Statistical Physics		Quantum Electronics	Signal Processing
Laboratory	Programming	Electronics	Renewable Energy	Wave Optics		Electro -dynamics	Nano -technology
Calculus	Calculus	Calculus of Several Variables	Advanced Programming	Differential Equations		Applied Spectroscopy	Microfluidics
Chemistry	Laboratory	Laboratory	Laboratory	Semiconductors		Mechanics	

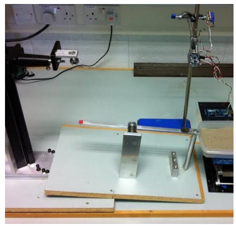
Overview of Physics with Astronomy Programme

Year 1		**Year 2**		**Year 3**		**Year 4**	
Semester 1	*Semester 2*	*Semester 1*	*Semester 2*	*Semester 1*	*Semester 2*	*Semester 1*	*Semester 2*
Motion & Energy	The Universe	Quantum Mechanics	Linear Mathematics	Laboratory	INTRA	Degree Project	Degree Project
Light & Optics	Waves & Electricity	Relativity & Nuclear	Electro -magnetism	Quantum Physics		Image Processing	Plasma Science
Computing	Thermal Properties	Vibrations & Waves	Solid State Physics	Statistical Physics		Mechanics	Signal Processing
Laboratory	Programming	Electronics	Renewable Energy	Wave Optics		Electro -dynamics	Astrophysics & Cosmology
Calculus	Calculus	Calculus of Several Variables	Advanced Programming	Differential Equations		Applied Spectroscopy	Galactic Astronomy
Chemistry	Laboratory	Laboratory	Laboratory	Stellar Physics			
			Space Science & Technology	Astronomical Techniques			

Overview of Physics with Biomedical Sciences Programme

Year 1		**Year 2**		**Year 3**		**Year 4**	
Semester 1	*Semester 2*	*Semester 1*	*Semester 2*	*Semester 1*	*Semester 2*	*Semester 1*	*Semester 2*
Motion & Energy	Understanding the Body	Quantum Mechanics	Linear Mathematics	Laboratory	**INTRA**	Degree Project	Degree Project
Light & Optics	Waves & Electricity	Biomechanics	Electro -magnetism	Quantum Physics		Advanced Biomaterials	Plasma Science
Computing	Thermal Properties	Vibrations & Waves	Solid State Physics	Statistical Physics		Quantum Electronics	Medical Diagnostics
Laboratory	Programming	Electronics	Physiology	Wave Optics		Image Processing	Digital Signal Processing
Calculus	Calculus	Calculus of Several Variables	Advanced Programming	Differential Equations		Applied Spectroscopy	Microfluidics
Chemistry for Health	Laboratory	Laboratory	Laboratory	Semiconductors			

Student Projects



Project Name: Creation and measurement of a deterministic coin toss

Student Name: Sean Blake

Email: sean.blake7@mail.dcu.ie

Supervised by: Dr Anthony McCoy

Personal Details: I am studying Physics with Astronomy. My INTRA placement was with a company called Golfgraffix who specialise in creating 3D graphical representations of golf courses. I worked as a shop assistant through college until the end of February final year. I would like my future job to be somewhere I could do hands on experimental work creating, collecting and analysing data.

Project Summary: My project was to build a coin flipping device that would toss a coin up in the air, spinning about its axis and eventually land either heads up or tails up. The aim was to make this toss as consistent as possible and so make the outcome as consistent as possible allowing prediction of the outcome. To measure the coins motion I used ultrasonics to monitor upwards velocity and a light sensitive resistor to catch the light reflected from the coins face while spinning and hence the number and rate of flips. This was then compared to my theoretical prediction of how the coin should flip based on the physical properties involved.

Project Name: Large Scale Integration (LSI) for incorporation of six sandwich ELISAs on a centrifugal microfluidic disc.

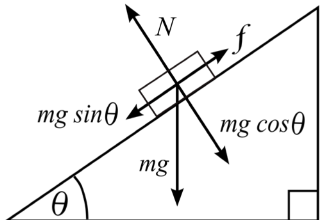
Student Name: Clare Corbally

Email: clare.corbally2@mail.dcu.ie

Supervised by: Dr Rohit Mishra, Prof Jens Ducree

Personal Details: I am a fourth year Physics with Biomedical Sciences student. My work experience includes an internship in the Biomedical Diagnostics Institute (BDI) where I built and tested centrifugal microfluidic platforms to be used for the detection of cancer cells in the blood. I also did a placement as a member of the technical support staff in the School of Physical Sciences in DCU. My roles here included experimental developments for an undergraduate experiment on the optics of the human eye in which I produced a prototype for an "artificial eye" that could be used as the basis for a future undergraduate experiment, and a survey of first year physics laboratory equipment. I hope to go on and pursue an M.Sc in Medical Physics followed by a radiation therapy training course and go on to become a medical physicist.

Project Summary: The aim of this project is to incorporate Large Scale Integration (LSI) on a microfluidic platform. LSI is the use of hundreds to thousands of valves on a single microfluidic platform.
More specifically the aim is to build and test a disk which can carry out 6 sandwich enzyme linked immunosorbent assays (ELISAs) on the one platform. This has the advantage of allowing multiple assays to be carried out on one disk which leads to a higher throughput while using considerably smaller amounts of reagents and samples among other advantages.
It offers advantages over other discs such as avoiding problems with fluid/material incompatibilities through non-inline release of fluids, and control of fluid is independent of the position of the fluid on the disc. Another attractive feature of this disc is that it offers full control of fluid movement through valve actuation. The small footprint also allows for future massive integration.



Project Name: Friction measurement on Surfaces

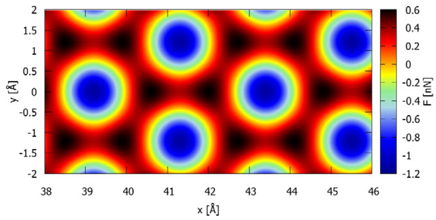
Student Name: Stephen Crawley

Email: stephen.crawley2@mail.dcu.ie

Supervised by: Dr Robert Copperwhite, Prof Colette McDonagh

Personal Details: I am currently in final year of the Applied Physics degree programme. My INTRA placement last year was with a small Dublin-based company, RaptTouch (www.rapttouch.com) who specialise in developing touch screen technology for a variety of applications. My time there involved working with engineers in the company on some optics and software. It was a really valuable experience and I was lucky enough to be able to do my final year project in this company also. I really enjoy physics and I intend to go abroad after graduation and hope to get a technical position in a company somewhere in Europe. Outside college, my main interest is in music.

Project Summary: The primary objective of my project is to design, build and test an apparatus which can be used to quantify the friction force between a finger and a glass touch screen surface. Glass/finger friction is an important characteristic of touch screen systems and can be influenced by 2 main controllable factors: touch screen antifingerprint coatings and touch screen glass texture. During the course of this project the friction between finger and glass coating pairs will quantified, and this data will feed into the choice of glass coatings / treatments for eventual employment in mass production touch screen systems.



Project Name: Determination of the Relationship between the Absolute Magnitude and Period of Cepheid Variable Stars and their Accuracy in Distance Determination.

Student Name: Adam Dempsey

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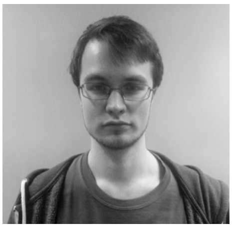
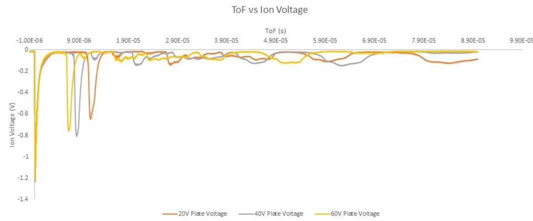
linkedin.com/in/adam-dempsey-a8aa7576

Supervised by: Dr Tony Cafolla

Personal Details: I am currently finishing an undergraduate degree in Applied Physics. I intend to follow up this study with a PhD in computational plasma physics. My work experience includes two summers working in the process development department of Boston Scientific. I also undertook an eight month placement with Tomra Sorting ltd in the research and development section. My work with Tomra revolved mainly around high speed PCB design, programming and manufacture. Outside of college and work I am interested in circus arts and practice skills such as juggling and tightrope walking.

