DEPARTMENT OF PHYSICS

Fourth Year Research Projects

2011

Table of Contents

Health and Safety

Undergraduate students need to undergo appropriate safety training for their projects. The University Occupational Health & Safety Arrangements state:

16.4 Supervision of Students

- Departments recognise that most undergraduate students are initially untrained in matters of health and safety, therefore, Academics will provide information, instruction, training and "such supervision as is necessary", for all aspects of coursework, to ensure, so far as is reasonably practicable, the health and safety of both postgraduate and undergraduate students;

- Coursework will cover, practical work, project work, fieldwork, work placements and any other aspect required of students by their courses;

- Departments will record the means of delivery of the health and safety programme for each course, each year;

- Academic Supervisors will determine the appropriate level of supervision, based on an assessment of risks of the research or teaching activity etc. and documented training received by students; Academic Supervisors will personally provide necessary supervision, unless others are identified by the relevant risk assessment.

An Undergraduate safety induction training record is required to be completed for each project student. Please ensure that the training is completed and the form returned to Lynn Gilmour before the project work begins. (see Appendix 1)

With thanks,

Dr Brian McNeil

NOTE: Laser safety training will be delivered on 11th October 2011 at 11 am, Colville, 5.04 (to be confirmed)

Nanoscience Division

Energy Transfer as a Nanoscale Ruler

Project Supervisors: (1) Dr Yu Chen, (2) Dr Olaf Rolinski

Project Description:

Forster resonance energy transfer (FRET) has served as a molecular ruler, commonly used for biological research to measure molecular distance and report conformational changes, based on the 6th order dependence of energy transfer rate on the separation of a donor and an acceptor. However, FRET technique is restricted to the upper limit of separation of only 8nm, as the energy transfer becomes too weak beyond this distance. Recent study on the energy transfer between dye molecules and metallic nanoparticles shows the possibility of extending the upper limit. This project intends to investigate the energy transfer mechanism and to understand the energy transfer from dye to metallic nanoparticle in order to exploit this process as a ruler for quantitative measurement of nanodistance.

Key Reference (if applicable): *T. Sen et al, Appl. Phys. Lett, 91, 043104 (2007)*

Ratio of Experiment/Theory/Computation:

	Exp:	80 %
	Theo:	10 %
	Comp:	10 %

Suitable for : *MPhys and BSc AP, P, LPO*

Safety Training Requirements: Contact the project Supervisor for further advice

Optical Properties of Nanoparticles

Project Supervisors: (1) Dr Yu Chen, (2) Dr Olaf Rolinski

Project Description:

Noble metal nanoparticles have great potentials for applications in biochemical sensing, medical diagnostics and therapeutics, as well as biological imaging due to their unique optical properties originating from the excitation of local surface plasmon resonance. In particular, gold nanoparticles, have attracted intensive interests because they are low toxic, photostable, and can be attached, readily, to molecules of biological interest.

The aim of this project is to investigate the optical properties of gold nanoparticles of different geometries and the environmental influence on their optical properties. Student will have an opportunity to become familiar with some aspects of nanotechnology and gain hands-on experience in using optical absorption spectroscopy as well as the state-of-the-art scanning near field optical microscope.

Reference: Relevant papers will be provided

Ratio of Experiment/Theory/Computation:	Exp:	80 %
	Theo:	10 %
	Comp:	10 %

Safety Training Requirements: Contact the project Supervisor for further advice

Ocean Colour Radiometry – Data Processing and Image Interpretation

Project Supervisors: (1) Prof Alex Cunningham, (2) Dr David McKee

Project Area: Nanoscience (Marine Optics and Remote Sensing)

Project Description:

Remote sensing using data from polar-orbiting satellites offers the only practical means of obtaining synoptic information on patterns of spatial and temporal variability in the marine environment.

This project involves the acquisition of ocean colour data via the NASA Goddard Data archive, the processing of this data to produce atmospherically corrected imagery using the SeaDAS data processing software, and the interpretation of these images to give insights into physical and biological interactions in shelf seas.

Key Reference (if applicable): http://oceancolor.gsfc.nasa.gov/

Ratio of Experiment/Theory/Computation: Exp: 0 %
Theo: 25 %
Comp: 75 %

Suitability: 12 421 MSci: P/AP/Phot/ PVS BSc: AP/P/LPO/MP
12 521 MSci PMF/Bio

Additional comments: The student needs to assimilate a lot of background material in oceanography, marine optics and satellite image processing.

Safety Training Requirements: None

Modelling the Interaction of Electron Beams with Semiconductor Devices

Supervisors: (1) Dr Paul Edwards, (2) Professor Robert Martin

Project Description:

When a semiconductor is irradiated with a beam of high energy electrons, electrons/hole pairs are generated in the material. This injection of excess carriers forms the basis of several scanning electron microscope (SEM) based characterisation techniques, such as cathodoluminescence and electron beam-induced current measurements. While this carrier generation can be readily simulated using existing Monte Carlo code, modelling the steady-state carrier concentrations requires the subsequent movement of carriers to be considered. This project will involve the use of finite difference methods to solve the carrier transport and Poisson's equations. The results will be used to determine the threshold for high-injection conditions in LED devices, and to predict the spatial resolution of the SEM techniques in different materials. Depending on progress, comparison will be made with SEM measurements, and the modelling may be extended to include the effects of p-n junctions and quantum wells.

Reference: "Introduction to Semiconductor Device Modelling", C. M. Snowdon (World Scientific Publishing, 1987)

Ratio of Experiment/Theory/Computation:

Exp:	20%
Theo:	0%
Comp:	80%

Suitable for: MPhys and BSc AP, P, LPO

Safety Training requirements: None

Predicting Solvation Thermodynamics of Bioactive Molecules

Project Supervisors: (1) Professor Maxim Fedorov, (2) Professor David Birch (tbc)

Project Description:

The project will study solvation thermodynamics of bioactive molecules by novel computer modelling methods. One of the main causes of the unacceptable attrition rate in drug discovery is the failure of molecules to reach the market place because they have the wrong physico-chemical properties to allow them to be orally administered to patients. Indeed, as many as 40% of all drug failures on the market have been attributed to these problems.

Experimental high-throughput measurements of physico-chemical properties of bioactive molecules (solubility, pKa, logP, etc) are traditionally used to screen candidate drug molecules. However, such experiments are expensive, time-consuming and can only be applied to molecules that have already been synthesized. An alternative approach is to use computer simulations to calculate the properties of putative drug molecules. Recently we developed a highly efficient method for predicting solvation thermodynamics parameters of bioactive molecules in a view of potential medical and environmental applications. The method is based on a molecular theory of solutions, Reference Interaction Sites Model (RISM). The student will have the opportunity to be involved into large-scale computational screening of thermodynamic properties of drug-like molecules and agrochemicals by this new method.

Key Reference (if applicable): *Kerns, E. H. & Di, L. (2008), Drug-like properties: concepts, structure design and methods: from ADME to toxicity optimization*, *Academic Press*; *Additional references will be provided.*

Ratio of Experiment/Theory/Computation: Exp: 0 %
Theo: 30 %
Comp: 70 %

Suitability: 12 421 MSci: P/AP/Phot/ PVS* BSc: AP/P/LPO/MP
12 521 MSci PMF/Bio**

*For MSci P/AP/Phot/PVS students the project should be designed to last for two years
**For MSci PMF/Bio students the project will commence January 2012.

Additional comments: Suitable for Masters-level students with good computer skills and an interest in chemical/molecular physics or biophysics. This is an excellent opportunity for students to get experience in novel state-of-the-art methods of molecular modelling.

Safety Training Requirements: None

Molecular Mechanisms of Biological Adaptation to Extreme Ionic Environments

Project Supervisors: (1) Professor Maxim Fedorov, (2) Professor David Birch (tbc)

Project Description:

The project will study molecular mechanisms of protein resistance to extreme ionic environments by use of different methods of computational molecular biophysics. Among different types of life there is one that exists under conditions considered for a long time as a dead zone. These living (micro)organisms are called "extremophiles". They feel comfortable at such extreme conditions as high (>70° C) temperatures (*thermophile*), extreme pH (*alkaliphile, acidophile*), high salinity (*halophile*) etc. In the current project we will study molecular structures of enzymes from *halophilic bacteria* that inhabit hypersaline environments such as those found in the Dead Sea and saltern evaporation ponds. It was found that such aggressive media where 'normal' organisms cannot survive are the optimum living conditions for the halophilic species. During the billions years of evolution, the halophilic organisms developed *molecular mechanisms* of adaptation to highly concentrated salt environments. However, these mechanisms are still poorly understood. There are several hypotheses for the main mechanisms of halophilic proteins resistance to extreme ionic envirnments: (i) accumulation of negative charges on the protein surface; (ii) minimization of the solvent accessible surface area. The main goal of the study will be to explore correlations between the surface charge and the surface area of different mutants of halophilic proteins compared to their homologous counterparts from 'normal' organisms. The project will involve homologous molecular modelling of proteins and structural analysis of the protein structures.

Key References: Gross M. "Life on the Edge: Amazing Creatures Thriving in Extreme Environments", New YorK: Plenum (1998); Lesk, A. M. "Introduction to protein architecture", Oxford(2001); SWISS-MODEL Protein Modelling Environment (http://swissmodel.expasy.org); additional references will be provided.

Ratio of Experiment/Theory/Computation: Exp: 0 %
Theo: 30 %
Comp: 70 %

Suitability: 12 421 MSci: P/AP/Phot/ PVS* BSc: AP/P/LPO/MP
12 521 MSci PMF/Bio**

*For MSci P/AP/Phot/PVS students the project should be designed to last for two years
**For MSci PMF/Bio students the project will commence January 2012.

Additional comments: Suitable for students at all levels with good computer skills and an interest in molecular biophysics. The student will get experience in modern state-of-the-art tools of protein structural analysis and bioinformatics applications in molecular biophysics.
Safety Training Requirements: None

Semiconductor Doped Glasses

Project Supervisors: (1) Dr Thomas Han, (2) Dr David Hollis, Kilbarchan Glass Research

Project Area: Nanoscience

Project Description:

The optical properties of semi-conductor doped glasses is mainly determined by the composition of the doped semi-conductors and the size of the crystallites formed during the manufacturing process. This project is to investigate the change of the optical properties of these glasses as a result of thermal treatment. It involves the determination of the shift in absorption edge and Raman spectroscopy as a function of temperature.

Reference:

Ratio of Experiment/Theory/Computation:	Exp:	90 %
	Theo:	7 %
	Comp:	3 %

Suitability: 12 421 MSci: P/AP/Phot/ * BSc: AP/P/LPO/MP

*For MSci P/AP/Phot/PVS students the project should be designed to last for two years
**For MSci PMF/Bio students the project will commence January 2012.

Additional comments: Student choosing this project should have a good understanding of his/her 3rd yr Solid State Physics.

Safety Training Requirements: General Laboratory and Laser safety.

Photo-thermal Measurements of Optical Absorption

Project Supervisors: (1) Dr Thomas Han, (2) Dr Nicholas Lockerbie

Project Description:

Photo-thermal measurements can potentially provide a higher sensitivity than traditional transmission measurements because rather than observing small changes in a large quantity, absorption-induced heating is detected directly. This project involves the development, construction and characterization of a self-balancing thermistor-based fast heat-pulse detector (Dr. Lockerbie) and then applying it to the photon-thermal measurements of the optical absorption of single crystals doped with various lanthanide or transition-metal ions. If time permits, one could also investigate the partition of non-radiative and radiative processes by combining these results with photo-excitation measurements.

Key Reference:

Ratio of Experiment/Theory/Computation:	Exp:	90 %
	Theo:	7 %
	Comp:	3 %

Suitability: 12 421 MSci: P/AP/Phot/ * BSc: AP/P/LPO/MP

*For MSci P/AP/Phot/PVS students the project should be designed to last for two years
**For MSci PMF/Bio students the project will commence January 2012.

Additional comments: This project requires experimental skills in both electronics and spectroscopic techniques and student(s) choosing this project should have a good understanding of his/her 3-rd yr Solid State Physics.

Safety Training Requirements: General Laboratory and Laser safety.

Renormalization of Alloys

Project Supervisors: (1) Dr Ben Hourahine, (2) Professor Gian-Luca Oppo

Project Description:

One of the major breakthroughs in statistical physics during the 20th century was the development of renormalization group methods (based on concepts first used in particle physics). The main idea of this approach is that interactions between particles on a given scale (say subatomic particles) lead to effective interactions on a larger scales (nuclear physics) which in turn give rise to effective interaction on still longer scales (atomic structure) and in turn even longer scales (solids), etc... In each case the effective interactions on a given scale doesn't require detailed knowledge of the scale below (or the effective levels above). This family of methods is the best way to understand many processes such as phase transitions, where there are simultaneous effects on many length scales, but also can produce coarse-grain models on large scales. However, these techniques are often applied to model systems (see the reference for a discussion about the Ising model). In this project we will investigate the feasibility of applying the Kadanoff method to study an alloy material, looking for evidence of phase transitions.

Key Reference: Chapter 5 (section 5.5) of "Principles of condensed matter physics" by Chaikin and Lubensky in the library (D 530.41 CHA)

Ratio of Experiment/Theory/Computation:	Exp:	0 %
	Theo:	40 %
	Comp:	60 %

Suitability: 12 421 MSci: P/PVS BSc: P
12 521 MSci PMF

Additional comments: Interest or previous experience in programming would be an advantage

Safety Training Requirements: None

Understanding the Optics of Marine Diatoms

Project Supervisors: (1) Dr Ben Hourahine (2) Dr Francesco Papoff (3) Prof Alex Cunningham

Project Description:

Diatoms are a group of common singled cell marine plants. Their cells are covered by a layer of amorphous silica, often of a complicated shape. It has been suggested that one reason for this layer is to act as an optical concentrator for light to increase the efficiency of photosynthesis. However this idea remains unproven, and several alternative possible functions for this layer have also been suggested.

In this project a recently developed method to simulate the optical properties of small particles will be applied to models of some of the simpler shapes of diatom. Initially, the structure will be modelled as an elliptical silica particle, calculating the light intensity and distribution inside of the particle for a range incident fields to simulate the surrounding optical conditions in the ocean. In the later stage of the project, a more realistic model containing an additional optically absorbing chloroplast will be considered.