Project Summary: The aim of my project is to develop a computational framework with which to investigate the forces that occur between atomic probes and surfaces. These forces depend on the atomic composition and shape of the probe used in the microscope. As such the images that an atomic force microscope can generate are affected by the properties of the probe. This project aims to provide a tool which can predict the aberrations a probe may introduce to an image. The applications of this project are within the atomic force microscope field. The model may help in identifying aberrations in captured images. Furthermore, it may be possible to parameterise probes using this model.





Project Name: Using Ion Mass Spectrometry to Investigate the Fast Ion Peak Present in Laser Generated Plasmas

Student Name: Columb Doherty

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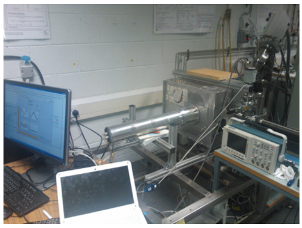
Supervised by: Dr Mossy Kelly

Personal Details: I've always had a desire to learn more about the world we live, to find out how things work, what makes the world go round. After 4 years of studying it I still haven't had enough, as I intend to pursue further study in the form of a PhD course. My fourth year project and INTRA experience from 3rd year played a large part in deciding what to do after 4th year ended. For my INTRA I had a position as a researcher in DCU, involved with the Laser Plasma Research Group working with Professor John Costello's research team to design enhanced Faraday Cup devices, and subsequent use of it to perform time-resolved plasma analysis of various elemental targets at 0 and 90 degrees to the detector. My 4th year project was a continuation of the experience I gained from this, working with laser, plasmas, vacuum systems and data analysis.

Project Summary: My project took place between DCU and TCD, using an ESA (Electrostatic Sector Analyser) to investigate the fast ion peak present in laser generated plasmas. In photonics labs Trinity I used nanosecond and femtosecond lasers to fire at a copper target placed under vacuum. This created an expanding plasma cloud, containing charged ions which were captured using the ESA. A voltage applied across curved plates within the ESA determined the pass energy of the ions which could reach the detector, an electron multiplier. This was connected to an oscilloscope, giving ToF (time of flight) and voltage characteristics of the ion signal. When examined in more detail (in terms of the mass to charge ratio of various peaks present in the signal) one can calculate which elements (and which ion states) are actually present in the initial target sample. Thus we can tell whether the fast ion peak is caused by accelerated copper ions, or contaminants such as carbon or hydrogen present in the chamber.

Project Name: Embedded control of a high-VHF match-box by measuring circulating energy and phase-mag relationships on the rf-input

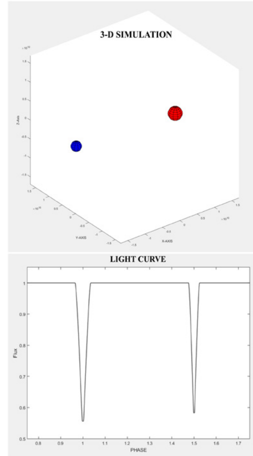
Student Name: Seán Donnelly

Email: sean.donnelly@mail.dcu.ie

Supervised by: Dr Bert Ellingboe

Personal Details: I am finishing my 4th year of Applied Physics this year. I was interested in physics since I was in secondary school, and still enjoy it now. I completed a work placement in DCU which involved programming and electronics; I am very interested in these topics in particular. In the past, I worked in a radio station for many years.

Project Summary: When using RF power (e.g. for generating plasma) the load from the power supply must match the load of the system receiving the power to avoid power loss and damage; this is done using a "match-box". My project involves measuring values from the power going in to the system, to ultimately design, program and build a device which will allow the matchbox to automatically match. From this project, I have learnt much about RF-electronics and have further developed my programming skills.



Project Name: Eclipsing Binary Stars

Student Name: Robert Doyle

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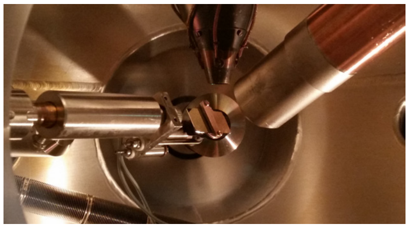
Supervised by: Dr Eamonn Cunningham

Personal Details: I am currently in my final year of a Degree in Physics with Astronomy here in DCU. I am also working part-time as a catering assistant at the Capuchin Day Centre for the Homeless and have been employed there over seven years. For INTRA last year we visited ESA, the European Space Agency. I was given great insight into the daily operations of this massive organisation and also gained great knowledge into the physics of certain aspects of astrophysics, mainly variable stars. My interests include: Advances in Technology, Programming, Video Editing, Sports, and Fitness.

Project Summary: For my final year project I am simulating eclipsing binary stars using the programming software MATLAB. These systems contain two stars orbiting one another. If the orbital plane of these stars is level with the view of the observer, the stars will eclipse one another. As these star systems tend to be so far away they appear to be a single star. They are found to be eclipsing binary stars from examining the light curves of the source. The light from the system will dim every time an eclipse occurs, therefore creating two troughs in the light curve. The project aim is to create a program that reads in parameters of known binary systems, and produce a 3-D simulation of this system accompanied by a light curve. My goal is to have the simulated light curves resemble as closely as possible the real recorded light curves.

Project Name: Electrochemical Intercalation of Sodium and Lithium in Crystalline Silicon

Student Name: Nicole Fleck

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Supervised by: Dr Robert O'Connor

Personal Details: I am currently in the final weeks of my final year studying Applied Physics. I expect to be graduating in October of 2016. Throughout my time in DCU I have undertaken numerous work experience placements. These include a placement in Germany in the research and development section of an electronics company as well as some time spent in DCU as a research assistant working with alternative material approaches to solar cells. My 8 month placement as part of the degree programme was spent in Intel in the far back end of the manufacturing process. Here I gained experience in process engineering and the physics mechanisms and control systems at work in high volume manufacturing.
My hobbies consist of circus skills, mainly stilt walking, juggling, unicycling and tight rope walking. I also enjoy gymnastics and reading.

Project Summary: My 4th year project is based on solid state batteries for application on computer chips. One electrode is a crystalline silicon wafer while the electrolyte is the silicon dioxide which naturally grows on the surface of silicon wafers exposed to atmosphere. The ions being investigated as charge carriers are lithium and sodium.
The aim is to show the migration of these into the silicon and back out again to simulate battery behaviour. The analysis is mainly concentrated on x-ray photoelectron spectroscopy (XPS). The x-ray gun, sample and analyser are visible in the image provided. The benefit of this solid state battery is the increased safety over liquid electrolytes which are more prone to leaking harmful compounds and the good contact between the silicon and silicon dioxide layers. The ease of miniaturisation and integration into high volume manufacturing prove beneficial due to the fact that the same processing techniques are employed.

 

Project Name: Determination of the Relationship between the Absolute Magnitude and Period of Cepheid Variable Stars and their Accuracy in Distance Determination.

Student Name: Andrew Fleming

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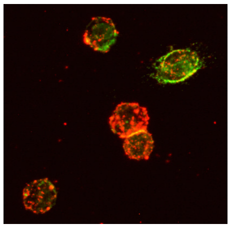
Supervised by: Dr Eamonn Cunningham

Personal Details: I am currently a fourth year student here in DCU, studying Physics with Astronomy. I chose to study physics because I wanted to learn how the world works. Throughout each year I have gained valuable experience working in the labs, developing skills in interpreting and analysing data, conducting experiments and reporting on my findings. My numerical and computational skills have been substantially developed to the point that I now feel very confident in proceeding into a maths based career. As an astronomy student I travelled to the European Space Astronomy Centre (ESAC) in Madrid for a week for my INTRA. In ESAC I got to talk to, and learn from researchers involved in many ongoing missions. They advised me on how to proceed towards joining ESAC and what roles I would have to potentially fulfil. Outside of college I enjoy airsoft, badminton and hurling.