Reference: K. Holms, B. Hourahine, F. Papoff, `Calculation of internal and scattered fields of axisymmetric nanoparticles at any point in space", Journ. Opt A, 11, 054009 (2009)

Ratio of Experiment/Theory/Computation:	Exp:	5 %
	Theo:	35 %
	Comp:	60 %

Suitable for: MPhys and BSc P, LPO

Safety Training Requirements: None

A Physical Investigation of Protein-drug Binding

Project Supervisors: (1) Neil Hunt, (2) Paul Hoskisson (SIPBS)

Project Description:

This project will use physical methods such as infrared and ultraviolet absorption spectroscopy to investigate the interactions between a drug molecule and the protein that it targets. The drug in question is currently used clinically to treat patients but a long course of treatment is required, which can lead to resistance. The aim of this project is to understand the physics of the binding between drug and protein by examining the structural interactions and hydrogen bonding that underpin drug activity and ultimately to discover ways of improving the effectiveness of future drug candidates.
If the project is successful later stages may progress to using ultrafast laser spectroscopy techniques to examine drug binding in real time.

The project lies at the boundary between physics and the life sciences and is an excellent opportunity to experience multidisciplinary research in the lab and to learn the skills that are required for this increasingly common type of study. The project will suit a motivated and ambitious student interested in taking part in a challenging project.

Key Reference (if applicable):

Ratio of Experiment/Theory/Computation:	Exp:	75 %
	Theo:	15 %
	Comp:	10 %

Suitability:	12 421 MSci: P/AP/Phot/ PVS*
	12 521 MSci PMF/Bio**

*For MSci P/AP/Phot/PVS students the project should be designed to last for two years
**For MSci PMF/Bio students the project will commence January 2012.

Additional comments: A background in biology (or chemistry) is not required but would be an advantage.

Safety Training Requirements: Laser and Chemical Safety

The Physics of DNA

Project Supervisors: (1) Neil Hunt, (2) Drs Marco Candelaresi (Physics), Glenn Burley (Pure and Applied Chemistry)

Project Description:

This project will use physical methods such as infrared spectroscopy and 2D-IR spectroscopy to investigate the binding interactions of DNA molecules in solution. The DNA molecule is central to biology but the physical details of the hydrogen bonding interactions that are fundamental to processes such as Watson-Crick base pairing or DNA binding to proteins are not well understood. In this project we will use infrared spectroscopy to determine useful infrared probe signatures for DNA and apply this to studies of processes such as thermal melting of DNA duplexes and investigations of DNA binding to species such as polyamides that find applications in DNA-based nanomaterials. If time allows we will apply new ultrafast 2D-IR spectroscopic methods to investigate the dynamics of these processes in real time.

The project lies at the boundary between physics, chemistry and the life sciences and is an excellent opportunity to experience multidisciplinary research in the lab and to learn the skills that are required for this increasingly common type of study. The project will suit a motivated and ambitious student interested in taking part in a challenging project.

Key Reference (if applicable): 'DNA-templated photonic arrays and assemblies: Design principles and future opportunities' Su, W., Bonnard, V., Burley, G.A. Chem Eur J 2011, 17, 7982
'2D-IR spectroscopy: ultrafast insights into biomolecule structure and function' Hunt, N. T. *Chem Soc Rev* 2009, 38, 1837-1848,

Ratio of Experiment/Theory/Computation: Exp: 75 %
Theo: 15 %
Comp: 10 %

Suitability: 12 421 MSci: P/AP/Phot/ PVS*
12 521 MSci PMF/Bio**

*For MSci P/AP/Phot/PVS students the project should be designed to last for two years
**For MSci PMF/Bio students the project will commence January 2012.

Additional comments: A background in biology (or chemistry) is not required but would be an advantage.

Safety Training Requirements: Laser and Chemical Safety

Characterisation of Copper Gallium Diselenide Layers for Solar Cells

Project Supervisors: (1) Professor Robert Martin, (2) Dr Michael Yakushev

Project Description

Efficient thin-film solar cells require an absorber layer with a band-gap well matched to the solar spectrum and a high optical absorption coefficient. The alloy Copper Indium Gallium Diselenide (CIGS) satisfies these criteria to a large extent and holds the record conversion efficiency, of just over 20%, for a single junction cell. CIGS can be viewed as a mixture of Copper Indium Diselenide ($CuInSe_2$) with Copper Gallium Diselenide ($CuGaSe_2$). This project involves the study of the less well characterised end member, namely $CuGaSe_2$. Recent work in our group has reported important material parameters for single crystals of this material (see key reference below) and the project will extend the study of the single crystals as well as bring in work on thin films of $CuGaSe_2$. An electron microprobe will be used to image the surfaces using secondary electron microscopy and to map the elemental composition using X-ray fluorescence. The optical properties of the layers will be investigated using photoluminescence (PL) spectroscopy as a function of the power of the exciting laser and of the temperature of the samples. The aim of the project is to better understand the CuGaSe2 and to explore similarities and differences of the single crystals and thin films.

Key Reference (if applicable): "Diamagnetic shift of the A free exciton in CuGaSe2 single crystals" by F. Luckert et al. in Applied Physics Letters vol 97, 162101 (2010)

Ratio of Experiment/Theory/Computation: Exp: 80 %
Theo: 20 %
Comp: 0 %

Suitability: 12 421 MSci: P/AP/Phot/ PVS* BSc: AP/P/LPO/MP

*For MSci P/AP/Phot/PVS students the project should be designed to last for two years

**For MSci PMF/Bio students the project will commence January 2012.

Additional comments:

Safety Training Requirements: Laser safety training required

Modelling the Scattering of Light in the Sea

Project Supervisors: (1) Dr David McKee, (2) Professor Alex Cunningham

Project Description:

Ocean colour remote sensing provides global views of oceans, seas and other natural waters. The remote sensing signal is generated by the scattering of light by particles suspended in the water column. Understanding this scattering process is a key step in developing physics based approaches to interpret ocean colour radiometry. Mie theory can be used to calculate scattering distributions for simple spheres. The difficulty is that the particle population covers huge ranges of: types (viruses, bacteria, phytoplankton mineral particles, flocs etc), sizes (sub-micron to millimetre), materials (organic, inorganic, mixtures) and shapes. Modelling such complex assemblages in detail is non-trivial and many studies have adopted simplifying assumptions (e.g. power law size distributions, average refractive indices) that are convenient, but not necessarily realistic. The aim of this project is to develop a new MATLAB tool for modelling scattering from complex particle populations using Mie theory. Initially this will be used to perform a sensitivity analysis to deviations from common assumptions in published models.

Key Reference (if applicable): McKee D., M. Chami, I. Brown, V. Sanjuan Calzado, D. Doxaran and A. Cunningham The role of measurement uncertainties in observed variability in the spectral backscattering ratio: a case study in mineral-rich coastal waters. Applied Optics 48(24): 4663 – 4675, 2009**.**

Ratio of Experiment/Theory/Computation:	Exp:	0 %
	Theo:	30 %
	Comp:	70 %

Suitability: 12 421 MSci: P/AP/Phot/ PVS BSc: AP/P/LPO/MP

12 521 MSci PMF/Bio

Safety Training Requirements: None

Inter and Intra-band Spectroscopy of GaN Quantum Dots

Project Supervisors: (1) Professor Kevin O'Donnell, (2) Professor Rob Martin

Project Description:

GaN (gallium nitride) is a material that forms the basis for a new generation of solid-state lighting and UV-visible laser technologies. By isolating a "quantum dot" (QD) of GaN within a matrix of larger-bandgap semiconductor (for example (AlN) it is possible to modify the band structure in interesting ways, through (1) the reduction of dimensionality from 3D to 0D, and (2) the operation of the quantum size effect, which generally increases electronic energies in confined surroundings. This project will undertake a detailed spectroscopic study of silicon-doped GaN QD with particular attention to comparing inter-band electronic transitions (from conduction band to valence band) with intra-band transitions (between quantum-confined levels in the conduction band). In particular we will attempt the first demonstration of optical double resonance in thie AlN/GaN materials system.