Project Summary: My project is a computational analysis of Cepheid Variable stars. Cepheid Variables exhibit a relationship between their absolute magnitudes i.e. brightness and their periods of pulsation. They are also some of the brightest objects in space. My goal is to determine the relationship between magnitude and period by searching for and analysing catalogued data. With this relationship determined my project will then focus on evaluating the distances to nearby Cepheids by means of the parallax and absolute magnitude methods. The results of these calculations will then be compared with published data to estimate the accuracy and reliability of using a Cepheid's absolute magnitude to determine its distance. While this project has been mostly computer based, it has required significant amounts of reading and research to determine the appropriate relationships and formulae.

Project Name: Cancer Cell Staining and Imaging using Cy5 Dye-Doped Silica Nanoparticles

Student Name: Rachel Hanley

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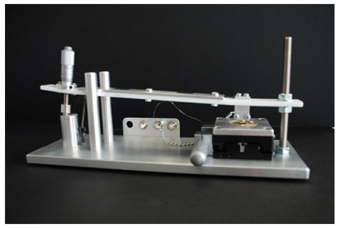
Supervised by: Prof Colette McDonagh and Ms Claire O'Connell

Personal Details: I am currently a final year student studying Physics with Biomedical Sciences and I intend to pursue further studies in Medical Physics following the completion of my degree. In the third year of my degree I completed an 8 month placement at Abbott Ireland Diabetes Care as part of INTRA. While on my work placement I worked as a technical services engineer where I assisted on engineering trials, worked on various R&D projects and was heavily involved in Abbott's corporate responsibility volunteering programme, Croí an Óir. In completing this internship I received the opportunity to expand on my existing skills and develop new ones while also gaining valuable experience. I have also been a member of the climbing, circus and basketball clubs as part of my extra-curricular activities throughout my degree.

Project Summary: My project involves the use of fluorescent dye-doped silica nanoparticles for the detection of MCF7 breast cancer cells. Cancer is a leading cause of death worldwide, with metastasis responsible for the majority of cancer-related deaths. Circulating tumour cells (CTCs) play a central role in metastasis. This project involves the synthesis of fluorescent silica particles (NPs) of diameter ~90 nm which contain a large concentration of Cyanine5 (Cy5) dye molecules to detect these rare CTCs. Due to their small size and high fluorescence these nanoparticles are more advantageous over regular organic dyes that were previously used for cancer cell detection which were susceptible to bleaching and not very bright. The nanoparticles that I have developed are almost 30 times brighter than the free dye. My project addresses the non-specific binding issues currently being encountered in cell staining experiments using MCF7 and HeLa cancer cell lines.

Project Name: Quantized Conductance in Gold Nanocontacts

Student Name: Ryan Healy

Email: ryan.healy24@mail.dcu.ie

Supervised by: Dr Tony Cafolla

Personal Details: I am currently a final year undergraduate student studying Applied Physics in Dublin City University. I chose physics because I have always enjoyed solving numerical problems with real world applications. During my degree I designed and manufactured an experiment to measure the charge-to mass ratio e/m of the electron using thermionic emission as exploited in vacuum tube technology. Two methods were used to make these measurements, the first method used the Child-Langmuir equation and the second method is called the Hull magnetron method. This allowed me to develop the necessary skills to be able to design, build and test scientific experiments. These skills were useful while conducting the fourth year project. Outside college I enjoy football and golf.

Project Summary: The purpose of this project is to observe and measure quantum conductance in gold nanowires. Conductance is an intrinsic property of materials, corresponding to how easily electrons flow through that material when subject to a potential difference. In instances when the lateral dimension of a conducting wire is reduced to the order of nanometres, the conductance of the material no longer changes continuously, but instead exhibits discrete quantized steps. Quantized conductance can be observed in metal nanocontacts, where the measured conductance is a multiple of the quantum conductance. Single molecule junctions are used to make single molecule electronic devices like single molecule switches, single molecule diodes and single molecule field effect transistors. A lot of work is still required for molecular electronics. The main aim now is to reduce the size of the junctions which are always quite large compared to the molecule.

Project Name: An investigation into the nature of the formation of high-mass protostars and their formation mechanisms.

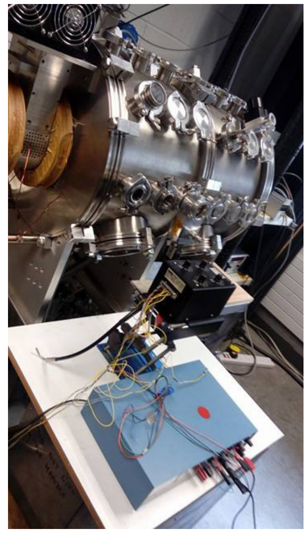
Student Name: Kim Heary

Email: kim.heary2@mail.dcu.ie

Supervised by: Dr Alessio Caratti o Garatti

Personal Details: I am a student of Physics with Astronomy. For my Intra I went on the field trip to European Space Astronomy Centre (ESAC) near Madrid for a week. Here we learned about the work and research done at ESAC .We also were given classes on certain topics from different members at ESAC during our week there. It was this field trip that influenced my final year project choice. Some of my interests and hobbies include dancing, tennis, life drawing and film. Also I have been a member of the film society and rockclimbing in previous years during my time at DCU.

Project Summary: I did my final year project off- campus at DIAS (Dublin Institute for Advanced Studies). Protostellar jets and outflows are a phonomenon of new forming stars of varying masses and luminosities. The role of disks and jets and outflows is a lot more tested and understood in low mass protostars .These phonomena are seen to play a major role in controlling accretion of matter onto protostars and removing excess angular momentum and also clearing out the protostellar envelope, whereas in high mass protostars much less is known. In my project I aimed to discover more of the nature of high mass protostars and their formation mechanisms. What my project entailed was firstly doing image reduction and analysis of spectral images of my source and jet .From my spectra and using other physical values from past literature I could do a detailed kinematical study along the jets, where I was able to obtain such things as the velocity of the jet, momentum, dynamical age, mass ejection rate, kinetic energy and thrust of this jet. From these values I was able to learn more about the accretion/ejection history of the high mass protostar.



Project Name: Fast Time Response Optical Emission Spectroscopy for Dynamic Plasma Chemistry Measurements

Student Name: Daniel Hurley

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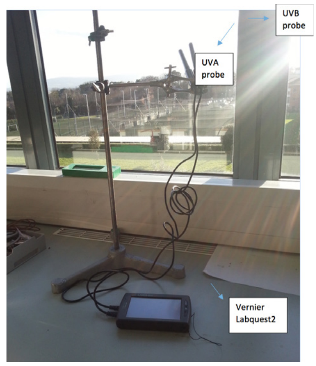
Supervised by: Dr Bert Ellingboe

Personal Details: I am currently finishing my final year of a Bachelor of Science in Physics with Astronomy. I am working on my Final Year Project on Plasma Spectroscopy. I recently completed an internship at SAP as a Support Engineer; analysing databases for companies, banks, government organizations etc. This may seem unusual for a company like SAP to hire Physicists, but like many modern companies, they appreciate the analytical abilities and the technical skillset offered by Physics students. I got the opportunity to work with multinational companies from all over the world, dealing with executive level customers. I gained experience in areas such as database optimization and SQL analysis. Prior to SAP, I worked in Argos as a customer advisor for two years.
My Interests include: Physics, New Technologies, Electronics, Programming, Reading, Fitness.

Project Summary: My project involves observing plasma emissions using optical emission spectrometry to learn about the energy transitions that occur in a radio frequency hydrogen plasma. This is done using a 4-channel spectrometer to detect light emitted from the plasma at different wavelengths. Each channel contains an interference filter, which only allows a certain range of wavelengths of light to pass through. These filters are carefully selected to view the emissions that correspond to energy transitions within the Hydrogen plasma. The transitions I want to work with are known as Fulcher transitions. Assuming that the Franck-Condon principle is correct, I should be able to determine the vibrational population of ground state hydrogen molecules. The Franck-Condon principle explains how a vibrational-electronic transition in a molecule occurs. Knowledge of vibrational excitation of molecular hydrogen in the electronic ground state is of high interest for understanding plasma reactions. Studying these vibrational transitions is important as vibrationally excited molecules lead to the formation of negative ions.



Project Name: Use of Vernier Lab-Quest Data Logger for Simultaneous measurements of field data (Temperature, Solar Irradiance, Turbidity, pH, DO2) for solar disinfection in Africa

Student Name: Mutsa Jamison

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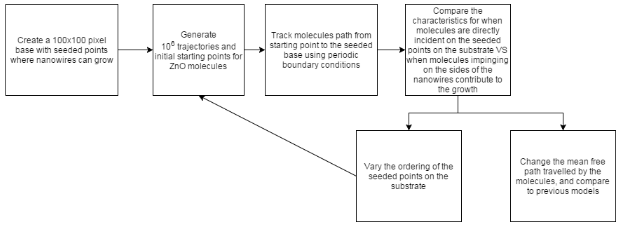
Supervised by: Prof Kevin McGuigan

Personal Details: I am currently a Physics with Biomedical Sciences student. My INTRA placement took place at the Hermitage Medical Clinic (HMC). My role was a student physicist. I gained experience working in the Radiology and Nuclear Medicine department and in the Radiotherapy department. I learned how to perform different Quality Assurance and Quality Control tests on various diagnostics equipment. I was able to use some knowledge I had gained from my course during my placement. However, I had to do a lot of self-learning to fully understand some of the tasks I performed and observed during my time at HMC. This placement showed me the work life of medical physicists. The experience I gained during this placement was very helpful during my final year of college and is also a great help in pursuing a career in medical physics.

Project Summary: Solar disinfection (SODIS) is a method that uses the sun to disinfect water. One of the limitations of SODIS research is the availability of reliable physical measurements from within the solar reactors during sunlight exposure. Vernier Europe have donated a Labquest 2 data logger unit and a variety of probes (UVA,UVB, Water temperature, pH, Dissolved oxygen levels, Turbidity). My project is to test how the Vernier Labquest 2 can be used in SODIS research to obtain reliable physical measurement. If this project is successful, the Vernier Labquest 2 can be used to improve field research studies of SODIS technologies used for producing safe drinking water in rural communities in Sub-Saharan Africa.



Project Name: Modelling growth of ZnO nanowires – effects of wire shadowing on growth

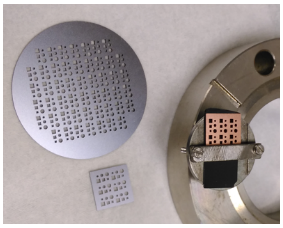
Student Name: Dáire Kelly

Email: daire.kelly85@mail.dcu.ie
linkedin.com/in/dairekelly85

Supervised by: Prof Enda McGlynn

Personal Details: I am a final year student in Applied Physics. My INTRA placement was at the Centre for Quantum Communication & Computation Technology (CQC2T) at the School Of Physics at the University of Melbourne. My research project there was to investigate the effect of surface termination of diamonds for the formation of nitrogen vacancy (NV) colour centres by ion implantation. NVs can be used as magnetic nano-sensors, and have applications in widefield microscopy, and in nano-scale thermometry. In my spare time, I am heavily involved in the university rock climbing club, and I am a volunteer climbing coach in my former secondary school.

Project Summary: My project uses MATLAB to model the growth of zinc oxide (ZnO) nanowires by vapour phase transport (VPT). There is very little in the way of theoretical work on this growth method. My program simulates ZnO molecules travelling along random paths to seeded spots in random positions on a silicon substrate to investigate the effect of shadowing on the variability in the height of the nanowires. This can be changed to have the seeded spots in an ordered array. The hope for this project is to model the growth when the molecules randomly change direction after a mean free path. This is to approximate collisions, as the growth process is done at atmospheric pressure. The model should be able to determine the best growth method to make the nanostructures, which can be used for piezoelectric devices, bio-sensors and gas concentration sensors.

Project Name: Fabrication and characterisation of capacitor test structures for copper diffusion barrier layer evaluation.

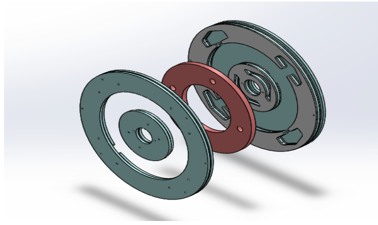
Student Name: Gary Kelly

Email: gary.kelly43@mail.dcu.ie

Supervised by: Prof Greg Hughes

Personal Details: I am currently a final year Applied Physics student in DCU.
My INTRA placement was an industry placement with RAPT Touch.
I enjoy Archery and Juggling and am currently in the Archery and Circus Arts Clubs and Societies

Project Summary: My Final Year Project is to investigate the diffusion of copper into semiconducting materials under certain conditions. Diffusion of copper entails some of the metal diffusing into the semiconducting material it is in contact with. My Project is to characterise and investigate this behaviour. The potential applications for this project are mainly in the field of Integrated Circuitry. The Benefits of accurately characterising copper diffusion include faster and smaller computer processors.



Project Name: Armoured Cell Lysis on a Rotational Platform

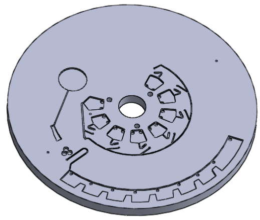
Student Name: Rob Kelly

Email: robert.kelly45@mail.dcu.ie
linkedin.com/in/rob-kelly-257a35aa

Supervised by: Dr Jennifer Gaughran, Dr David Kinahan, Prof Jens Ducreé

Personal Details: I did my INTRA in BDI constructing and testing microfluidic disks and continued working there over the summer as a research assistant. I hope to go on and do a masters or PHD in medical diagnostics.

Project Summary: My project uses a rotating millstone to break down the cell walls of armoured algae samples. The millstone is placed within a microfluidic platform or disk. This millstone is held in place while the sample suspended in fluid is loaded into the disk and the disk is rotated. The millstone is stationary as the disk is rotated around it. The fluid is forced out of the loading chambers by the centrifugal force and under the millstone. The sheer force caused by the relative motions of both components breaks down the cell walls of the sample. Armoured algal cells can be extremely difficult to lyse (break down), and having a method to break down these samples that can be integrated into Lab-on-a-Disk systems opens up the possibility of fully automated sample-to-answer systems that include downstream processing. As an example, this allows water samples to be tested for the presence of Harmful Algal Blooms (HABs) which may cause Paralytic Shellfish Poisoning in consumers.

Project Name: Development and Optimisation of a Chemiluminscent Assay on Lab on a Disc for Cardiac Marker Detection

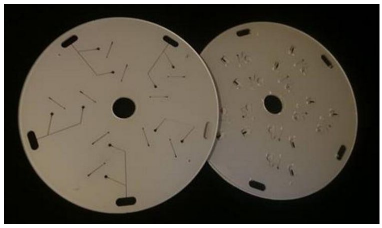
Student Name: Niamh Kilcawley

Email: niamh.kilcawley3@mail.dcu.ie

Supervised by: Professor Jens Ducrée, Dr David Kinahan

Personal Details: I entered Physics with Biomedical Sciences in 2nd year having completed first year in Common Entry Science. I chose the Microfluidics Platform group in DCU for my INTRA work placement. I continued working in the labs for 15 months in total and received an opportunity to work on my own design which led to an abstract of my work being accepted to a microfluidic conference; MicroTas 2014. Following that, I secured a 3 month internship in BluSense Diagnostics, Denmark. Presently, I have accepted a Marie Curie PhD position due to start in the summer of 2016 and my work will be focused on designing microfluidic devices to test for rare anaemia in new-borns. Outside of college, I enjoy music and have been classically trained on the piano. I often gig in various venues around Dublin City.