Key Reference (if applicable): A general introduction to QD can be found in the library:
Semiconductor and metal nanocrystals Nanocrystal quantum dots, Victor I Klimov, 2nd ed. Boca Raton : Taylor & Francis 2010

Ratio of Experiment/Theory/Computation:	Exp:	60 %
	Theo:	20 %
	Comp:	20 %

Suitability: 12 421 MSci: P/AP/Phot/ ~~PVS*~~ BSc: AP/P/LPO/
12 521 MSci

*For MSci P/AP/Phot/PVS students the project should be designed to last for two years
**For MSci PMF/Bio students the project will commence January 2012.

Additional comments: Potential students should be familiar with Band Theory and be registered for 12.423 Semiconductor Physica and Devices.

Safety Training Requirements: Laser safety training required.

Fabricating Amyloid Functional Materials for Artificial Photosynthesis

Project Supervisors: (1) Dr Olaf Rolinski, (2) Dr Jan Karolin

Project Description:

Propensity of certain peptides and proteins to self-assemble into oligomers and fibrils (amyloids) that are rich in β-sheet secondary structure first received attention through its association with diseases related to protein misfolding, including neurodegenerative disorders, like Alzheimer's and Parkinson's diseases. However, amyloid materials have also been used for functional purposes over millions of years of evolution by organisms ranging from bacteria to mammals. Moreover, a range of peptides and protein have been observed to self assemble in certain conditions *in vitro*, paving the way to manufacturing the artificial functional nanomaterials.

The proposed project includes monitoring and control of self-assembling of amyloids to fabricate the light-harvesting functional materials for artificial photosynthesis.

The role of such a material is to transform the broad energetic spectrum of the sunlight into a possibly narrow band that can be efficiently converted into electricity by a solar cell. The molecular mechanism to execute such transformation will be fluorescence resonance energy transfer (FRET) between two organic molecules, donor (D) and acceptor (A). The photon of higher energy, that cannot be exploited by the solar cell directly, will be absorbed by D, its excitation energy transferred via FRET to A, and A will emit the photon of fluorescence of the lowered energy, suitable for the solar cell response. Fabricating the amyloid light-harvesting materials will be based on triggering self-assembly of the dye-labelled beta-amyloids in controlled conditions.

Key Reference (if applicable): Relevant research papers will be provided

Ratio of Experiment/Theory/Computation:	Exp:	80 %
	Theo:	10 %
	Comp:	10 %

Suitability: 12 421 MSci: P/AP/Phot/ PVS BSc: AP/P/LPO/MP
12 521 MSci PMF/Bio

Additional comments: Project is a part of the current research of the Photophysics Group

Safety Training Requirements: Laser safety training

Intrinsic Fluorophores in Sensing Applications

Project Supervisors: (1) Dr. Olaf Rolinski, (2) Dr. Yu Chen

Project Description:

Fluorescent aminoacids, tryptophan (Trp), tyrosine (Tyr) and phenylalanine (Phe) occur in most proteins and are involved in a large number of bioactivities. Their fluorescence responses, usually altered by this activity or an analyte, provide valuable information on the events occurring in nanometre scale. For example, binding ligands to proteins is usually reflected by shifts in the absorption and fluorescence spectra, changes in quantum yield and alterations in fluorescence decay kinetics.

The aim of the project is to investigate the spectroscopic properties of the number of dyes, including fluorescent aminoacids, and determine their excited-state kinetics. Student will have an opportunity to become familiar with some aspects of photophysics, sensing, fluorescence, time-resolved spectroscopy and state-of-the-art SNOM instrumentation.

Reference: http://www.photobiology.info/Visser-Rolinski.html Relevant research papers will be provided

Ratio of Experiment/Theory/Computation: Exp: 80 %
Theo: 10 %
Comp: 10 %

Suitable for: BSc of AP, P and LPO and MPhys of P, AP & Photonics

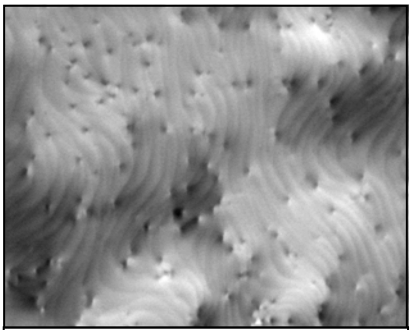
Additional Comments: Project is a part of the current research of the Photophysics Group

Safety Training Requirements: Laser Safety Training

Nanoscale Characterisation of Nitride Semiconductors using Electron Channelling Contrast Imaging

Project Supervisors: (1) Dr Carol Trager-Cowan, (2) Dr Paul Edwards

Project Description:



ECC image from GaN

Today's scanning electron microscopes allow the properties of materials and devices to be interrogated on the nanoscale. The technique of electron channelling contrast imaging (ECCI), in the scanning electron microscope, can reveal defects such as dislocations in nitride semiconductor thin films (i.e., the "black spots" in the image opposite). Nitride-based optoelectronic devices are commercially available, e.g., UV/blue laser diodes, UV/visible LEDs and white LEDs; however, the presence of dislocations can limit the performance of these devices. Here at Strathclyde, using an FEI Sirion scanning electron microscope; experiments, computer simulations of electron channelling contrast and image processing software are under development to understand the distribution of defects in nitride semiconductors. This project will involve the use of the scanning electron microscope to acquire electron channelling images and image analysis to analyse and extract information from the acquired images. There may also be the opportunity to combine ECCI with other imaging techniques such as hyperspectral cathodoluminescence imaging which is used to interrogate the optical properties of the material under study.

Reference: http://ssd.phys.strath.ac.uk/index.php/Electron_channeling_contrast_imaging
C. Trager-Cowan, F. Sweeney, P. W. Trimby, A. P. Day, A. Gholinia,, N. -H. Schmidt, P. J. Parbrook, A. J. Wilkinson and I. M. Watson, "Electron backscatter diffraction and electron channelling contrast imaging of tilt and dislocations in nitride thin films", Phys. Rev. B 75, 085301 (2007).

Ratio of Experiment/Theory/Computation:

Exp:	40 %
Theo:	30 %
Comp:	30 %

Suitable for: MPhys and BSc AP, P, LPO

Safety Training Requirements: None

Optics Division

Nonlinear Optics of Rb vapour

Project Supervisors: (1) Dr Thorsten Ackemann, (2) Dr Aidan Arnold

Project Description:

Laser-cooled atoms emerged as a well controlled experimental system for quantum dynamics and cooperative effects. The project will set up an external-cavity laser system at the D1 and D2-lines and locking electronics for the nonlinear optical spectroscopy of Rb vapour. The laser will be used to investigate spatial self-organization effects due to the interplay of diffraction and nonlinearities first in a hot Rb cell. The longer-term aim are experiments in a magneto-optical trap with laser-cooled atoms (100 μK).

Key Reference (if applicable): Arnold et al., Rev. Sci. Instr. 69, 1236 (1998) Chu, Rev. Mod. Phys. 70, 685 (1998); Ackemann, Appl. Phys. B 72, 21 (2001)

Ratio of Experiment/Theory/Computation:	Exp:	75 %
	Theo:	10 %
	Comp:	15 %

Suitability: 12 421 MSci: P/AP/Phot/ BSc: AP/P/LPO

*For MSci P/AP/Phot/PVS students the project should be designed to last for two years
**For MSci PMF/Bio students the project will commence January 2012.

Additional comments: Student should also attend PH418. The project demands the commitment to experimental work, in particular tedious optical alignments, and to engage with Gaussian beam optics and resonator theory.

Safety Training Requirements: Laser Safety Training

Bose-Einstein Condensate Experiments

Project Supervisors: (1) Dr Aidan Arnold, (2) Professor Erling Riis

Project Description:

This project involves performing experiments on the coldest material in the known universe – a Bose-Einstein condensate, at a chilly 10nK. You will observe and manipulate a real quantum mechanical object that can be seen on a video camera.

Caution: This experiment involves a vast array of lasers, optics, vacuum equipment, computer control and electronics – there is a steep learning curve. Normally reserved for PhD projects, but available for hard-working 2-year (MPhys) project students.

Key Reference (if applicable): [1] M.E. Zawadzki, P.F. Griffin, E. Riis, and A.S. Arnold, Spatial interference from well-separated split condensates, Phys. Rev. A 81, 043608 (2010). [2] A.S. Arnold, C.S. Garvie, and E. Riis, Large magnetic storage ring for Bose-Einstein condensates, Phys. Rev. A 73, 041606(R), (2006).

Ratio of Experiment/Theory/Computation:	Exp:	70 %
	Theo:	20 %
	Comp:	10 %

Suitability: MPhys only

Safety Training Requirements: Laser Safety Training

Quantum Optical Computational Toolbox

Project Supervisors: (1) Dr John Jeffers, (2) Professor Gian-Luca Oppo

Project Description:

The aim of this project is to develop a computer program to mimic the propagation of light through optical elements, and to take account of quantum processing such as unitary evolution (e.g. beam splitters, polarisers and interferometers) and nonunitary evolution (e.g. measurement, loss). It is expected that the student will use Matlab, but other mathematical programming packages could be used.

Ratio of Experiment/Theory/Computation:		
	Exp:	0 %
	Theo:	30 %
	Comp:	70 %

Suitable for: BSc MPhys

Additional Comments: This project will suit a mathematically and computationally minded student. Not suitable for those who simply do not like experiments. Students must have taken, and passed well, 12.321 Quantum Physics. Taking 12.483 Quantum and Nonlinear Optics would be an advantage, although not essential.

Safety Training Requirements: None

Resonant and Non-resonant Optical Cavities

Project Supervisors: (1) Dr Nigel Langford, (2) Professor Geoffrey Duxbury

Project Description:

Optical absorption is an effective way of detecting pollutants. Many key pollutants exhibit low absorption coefficients per unit length and an effective way to produce detectable signals is to have a long interaction length between the pollutant and the light. The simplest way is to allow the light to travel a long way through the sample but in many cases this is impractical. An alternative approach is to use an optical cavity. The aim of this project is to investigate the design of optical cavities that can produce effective long path lengths and look at the effect of controlling the light that enters the cavity. You will design and develop a computer program that will simulate and give a visual output of the optical path a beam of light will take around a cavity.

Reference: *Astigmatic mirror multipass absorption cells for long-path-length spectroscopy; J. B. McManus, P. L. Kebabian, and M. S. Zahniser APPLIED OPTICS, Vol. 34, p 3336, 1995*

Ratio of Experiment/Theory/Computation:	Exp:	10 %
	Theo:	10 %
	Comp:	80 %

Suitable for : *BSc AP, P, LPO not suitable for MPhys students*

Additional Comments: *An interest in programming.*

Safety Training Requirements*: VDU Assessment*

Modelling 4th Generation Light Sources

Project Supervisors: (1) Dr Brian McNeil, (2) Dr Gordon Robb

Project Description:

Free Electron Lasers (FELs) are the next (4th) generation light sources. These can generate very intense, short pulses of electromagnetic radiation in the UV and in the future beyond into the x-ray. Such output would allow resolution of both the spatial and temporal resolution of atomic processes. This will allow 'movies' to be made of atomic bonds being made and broken and therefore potentially allow the process to be directly influenced and controlled.

The active medium of the FEL is a beam of relativistic electrons. When these electrons interact with an undulating magnetic field they radiate at a well defined wavelength. Subsequent interaction modulates the electron beam density at this wavelength so generating coherent light. You will develop the mathematical model of this process and then solve the resulting equations numerically. A good student can expect to use their model to research new physical processes that may occur and possibly make a new and useful contribution to the field.

Reference: Free-Electron Lasers: The Next Generation by Davide Castelvecchi New Scientist, January 21, 2006. See also: www.4gls.ac.uk, www-ssrl.slac.stanford.edu/lcls/, xfel.desy.de/, http://www.newlightsource.org/

Ratio of Experiment/Theory/Computation: Exp: 0 %, Theo: 50 %, Comp: 50 %

Suitable for: P, LPO, M&P, MPhys(P), MPhys(LPO).

Additional Comments:

Students will require or will be expected to develop a working knowledge of a computer language (such as Fortran or MATLAB.) and have a good proficiency at mathematics.

Safety Training Requirements: Contact the project Supervisor for further advice

Colour Digital Photography

Project Supervisors: (1) Dr Daniel Oi, (2) Dr Ben Hourahine

Project Description:

Conventional digital imaging devices register the absorption of light in a silicon photodiode. A bare photodiode has a broadband response in the visual spectrum leading to monochrome, or “black & white” images. To create colour photographs, a Bayer colour matrix filter array is commonly used, whereby an alternating pattern of red, green, and blue colour filters is placed over the photodiodes modifying their spectral response functions. The resultant captured data is “de-mosaiced” to reconstruct an approximation of the colour and detail at the image plane. Bayer matrix capture and reconstruction can suffer from artefacts such as moiré and staircasing. Eliminating these can compromise other aspects of the image such as sharpness, colour fidelity, and noise performance. New patterns and reconstruction algorithms operating in the combined spatial-spectral domain have been proposed to ameliorate artefacts yet remaining computationally simple. This project will examine the information sampling theory behind Bayer reconstruction and relate these new image sampling and reconstruction approaches to compressive sensing.

Reference : Bayer Patent http://www.pat2pdf.org/pat2pdf/foo.pl?number=3971065
R. Ramanath, W. Snyder, G.L. Bilbro, W.A. Sander, "Demosaicking Methods in Bayer Color Arrays", Journal of Electronic Imaging, 11(3): 306-315, July 2002
http://www.accidentalmark.com/research/papers/Hirakawa08CFA_TIP.pdf
http://www.greyc.ensicaen.fr/~lcondat/publis/condat_icip09_newCFA.pdf
http://dsp.rice.edu/cs Compressive Sensing Resource

Ratio of Experiment/Theory/Computation: Exp: 0 %
Theo: 70 %
Comp: 30 %

Suitable for : MPhys, BSc AP, P, LPO

Additional Comments: This project would be suitable for the more mathematically able student and also involves computational simulation. Background in linear algebra and familiarity in Mathematica or Matlab would be useful.