Project Summary: My project title is 'Development and optimisation of a chemiluminescent based assay on Lab-on-a-Disc for cardiac marker detection'. I am taking an on-bench enzyme-linked immunosorbent assay (ELISA) and incorporating it into a Lab-on-a-Disc system. The chemiluminescent ELISA assay detects levels of C-reactive protein (CRP), which is a biomarker for cardiovascular disease, in a blood sample. Elevated levels of this biomarker in the blood can indicate that a patient is at risk of a cardiovascular disease (e.g. heart attack) and the current on-bench methods are quite time consuming and labour intensive thus a more efficient method of detection is needed. I am also implementing a wireless power transfer unit for real time detection of the chemiluminescent levels present in the sample. This will eradicate the need to remove samples from the disc for analysis making both testing and detection times of the elevated CRP levels in patient's samples much less than the current times.



Project Name: Solute Selective Logical Flow Control of Centrifugal Microfluidic Networks

Student Name: Stephen Lalor

Email: stephen.lalor2@mail.dcu.ie

Supervised by: Prof Jens Ducrée & Dr Rohit Mishra.

Personal Details: I am a final year student in Physics with Biomedical Sciences. I completed my INTRA placement at the microfluidics labs here in DCU and went on to work there as a research assistant during the Summer. I plan to undertake a masters in financial mathematics after I graduate and will consider pursuing a PhD subsequently. I am an enthusiastic gamer and weight-lifter and I plan to travel to as many countries in the world as I can – currently only 14 out of 196 completed so far!

Project Summary: My project hinges on controlling the flow of small volumes of liquids in a hand-sized disc platform, with the end goal of performing a useful function such as a medical diagnostic test.
This project attempts to use a novel "smart" materials approach, whereby a selectively permeable valve is constructed using a special polymer. This valve would be permeable to a chemical solvent, but not permeable to air, water or other liquids.
The use of this valve will provide additional, robust methods by which fluid can be routed in the disc. The device will be easy to use – it merely has to be spun by an electric motor to perform its function, and it is cheap – constructed of common materials such as acrylic and built using simple methods.

```
//omega_o = omega_R + iomega_I
// where         omega_o^* = omega_R - iomega_I       so omega_o = omega_0^*

delta = 0;
E1    = 0.0;       // depends on atom such as 2p of hydrogen (1s & 2p) distance
E2    = 0.375;     // value of atmu of 2p of hydrogen
u_12  =  0.7449;   // * E0 and u_21 * E0
Eo    = 0.4632;    // amplitude if you have intensity of E field
                  //(need to calculate, check electrodynamics notes I = 10^13 W/cm^2 keep in atmu


w =  E2 - E1 + delta;     // close to resonate frequency e.g. close to E1-E2
omega_I = 0 ;
omega_R = u_12 * Eo ;     // = omega_o = u_12 * E0

y1 = Ith(y,1) ;
y2 = Ith(y,2) ;
y3 = Ith(y,3) ;
y4 = Ith(y,4) ;
y5 = Ith(y,5) ;
y6 = Ith(y,6) ;


//        y1,y2,y3,y4,y5,y6
// y(o) = (1, 0, 0, 0, 0, 0)


// nned to calculate integral ground state of hydrogen eigenstate hydrogen

        Ith(ydot,1) = (omega_R * y6 - omega_I * y5);
        Ith(ydot,2) =  0 ;
        Ith(ydot,3) = ( - omega_R * y6 + omega_I * y5);
        Ith(ydot,4) =  - omega_I * y6 ;
        Ith(ydot,5) = - delta * y6 + 0.5 * (omega_R * y2 + omega_I * y1 - omega_R * y4 + omega_I * y3);
        Ith(ydot,6) = delta * y5 + 0.5 * (omega_I * y2 + omega_R * y3 - omega_R * y1 + omega_I * y4);
}
/* Jacobian routine. Compute J(t,y). */

static void Jac(integer N, DenseMat J, RhsFn f, void *f_data, real t,
                N_Vector y, N_Vector fy, N_Vector ewt, real h, real uround,
                void *jac_data, long int *nfePtr, N_Vector vtemp1,
                N_Vector vtemp2, N_Vector vtemp3)
```

Project Name: Modelling Stochastic X-Ray Radiation in a 2-Level System

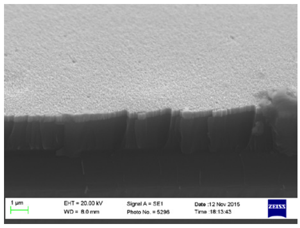
Student Name: Nicholas Lannoote

Email: nicholas.lannoote2@mail.dcu.ie

Supervised by: Dr Lampros Nikolopoulos

Personal Details: I am currently a final year undergraduate student studying Applied Physics in Dublin City University. I chose to study physics because of my huge interest in how the general world works and my interest in the semiconductor field. I gained a lot of skills from all of my lab experience. My favourite lab was modelling the chaos theory in third year. I did my INTRA placement in the Biomedical Diagnostic Institute. During my placement I learned how to use AutoCad and SolidWorks to design a working diagnostic disc. I learned a lot of valuable lab experience and how to work within a clean room. From all of my experience gained I wish to pursue a math and statistics based career. Outside of college I enjoy cycling and American Football.

Project Summary: My project, which is a theoretical project and involves a lot of computational work, is to investigate the quantum physics involved around the interaction of a free-electron laser (FEL) with a sample atom. The FEL is used to create a coherent source of radiation. Several effects are taken into consideration and calculated such as the Auger effect and detuning and Rabi frequency. The theory is to mathematically model the stochastic variations of the electric field of the x-ray radiation and analytically re-formulate the stochastic time dependent Schrodinger equation in terms of a set of averaged ordinary differential equations.



Project Name: Solution deposition of ZnO nanowires on metallic films, with a view towards generating x-rays via relativistic laser plasmonics

Student Name: Susan Lowry

Email: susan.lowry4@mail.dcu.ie
linkedin.com/in/susan-lowry-60589291

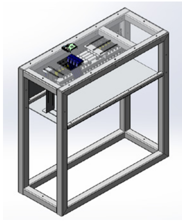
Supervised by: Dr Daragh Byrne, Prof Enda McGlynn

Personal Details:

I began first year in Common Entry into Science from which I transferred into Physics with Biomedical Sciences in second year. My INTRA was unpaid and six months long- I negotiated having a four day week to allow for a part-time job at the weekends. I worked in the NICB (National Institute for Cellular Biotechnology) with the MTCI group (Molecular Therapeutics for Cancer Ireland). The work was mostly cell culture, western blots and assays. I got the chance to present my findings to many of the researchers in the building. Some of these results will be included in a paper being written by Denis Collins (post-doctoral researcher for Roche). I joined rock-climbing this year for fun, engineering society for the microwave and was treasurer of fencing club until last year.

Project Summary:

My project had two aspects. The first aspect of the project was largely chemistry based. I had to grow zinc oxide (ZnO) nanowires on a metallic film. This was a proof of concept project, whereby I would grow these nanowires on a thin metallic film, gold in this case, and our collaborators in the Max-Born Institute will fire a high power femtosecond laser at the nanostructured substrates. The hope was to develop a novel method for generating x-rays. The second aspect of the project was simulation based. I used Lumerical software to input relevant parameters and gain insight into the electrical signals being generated and propagating through the sample.



Project Name: Testing and Classification of components in Ejection Systems in Optical Sorting Devices.

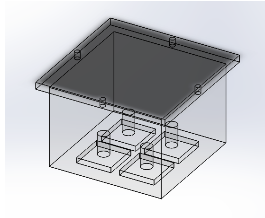
Student Name: Brian Martin

Email: brian.martin7@mail.dcu.ie
linkedin.com/in/brianmartin7

Supervised by: Dr Brendan Byrne and Prof Enda McGlynn

Personal Details: I am a final year Physics with Astronomy student in Dublin City University. I wish to persue a challenging career in the mechanical engineering industry. During my studies I did a 9 month internship at Tomra Sorting Solutions. Over the course of the internship I worked as part of a large multinational Research and Development team which was tasked with solving many problems and developing effective, timely results for corporate customers.
I am skilled in 3D modelling, mechanical design and report writing among other areas. I have worked on many projects during my education and career including a web based startup. I am currently working on my final year project to develop a sensor based data aquisition device which will be used to solve a problem encountered during my internship.