Safety Training Requirements: None

Two-species Bose-Einstein Condensates in Optical Lattices

Project Supervisors: (1) Professor Gian-Luca Oppo, (2) Dr Gordon Robb,

Project Description:

Models describing the behaviour of Bose-Einstein Condensates (BEC) [1] in optical lattices can be easily integrated on computers (codes already available) [2]. Optical lattices, generated by counter-propagating laser beams, form a sequence of potential wells where the BEC can be trapped. It has been demonstrated experimentally that BEC of two separate atomic species (such as a mixture of two ytterbium isotopes or a mixture of rubidium and potassium) can be trapped in the same lattice and interact with each other. The project studies the interaction and distribution of two-species BEC in optical lattices via computer simulations. Collaboration with international research groups performing these experiments may lead to the observation of the phenomena described theoretically and simulated numerically.

Key Reference (if applicable):

[1] Bose–Einstein Condensation. L. Pitaevskii and S. Stringari, Oxford University Press, 2003
[2] R. Franzosi, R.Livi, G.-L. Oppo and A. Politi, "Discrete breathers in BEC" to appear in Nonlinearity (2011)

Ratio of Experiment/Theory/Computation:	Exp:	10 %
	Theo:	40 %
	Comp:	50 %

Suitability: 12 421 MSci: P/AP/Phot/PVS* BSc: LPO/MP, 12 521 MSci PMF

*For MSci P/AP/Phot/PVS students the project should be designed to last for two years
**For MSci PMF/Bio students the project will commence January 2012.

Additional comments: Excellent project.

Safety Training Requirements: None

Weird Helical Waves in Optical Cavities

Project Supervisors: (1) Professor Gian-Luca Oppo, (2) Dr Alison Yao

Project Description:

Spatial patterns are ubiquitous features in broad-area optical and, more generally, complex systems outside of thermodynamic equilibrium [1]. A system that displays many of these features is the optical parametric oscillator where a crystal in an optical cavity generates twin photons under the action of an external pump [2]. When the frequency of the twin photons is the same, helical waves of peculiar shape can be generated [2]. Helical waves correspond to light beams with a phase surface in the shape of a corkscrew (or fusilli pasta) and intensity distributions with a hole in their centre. Recently, progress has been made in the superposition of helical wave states without a cavity (also known as orbital angular momentum states) [3]. This project investigates the formation of even more exotic and counter-intuitive light beams in optical cavities leading for example to fractional helical waves and complex ensembles of angular momenta states. Numerical codes have already been developed in our research group [2,3] so that the project directly focuses on the theory and simulation of a variety of new helical waves with possible comparison with experimental results.

Key Reference (if applicable):

[1] 'Formation and control of Turing patterns and phase fronts in photonics and chemistry', G.-.L. Oppo, J. Math. Chem. **45**, 95 (2009)
[2] 'Spatial structures in parametric oscillators', G.-L. Oppo, A.J. Scroggie and W.J. Firth, Phys. Rev. E **63**, 066209 (2001)
[3] 'Angular momentum decomposition of entangled photons with an arbitrary pump', A.M. Yao, New J. Phys. **13,** 053048 (2011)

Ratio of Experiment/Theory/Computation: Exp: 10 %
Theo: 40 %
Comp: 50 %

Suitability: 12 421 MSci: P/AP/Phot/PVS* BSc: LPO/MP
12 521 MSci PMF

*For MSci P/AP/Phot/PVS students the project should be designed to last for two years
**For MSci PMF/Bio students the project will commence January 2012.

Additional comments: Really marvellous project.

Safety Training Requirements: None

Complex Patterns in Media Displaying Electromagnetically Induced Transparency

Project Supervisors: (1) Professor Gian-Luca Oppo, (2) Dr Gordon Robb

Project Description:

Spatial patterns and solitons are ubiquitous features in broad-area optical and, more generally, complex systems outside the thermodynamics equilibrium [1]. The project concerns with the formation of complex patterns and spatial solitons in three-level media in optical cavities under the action of two external driving beams. Three-level media driven by two quasi-resonant lasers are well known to display un-intuitive features like electromagnetically induced transparency, giant refractive indices, slow light, sub-natural line-widths, and coherent population trapping [2]. These features can be enhanced by the coupling of the media properties with the nonlinear propagation of light resulting in beautiful spatial structures with wildly unusual optical properties. Numerical codes have already been developed in our research group [3] so that the project directly focuses on the simulation of a variety of spatial structures in driven three-level systems with possible comparison with experimental results.

References: [1] 'Formation and control of Turing patterns and phase fronts in photonics and chemistry', G.-.L. Oppo, J. Math. Chem. 45, 95 (2009) [2] 'Quantum Optics', M.O. Scully and M.S. Zubairy, (Cambridge University Press, Cambridge, 1997) [3] 'Complex spatial structures due to atomic coherence', G.-L. Oppo, J. Mod. Optics 57, 1408 (2010)

Ratio of Experiment/Theory/Computation:	Exp:	10%
	Theo:	40%
	Comp:	50%

Suitable for : MPhys(P), MPhys(LPO), MPhys(AP).

Additional Comments: The project is the continuation of a successful project performed in the 2009 academic year.

Safety Training Requirements: Contact the project Supervisor for further advice

Electromagnetic Resonances in Nanoparticles

Project Supervisors: (1) Dr Francesco Papoff, (2) Drs Ben Hourahine & Yu Chen

Project Description:

Metallic nano-particles can massively enhance the local electromagnetic field close to the particle (the near field). This effect is used to visualize biological samples near to nanoparticles, even at the level of single molecule detection, and to transfer and process information and energy at scales smaller than the wavelength of the incident light. The basis all these applications is that particle-light interactions, which depend on the composition and shape of the particle and on the properties the incident light, can become very strong around resonances. Recently we have devised a new theoretical method able to find the resonances of nano- and micro-particles based on finding the surface fields that are characteristic of the particle. In this project, we aim to expand this theory to particles of arbitrary shape and determine how the structure of the particle affects its resonances.

Key Reference (if applicable): K. Holms, B. Hourahine, F. Papoff, ``Calculation of internal and scattered fields of axisymmetric nanoparticles at any point in space", Journ. Opt A, 11, 054009 (2009)

Ratio of Experiment/Theory/Computation:	Exp:	0 %
	Theo:	40 %
	Comp:	60 %

Suitability: 12 421 MSci: P/AP/Phot/ PVS BSc: P/AP/LPO

Safety Training Requirements: None

Surface Fields in Nano and Micro Particles

Project Supervisors: (1) Dr Francesco Papoff, (2) Dr Ben Hourahine

Project Description:

Nano- and micro-particles have remarkable optical properties: they can massively enhance the local electromagnetic field close to the particle (the near field) while also acting as optical cavities with exceptionally high Q factors. Recently we have devised a theoretical method which is able to calculate the response of nano and micro particles to external electromagnetic fields and predict their emitted light at any point in space. In this project, we aim to apply this theory to calculate the responses of this type of particle when illuminated by light sources that are close to the particle surface. This mimics the conditions used by an experimental group we collaborate with in Japan, where they precisely measure the surface fields of particles by exciting them with a light source close to the particle via a small optical probe, and measuring the resulting emitted light.

Key Reference (if applicable): K. Holms, B. Hourahine, F. Papoff, "Calculation of internal and scattered fields of axisymmetric nanoparticles at any point in space", Journ. Opt A, 11, 054009 (2009)

Ratio of Experiment/Theory/Computation: Exp: 0 %
Theo: 40 %
Comp: 60 %

Suitability: 12 421 MSci: P/LPO BSc: P/LPO

Safety Training Requirements: None

Fluctuations and Noise in Free Electron Lasers

Project Supervisors: (1) Dr Francesco Papoff, (2) Dr Gordon Robb

Project Description:

Noise plays a crucial role in all physical systems and in many cases it is not an hindrance, but an essential ingredient for the observation of processes as important as laser emission, for instance. In this project we will investigate theoretically and numerically the nature of small noisy fluctuations present in free electron lasers, a very important class of devices that provide researchers with light over a range of frequencies not easily accessible with other means. In particular, we will find how these noisy perturbations affect the performances of free electron lasers and explore regimes where they are be amplified.

Reference: F. Papoff, G. D'Alessandro, G.-L. Oppo, Phys. Rev. Lett. 100, 123905, 1-4, (2008)
http://sbfel3.ucsb.edu/www/vl_fel.html

Ratio of Experiment/Theory/Computation:	Exp:	0 %
	Theo:	50%
	Comp:	50%

Suitable for : MPhys and BSc AP, P, LPO

Safety Training Requirements: None

A Laser System for Laser Cooling of Rubidium Atoms

Project Supervisors: (1) Professor Erling Riis, (2) Dr Aidan Arnold

Project Description:

We will set up a laser system consisting of 780nm diode lasers resonant to the 5S-5P transition of 87Rb. Master and a repumping laser are locked to a saturation spectroscopy, and a tapered amplifier is offset locked to the master laser. The tapered amplifier will serve as the cooling laser for a two-stage magneto-optical trap (double MOT) system, as well as for and optical molasses for fluorescence imaging of the atoms. The stable and narrow linewidth master laser will be used for absorption imaging of Rb atoms as well as a pushing laser for the 2D-MOT. The different laser beams need to be switched and detuned via a computer control system and they will be guided to the experimental setup via fibers. A similar setup will be set up for laser cooling of potassium atoms.

Ratio of Experiment/Theory/Computation:	Exp: 80% Theo: 10% Comp: 10%

Suitable for : MPhys

Safety Training Requirements: Contact the project Supervisor for further advice

A Two-species Vacuum System for Bose-Einstein Condensation and Degenerate Fermi Gases

Project Supervisors: (1) Professor Erling Riis, (2) Dr Aidan Arnold

Project Description:

We will set up a vacuum system for laser cooling of bosonic 87Rb and fermionic 40K atoms. The system is a two chamber-setup consisting of a two-dimensional magneto-optical trap (2D-MOT) as a beam source for ultracold atoms. The atoms are collected in the main chamber with ultra-high vacuum (10^-12 mbar) , separated from the 2D-MOT by a differential pumping tube. The main chamber will have a special deformation-free vacuum viewport through with we will image individual atoms in an optical lattice. The setup will first be used to produce a Rb Bose-Einstein condensate in a hybrid trap. In a second step the Rb atoms will be used to sympathetically cool the potassium atoms to quantum degeneracy.

Ratio of Experiment/Theory/Computation:	Exp:	80%
	Theo:	10%
	Comp:	10%

Suitable for: MPhys

Safety Training Requirements: Contact the project Supervisor for further advice

Bose Einstein Condensate (BEC) Simulations

Project Supervisors: (1) Dr Gordon Robb, (2) Dr Aidan Arnold

Description:

When a gas of atoms is cooled to a temperature < ~1μK , it can stop behaving as a cloud of classical particles and instead behave as a "matter wave" or Bose-Einstein Condensate (BEC), whose behaviour is governed by the laws of quantum mechanics [1]. BECs were first realised experimentally in 1995 and the only one in Scotland is here at Strathclyde.

This project will involve theory and simulation of a BEC in a storage ring [2].

[2] A. S. Arnold, C. S. Garvie, and E. Riis, Phys. Rev. A 73, 041606(R) (2006)

References : [1] Allan Griffin, D. W Snoke, S Stringari , Bose-Einstein condensation

Cambridge, New York : Cambridge University Press (1995).

Ratio of Experiment/Theory/Computation:	Exp:	0 %,
	Theo:	50 %
	Comp:	50 %

Suitable for : P, LPO, M&P, PTQ, MPhys(P), MPhys(PMF), MPhys(LPO), MPhys(AP).

Additional Comments: Some experience of programming would be preferred, but is not essential.

Safety Training Requirements: Contact the project Supervisor for further advice

Simulating Entangled Quantum States with Communication

Project Supervisors: (1) Dr Shashank Virmani, (2) Dr Daniel Oi

Project Description:

One of the most remarkable features of quantum theory is the phenomenon of non-locality. When two quantum particles are prepared in a special type of state (an entangled state) and separated over long distances, then measurements of the particles can exhibit so-called non-local correlations. These correlations cannot be generated by classical physical systems unless you allow them to communicate instantly. In recent papers the amount of instant communication required has been quantified: we know that for particular families of measurement on a singlet state, one bit of communication is sufficient. The project will require the student to understand the papers that have led to this result, and to understand whether the results can be extended to cover other types of measurement.

Reference: B. Toner and D. Bacon, "Communication Cost of Simulating Bell Correlations", Physical Review Letters, Vol 91, No. 18, 189704 (2003)

Ratio of Experiment/Theory/Computation:	Exp:	0%,
	Theo:	at least 65%
	Comp:	at most 35%

Suitable for: P, LPO, M&P, MPhys(P), MPhys(LPO).

Additional Comments: Don't attempt this project just because you don't like experiments. You need to be comfortable with the mathematics of quantum theory, in particular Dirac notation and how to compute probabilities of measurement outcomes.

You must have taken and passed well 12.321 Quantum Physics. Course 12.483 Quantum and Nonlinear Optics would be useful background, but is not strictly necessary.

Safety Training Requirements: Contact the project Supervisor for further advice

Plasmas Division

Excitation of Heavy Atomic Species for ITER

Project Supervisors: (1) Professor Nigel Badnell, (2) Professor Bob Bingham (tbc)

Project Description:

The development of the ITER device for magnetic fusion requires the use of much heavier elements (Kr, Xe, W etc) than have traditionally been used, such as at the JET device.

Consequently, spectoscopic diagnostic modelling at ITER, which is already being simulated, requires atomic data where relativistic effects are likely much larger than have been seen before. The goal of the project is to assess the degree of importance of relativistic effects of relevance to ITER diagnostics. This will entail computational calculations of atomic data with varying degrees of treatments of relativistic effects viz. non-relativistic vs relativistic wavefunctions, the importanc e of the Breit interaction and the validity of its Pauli approximation at `low'-charge.

Key Reference (if applicable): http://www.iter.org/

Ratio of Experiment/Theory/Computation: Exp: 0 %
Theo: 30 %
Comp: 70 %

Suitable for: MPhys

Additional Comments: Familiarity with Unix (e.g. Linux) working environment and good computing skills in general.

Safety Training Requirements: Contact the project Supervisor for further advice

Design and Simulation of Millimetre Wave Cavities

Project Supervisors: (1) Dr Adrian Cross, (2) Dr Helen Yin

Project Description:

A project is proposed to design, simulate and numerically model a millimetre wave cavity. The project will involve the design of a millimetre wave cavity for a beam wave interaction region using analytical theory. The cavity will be computationally modelled using Microwave Studio with the transmission and reflection properties of the cavity as well as their Q-factors calculated. The beam/wave interaction will be modelled using the numerical simulation code MAGIC.

The prerequisite skills required for this project are successful completion of the undergraduate quantum electromagnetism course.