Project Summary: The automated food sorting industry relies on product ejection systems to remove unwanted products from production lines. As a result, a lot of time goes into designing these product ejection systems. For my final year project I was tasked with designing a test platform to categorize and evaluate various different components that go into these product ejection units.



Project Name: Near-Atmospheric High-VHF Plasma for Epitaxial Silicon Growth

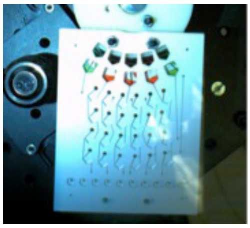
Student Name: Luke Maycock

Email: luke.maycock2@mail.dcu.ie
linkedin.com/in/luke-maycock-35a48883

Supervised by: Dr Bert Ellingboe

Personal Details: I am currently studying Applied Physics. Throughout the course I've opted for modules that lean toward areas of both astronomy and medical physics, hoping to benefit as much as possible from the flexibility of the Applied Physics course. During my INTRA placement I worked in DCU's Microfluidics Research Platform for a team headed by Professor Jens Ducree. Working exclusively in the research field gave me an understanding of the work ethic required of a research physicist. Apart from the time spent working in the lab, I tried to spend as much time as possible learning the full breadth of the work required of the discipline, from preparing to reviewing papers, lab safety, etc. in the hopes of one day applying the skills I picked up in my course to a career in the field.

Project Summary: The aim of my project is to first design and construct a plasma cell, then to use this apparatus to strike a plasma, in atmospheric conditions, in which Silicon can be grown from a given sample. The project involves solving any of the potential problems that could occur within the experiment throughout the process of designing the apparatus. Once a theoretical model has been thought through and all the necessary safety precautions considered, the experiment will be built. The next step then is to place a sample silicon crystal in the plasma cell and pass through gas that will be excited to the state of a plasma through an array of electrodes. Epitaxially grown Silicon is the most effective, defect free material used in certain semi-conductors at present, and the type of cell I'm working on will one day become an industry standard in the production of the type of Integrated Circuits used in modern computing.

Project Name: Development of Large Scale Combinational Mixing on a Centrifugal Platform toward Genotyping Applications

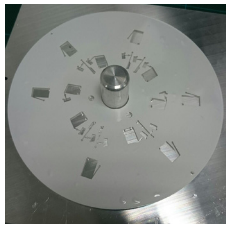
Student Name: Niamh McArdle

Email: niamh.mcardle5@mail.dcu.ie
linkedin.com/in/niamh-mcardle-439771b5

Supervised by: Dr David Kinahan, Prof Jens Ducree

Personal Details: I began studying Physics with Biomedical Science in 2012 and from the very beginning I knew it was something I would very much enjoy for the next four years. In third year I had the opportunity to work in the Medical Physics and Clinical Engineering Department in Beaumont Hospital. During my time there I worked in different areas of the hospital including nuclear medicine, theatre, dialysis and radiology. I thoroughly enjoyed this work and it greatly influenced my decision to apply for the MSc in Medical Physics in Galway. My hope for the future is that I will complete this masters course and go on to work as a radiation therapist in a hospital. Outside of college I enjoy keeping fit. I enjoy going to the gym and swimming as often as I can.

Project Summary: Comparison of DNA sequences and their genetic variations with a reference sample can help in the identification of a suspect in a criminal case, diagnose a genetic disease and help tailor a drug regime suited to an individual patient. The screening process for such analysis, however, can prove very tedious and laborious. The screening of multiple samples against multiple reagents for numerous tests is very time consuming. These tests require a minimum screening protocol of M*N*2 pipetting steps, with M representing the number of samples to be tested and N the number of reagents to be used. Centrifugal microfluidics offers the ability for these screening protocols to be reduced. My aim in this project is to fabricate a microfluidic chip, which can enable rapid combinational mixing of samples and reagents with high fidelity. If within scope, this chip will be used to demonstrate genetic screening.

Project Name: Implementation of Diagnostic Assays on a Lab-on-a-Disc using Serial Dissolvable Film Valve Control

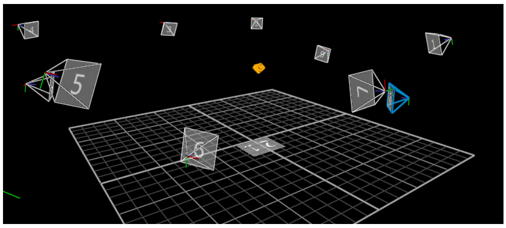
Student Name: Kate McConville

Email: kate.mcconville8@gmail.com
linkedin.com/in/katemcconville

Supervised by: Prof Jens Ducrée and Dr David Kinahan

Personal Details: I came to DCU to study Physics with Biomedical Sciences because of my interest in both Physics and its application to the medical industry. During my 2nd year I spent a few weeks in St. James Hospital in Dublin to observe the Medical Physics department. While there I learned a lot about the applications of Medical Physics in the Radiology Department and others. For my INTRA I worked in the BDI on campus as a Research Assistant and was involved in the fabrication of centrifugal microfluidic devices. When I graduate I would like to go into the field of Science Journalism or into the Medical Device Industry. Outside of college I am interested in reading, writing and drawing.

Project Summary: My project involves the design and testing of new valve configurations for Lab-on-a-Disc platforms. The aim of the project is to use the new configurations to overcome the Frequency Band Limit faced when implementing multiple Dissolvable Film Valve steps on a disc. This will allow for more complex diagnostic assays to be implemented on a single Lab-on-a-Disc and more tests to be performed.
The ability to implement more intricate designs onto a Lab-on-a-Disc will be of great benefit to many industries.
It will allow analysis and diagnostic testing to be performed outside of a centralised laboratory and also has the potential to advance medical testing in developing nations that may not have sufficient resources available.



Project Name: Motion of a Rotating Spherical Projectile: Application to Ball Games

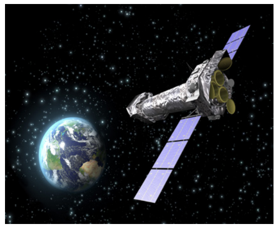
Student Name: Cathal Mc Grane

Email: cathal.mcgrane4@mail.dcu.ie

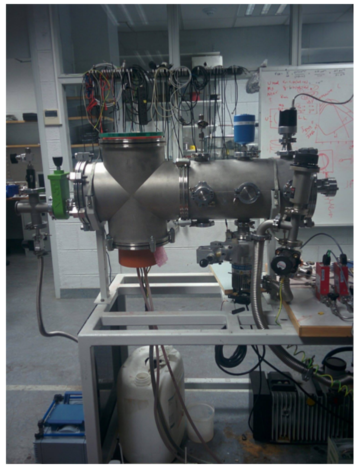
Supervised by: Dr Jean-Paul Mosnier

Personal Details: I am a 22 year old student from Athlone currently in fourth year Applied Physics. I'm an avid football fan, supporting Manchester United, and this helped with my choice of Final Year Project. Previously I have worked several summers in a pharmaceutical plant with my duties generally being maintenance and cleaning. Along with football I also enjoy juggling and love to read when I get the chance. I am hoping to eventually go into teaching physics.

Project Summary: My project is on the rotation of a spherical projectile, in this case the motion of a football under the influence of arbitrary spin and wind. Several similar experiments have been conducted on golf and cricket balls, and some wind tunnel experiments measuring the flow of air around a football. It is my intention to extend some of the models applied in these experiments to a football. This will allow for more accurate predictions of the flight of a football and this could be used to enhance products such as hawkeye, or similar goal line technology. The experiments carried out in this project are, Modelling the ideal flight of the ball, Testing the flight under different spin using motion capture, and investigating the flight under the presence of a wind.

Project Name:	Analysis of anomalous events in XMM-N's radiation monitor.
Student Name:	James Murphy
Email:	jdm.som@gmail.com
Supervised by:	Dr Hugh Evans, Dr Masha Chernyakova
Personal Details:	I am currently searching for postgraduate work or a career in space science once I complete my undergraduate degree in Physics with Astronomy. I am interested in the space industry or in astrophysics. I had an excellent opportunity to do my internship with the European Space Agency (ESA) at ESTEC in the Netherlands for 6 months. I got to work on a great project with an amazing team. My supervisor from this internship continued to supervise my final year project at DCU. We hope to publish and present this project work in the summer of 2016. Before studying physics with astronomy, I studied psychology, philosophy, and anthropology in Maynooth. I also have experience working in non-academic roles such as a playschool teacher, Xbox customer support, bookkeeper, and in the service industry. My interests include triathlon, mountain biking, saxophone, guitar, and homebrewing.
Project Summary:	My final year project is a continuation of work I did during my ESTEC internship. My task then was to analyse unexpected particle counts (by current space environment models) seen in the previous 15 years of data. This required steps including: Monte Carlo simulations of the detector response to electrons, and designing a calibration model to convert detector counts to a real world flux. As a continuation, the goal of my FYP was to use this model to complete the analysis. Some statistical analysis was carried out using the model and some interesting characteristics were observed. However this showed the necessity of detector noise and background removal before a statistical event analysis can be performed. This analysis can be used to develop space environment models which are important for designing satellite missions. Better understanding of the space environment will tighten design specifications, increase the life of satellites, and reduce costs.



Project Name: Poisoning a Magnetron

Student Name: Colm O' Brien

Email: colm.obrien85@mail.dcu.ie

Supervised by: Dr Paul Swift

Personal Details:

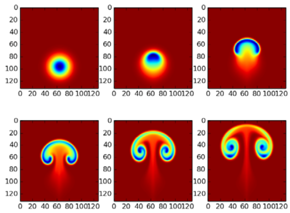
I am currently a final year Applied Physics student at Dublin City University. Prior to attending Dublin City University, I did my leaving certificate at the Institute of Education. I did leaving certificate physics at the Institute of Education. I really enjoyed this course and as a result of doing it I decided to undertake an undergraduate degree in physics. During my studies in Dublin City University I worked in a physics lab as part of my degree. This allowed me to become proficient at conducting experiments and analysing results. These skills will benefit me greatly later in life. My personal hobbies include playing football, basketball and golf. I am an avid fan of all 3 of these sports.

Project Summary:

The performance of reactive sputtering is impeded by the effect of target "poisoning", which means that a compound film is not formed on the substrate as desired. My project attempts to determine the specific parameters that will cause a magnetron to "poison". The method I am using to cause the magnetron to poison has a few simple steps. They are:

1. Add argon into the chamber until a plasma is produced
2. Record the pressure of the argon added
3. Add Oxygen into the chamber so an oxide layer forms on the magnetron causing the plasma to turn off ("poison" completely).
4. Record the oxygen pressure and power for which the plasma turned off.

This allowed me to determine when the magnetron becomes completely "poisoned" so if reactive sputtering was to be done to produce films the parameters that poisoning would occur could be avoided in order to produce high quality films.



Project Name: Parallel Simulations of Carbon Transport on the Mast Tokamak

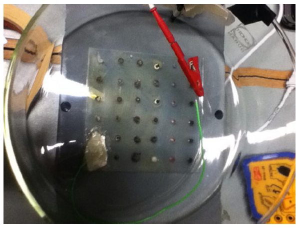
Student Name: Richard O' Neill

Email: richard.oneill36@mail.dcu.ie
linkedin.com/in/richard-o-neill-98714193

Supervised by: Prof Miles Turner and Dr Huw Leggate

Personal Details: I am currently studying towards a BSc(Hons) in Physics with Astronomy. I entered the course in September 2011 via the mature student entry route. In 2005, I graduated from Athlone I.T. with a Higher Certificate in Construction Studies. After my studies I began working as a Road Design Technician. In 2008, I moved to Northern Ireland and was employed as a Technical Inspector on a major infrastructure project. During my time studying in DCU, I was a member of the DCU MMA and Boxing Clubs and Mature Student Society. I was chairperson of the Boxing Club during my 2nd year. For my 3rd Year INTRA, I went on a field trip abroad, for this we went to the European Space Agency's Astronomy Centre in Madrid.

Project Summary: My final year project involves running computer simulations of carbon moving through a plasma in the MAST Tokamak in Culham Centre for Fusion Energy in the UK. To do this I am required to use a 3D plasma fluid simulation code called BOUT++. Due to the amount of data that this code uses, I was required to set-up an account on the FIONN supercomputer in INTEL and process my data through this. Once the information had been processed, I could then analyse the data to see what effect the carbon had on the temperature of the plasma as it moved from the outer confinement wall to the inner core plasma. I also analysed what effect the carbon transport had on the density of the plasma and also the effect this change in density had on the movement of other impurities in the plasma.

Project Name: Investigation of the potential of Lithium Vanadate to split water under illumination

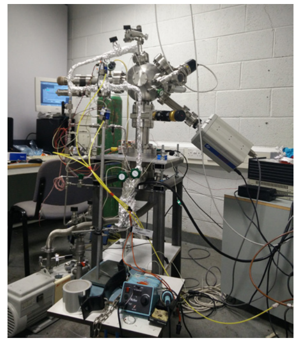
Student Name: Liam Phelan

Email: liam.phelan8@mail.dcu.ie
linkedin.com/in/liam-phelan-b69905a0

Supervised by: Dr Robert O'Connor

Personal Details: At the time of writing, I am a fourth year student in Physics with Astronomy. I chose to do INTRA instead of the observatory field trip in 3rd year. As a result of this, I worked on a project to prevent falls among hospitalised patients. This offered a great opportunity to build upon electronic engineering skills from second year. I also partook in UCD's Summer of Physics intern programme, doing a space science project. I love to travel and discover new places, although I've found that reading is oft a cheaper and more comfortable alternative than flights across the globe.

Project Summary: My project is investigating whether lithium vanadate is a suitable material for the splitting of water into its atomic components of oxygen and hydrogen under solar illumination. It involved the preparation of chemicals in the lab, analysing their composition through spectroscopy and testing how the samples react to an applied electric potential. An increasing percentage of the world's energy is produced through "green" energies using renewable sources; solar, wind and hydroelectric are some that jump to mind. The development of a cheap, efficient and reliable method of converting the light which we receive from the sun into hydrogen that can then be used as a fuel cell could revolutionise the energy market. Additionally, a semiconductor material which can convert water into oxygen and hydrogen is highly beneficial for space exploration. The ISS already uses O_2 produced from electrolysis as a means of keeping the crew breathing.



Project Name: Design and Construction of an Atomic Layer Deposition System

Student Name: Eoghan Rattigan

Email: eoghan.rattigan4@mail.dcu.ie
linkedin.com/in/eoghan-rattigan-2bb5b9a6

Supervised by: Prof Greg Hughes

Personal Details:

I started in DCU studying Physics with Astronomy but after first year I decided that the Applied Physics course was more suited to my interests (the courses are identical in first year). While in DCU I was highly involved with the Ultimate Frisbee club as both a committee member and player. I was a class representative for all 4 years of my undergraduate degree during which time it was nice to be able to actively engage with the course and the people who run it.

From here I'm hoping to go into condensed matter or nanotechnology research. I am in the process of applying for doctoral positions and for the coming summer months I will be working as part of a photonics research group. The great strength of physics is the flexibility that the transferrable skills I've picked up allow me.

Project Summary:

My final year project was the construction of an Atomic Layer Deposition (ALD) system. An ALD is a fabrication system that is used to grow ultra-thin films of certain materials, one atomic layer at a time. I will be growing the films under ultra-high vacuum (UHV) conditions, a relatively unresearched area. The hope is that this can be used to control the growth of Manganese Oxide films on silicon wafers. When operational it will be used to grow controlled thicknesses of Manganese Oxide to be used as copper diffusion barriers. This will be used by Prof. Greg Hughes' Surface Science group to gain greater control on the thickness of the barriers they create. Growing the films under UHV conditions allows the films to be grown and analysed in situ by x-ray photoelectron spectroscopy (XPS) without the need to expose them to atmospheric conditions, which could compromise the samples.

Project Name: Capillary Based Metering for Serial Dilutions on a lab on a disc.

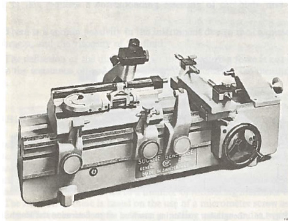
Student Name: Conor Reilly

Email: conor.reilly38@mail.dcu.ie

Supervised by: Dr Niall Maloney

Personal Details: I am currently an undergraduate in DCU studying Physics with Biomedical Sciences. My Final Year Project is based on Centrifugal Microfluidics which I have experience in due to my INTRA placement being in the Biomedical Diagnostics Institute on campus in DCU.

Project Summary: Labour intensive assays in the laboratory environment requiring numerous pipetting steps are prone to human error. My project uses a novel metering structure, based on hydrophilic capillary flow, to transfer liquid between two or more chambers which are on an identical radius on a disc. Briefly, a disc is loaded and spins at a high spin rate. Here the centrifugal force is stronger than capillary force and no liquid enters the micro channels. Reducing the spin rate allows the capillary force to wick liquid radially inward and fill the metering channel. This process can be repeated to create a dilution gradient across a number of chambers. This approach has advantages as it transfers very small volumes from one chamber to the next and, as the chambers are all on the same radius, uses a minimal amount of valuable disc real-estate.
A potential application of this is in an environment where pipetting is carried out numerous times. This design is able to carry out the serial dilutions obtained from pipetting without the possibility of error.



Project Name: The Construction, Characterisation, and Optimisation of a Length Scale Measurement System

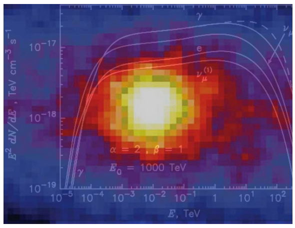
Student Name: Peter Reynolds

Email: peter.reynolds4@mail.dcu.ie
linkedin.com/in/peter-reynolds-5770a4116

Supervised by: Dr Paul Swift, Mr Rory Hanrahan

Personal Details: I am a final year student studying Applied Physics, with an interest in many areas, including materials and surface science. During my INTRA placement I interned at the National Metrology Laboratory and am currently undertaking my final year project with them as well. My goal after graduation is to do either a Masters or Ph.D. degree.

Project Summary: A large amount of companies in Pharmaceuticals, Medical Devices, Manufacturing use simple steel rules. In these industries, all rules require calibration. Despite low accuracy applications for these rules the standard specifications are quite tight, about 50 – 80 microns, and the calibration uncertainty for these must be in the order of 0.25 – 0.5 times that. The current calibration method employs costly CMMs, better used for more accurate calibrations. Given these tight specs, the sheer number of these instruments in use, and the current method employed, a new system to calibrate these rules must be developed, which is fast, accurate and cheap. The project is the construction and optimisation, from scratch, of this new system. In this system, rules are laid against a magnetic binary strip, on a 1D moving table. The magnetic strip acts as a reference length scale. The scale on the rule is calibrated against the strip.



Project Name: Calculation of the Possible Flux of High Energy Neutrinos from High Energy Sources Observed in GeV and TeV Energy Bands.

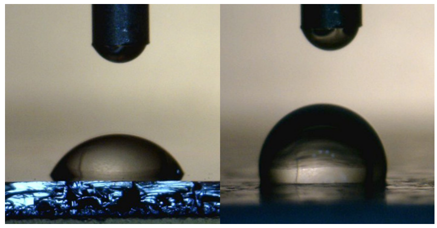
Student Name: Eoghan Rutherford

Email: eoghan.rutherford2@mail.dcu.ie
linkedin.com/in/eoghan-rutherford-796329116

Supervised by: Dr Masha Chernyakova

Personal Details: I am a final year student on the B.Sc. in Physics with Astronomy programme. Grade averages were 1.1 in first and second year and 2.1 in third year. As part of a third year programme, I attended a research trip to the European Space Astronomy Centre in Spain. My interests include literature and video games and I've played for my local football team, Balbriggan FC, as a goalkeeper for the past number of years.

Project Summary: In astronomy, a growing body of research focusing on neutrinos is facilitating potential advances in our understanding of phenomena that are difficult to observe using contemporary light based techniques, such as the mechanisms behind supernovae and nuclear fusion in stars. But because neutrinos interact so weakly with matter, year long observations in cubic kilometre sized observatories are required for reliable measurements. With such lengthly timescales, it becomes necessary to make predictions in order to decide their primary targets, for example, those with high fluxes at high energies. One can derive the expected neutrino flux value of an object by modelling atomic interactions that produce neutrinos in that object. This research project aims to develop a program to compute the potential neutrino flux for a given target. This program will then be tested using data from the supernova remnant RXJ1713.7-3946 from which a high neutrino flux is widely expected.



Project Name: Design, Construction and Testing of a Dynamic Sessile Drop Water Contact Angle System

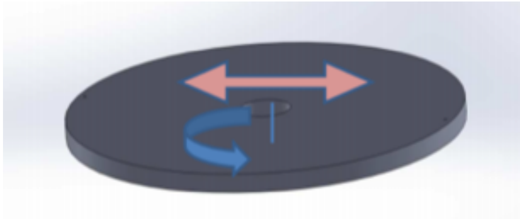
Student Name: Frances Ryan

Email: frances.ryan25@mail.dcu.ie

Supervised by: Dr Justin Bogan and Prof Greg Hughes

Personal Details: I am working towards a B.Sc. in Physics with Biomedical Sciences. For my INTRA placement I was employed with SAP- a leading business software company, where I gained and improved many technical skills and was exposed to a fast-paced business environment. I also worked as an intern in the National Centre for Sensor Research during the summer of second year where I carried out a project involving the investigation of different materials for use as reference electrodes for wearable applications. In my free time I enjoy music and drama and was a member of DCU drama society.

Project Summary: Having easy access to an instrument for measuring dynamic contact angle(DCA) would be beneficial as contact angle measurements are used across a variety of disciplines for characterizing surface topology, wettability and heterogeneity. The measurement is often used in conjunction with Atomic Force Microscopy and X-Ray Photoelectron Spectroscopy to provide a thorough picture of the surface structure. DCA measurement involves depositing a droplet of water onto a surface and then increasing the volume. As the volume of liquid is increased the size of the droplet will increase until a point where the circumference of the liquid in contact with the surface begins to increase. The angle formed just before this point is referred to as the advancing angle and it approaches a maximum value. Similarly when the volume is decreased, the liquid contracts and forms a receding angle.



Project Name: Enhanced Mixing/Mechanical Cell Lysis on a Lab on a Disc using cam like motion.

Student Name: Jessica Spain

Email: jessica.spain4@mail.dcu.ie

Supervised by: Dr Niall Maloney

Personal Details: I am currently a final year undergraduate student studying Physics with Biomedical Sciences. I chose PBM because I have always enjoyed problem solving and applying this to the human body was particularly appealing. During the 3rd year of my degree I had the opportunity to work within the BDI. The BDI is a centre of excellence in biomedical diagnostics. It pioneers advances in the science and technology of integrated point-of-care biomedical diagnostic devices. I worked with a range of scientific and engineering experts within the BDI. Outside of university I enjoy playing rugby at a provincial standard.

Project Summary: Centrifugal disk technology has been shown to have potential in the area of point of care diagnostics. Liquid mixing and cell lysis (breaking a cell membrane to access intracellular substances) are an important step in sample preparation. This project involved the design (AutoCAD and Solidworks) and manufacture (3D Printing) of a device to house a spindle motor, and lab on a disc devices to be spun. It then involved characterising mixing and cell lysis both with and without cam like motion.

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