Theory: 40%, Computational: microwave studio-30% and MAGIC-30%

Suitability: BSc student

Safety Training Requirements: Contact the project Supervisor for further advice

Sweep Frequency Microwave Pulse Compression using a Helically Corrugated Waveguide

Supervisors: (1) Dr Kevin Ronald, (2) Dr Wenlong He

Project Description:

A project is proposed to investigate a new type of pulse compressor based on compression of frequency-modulated pulses using a helically corrugated waveguide as a dispersive medium. If the wave group velocity in the dispersive medium is an increasing function of frequency then the tail of the pulse will overtake its leading edge, resulting in pulse shortening and a corresponding growth in the amplitude if the loses are sufficiently low. A helically corrugated waveguide operating far from cut off can be used to couple a rotating TE31 wave and a counter rotating TE22 wave, and in the region of their coupling the group velocity of the eigenwave can be a rapidly varying function of frequency, which is attractive for pulse compression. An experimental and theoretical study of swept-frequency based pulse compression will be carried out. A conventional X-band TWT with an output power of 5kW driven by a solid-state frequency tuneable oscillator will be used to generate an input pulse for the compressor. A pulsed generator will be used to produce a sweep voltage which will be applied to a special pin of the solid state source to control its oscillation frequency. The frequency modulation of the input pulse will be measured using a heterodyne technique and a fast digitising oscilloscope. The maximum optimum power compression ratio, time compression factor and efficiency will be measured. In addition the dispersive properties of a circular waveguide with a helical corrugation on its inner surface will be measured using a vector network analysers with the results compared to the predictions obtained using numerical simulation codes such as Magic. The prerequisite skills required for this project is successful completion of the third year undergraduate course on electromagnetic theory.

Reference'Compression of frequency-modulated pulses using helically corrugated waveguides and its potential for generating multigigawatt RF radiation', 2004, S.V. SamsonovA.D.R. Phelps et al, Physical Review Letters, 92,

Ratio of Experiment/Theory/Computation:	Exp:	50 %
	Theo:	25 %
	Comp:	25 %

Suitable for : MPhys and BSc

Safety Training Requirements: Contact the project Supervisor for further advice

Laser Wakefield Acceleration and Betatron Gamma Ray Radiation

Project Supervisors: (1) Professor Dino Jaroszynski, (2) Dr M Ranaul Islam

Project Description:

The student will carry out analytical and numerical work on laser plasma wakefield acceleration. This is a method of accelerating electrons using plasma waves. The attraction of this method, being investigated experimentally and theoretically at Strathclyde University, lies in the propagation of intense laser pulses in under-dense Plasma, which can accelerate energetic electron beams up to 1 GeV by utilizing the huge longitudinal electrostatic fields produced by displaced electrons. These forces create a bubble-like ion structure, and the transverse restoring force in such ionic-background leads to acceleration and the emission of intense femtosecond duration gamma-ray betatron radiation. The emphasis of this project will be on controlled acceleration, investigating ways to obtain high energy X-rays, and studying the efficiency, which can be comparable with conventional accelerators. These new types of radiation sources could be used to probe the structure of matter on unprecedented length and time scales. The student will use particle-in-cell (PIC) codes such as VORPAL and OSIRIS. The project forms part of the ALPHA-X project at Strathclyde University.

Reference : (1)PhD thesis http://alexandria.tue.nl/extra2/200212656.pdf (2) http://phys.strath.ac.uk/alpha-x (3) Mangles, S. P. D. et al. Electron acceleration from the breaking of relativistic plasma waves. Nature 431, 535538 (2004).

Ratio of Experiment/Theory/Computation: Exp: 0 %
Theo: 30 %
Comp: 70 %

Suitable for : MSci

Additional Comments: This is challenging project requiring good mathematical and numerical skills. Anyone interested in this project should contact the supervisors in advance.

Safety Training Requirements: Contact the project Supervisor for further advice

Radiation Reaction

Project Supervisors: (1) Prof Dino Jaroszynski, (2) Dr Adam Noble

Project Description:

This project is an opportunity to investigate the interaction of a charged particle with its own radiation field. As well as being vital for the development of new technologies at the cutting edge of scientific discovery, this is a problem of fundamental importance in classical and quantum electrodynamics. Indeed, it is one of the classic unsolved problems in physics.

The Lorentz-Dirac equation, which describes radiation reaction, exhibits unexpected behaviour, such as unbounded accelerations and particles responding to a force before it acts. You will explore the origins of these pathologies and some of the attempts to eliminate them, as well as applying the equation to some of the latest accelerator designs and interactions of electrons with the electromagnetic fields that will be available from a new generation of powerful laser sources, such as that being constructed at the EU Extreme Light Infrastructure.

Reference:
J.D. Jackson, Classical Electrodynamics, 3rd ed. New York : Wiley, 1999. Main Library: D537.6 JAC;
E. Poisson, An introduction to the Lorentz-Dirac equation, arXiv: gr-qc/9912045.

Ratio of Experiment/Theory/Computation:	Exp:	0 %
	Theo:	70 %
	Comp:	30 %

Suitable for: MPhys and BSc AP, P, LPO

Additional Comments: This challenging project will be of interest to someone with strong mathematical skills, who enjoys exploring technical and conceptual questions. Anyone interested in pursuing this project should contact the supervisors beforehand

Safety Training Requirements: Contact the project Supervisor for further advice

Non-linear Optics in Plasma: Raman Amplification and Frequency Mixing

Project Supervisors: (1) Professor Dino Jaroszynski, (2) Dr Bernhard Ersfeld

Project Description:

This project offers the opportunity to investigate, both theoretically and numerically, non-linear interactions between (transverse) electromagnetic waves through a (longitudinal) plasma wave. It has been suggested to use such a process, stimulated Raman scattering, to amplify a seed pulse by extracting energy from an intense pump pulse to provide a new type of light amplifier to reach petawatts, exawatts and beyond. Plasma as a non-linear optical medium for intense laser pulses has additional interest when optical pulses are sufficiently intense to drive electrons (and holes or positrons) to relativistic energies, and thus to generate astrophysical conditions in the laboratory.
The investigation may build on an existing code for the hydrodynamic simulation of plasma taking into account a variable number of carrier species, such as electron-positron plasmas, and electrons and ions, or holes in the case of a semiconductor plasma.

Reference: William L. Kruer: The physics of laser plasma interactions, Addison-Wesley, Redwood City, Calif. c1988. Main Library: D 530.44 KRU (or other textbooks on laser-plasma interaction)

Ratio of Experiment/Theory/Computation:	Exp:	0 %
	Theo:	50 %
	Comp:	50 %

Suitable for: M&P, PTQ, MPhys(P), MPhys(AP), MPhys(LPO).

Additional Comments: Knowledge in the following areas would be advantageous: wave propagation, Fourier theory; computer programming (C or similar). Anyone interested in taking up this project should contact the supervisors beforehand.

Safety Training Requirements: Contact the project Supervisor for further advice

Electron Beam Transport and Diagnostics

Project Supervisors: (1) Professor Dino Jaroszynski, (2) Dr Enrico Brunetti

Project Description:

Laser-driven particle accelerators are compact sources of high quality electron beams with potential applications to fields such as medicine, biology and material science. Since many applications require the transport and focusing of a beam over long distances, a good quality transport system is essential. This project consists of the theoretical study of the transport of an electron beam through magnetic devices, with particular emphasis on properties such as transverse emittance and bunch length.

Reference: Wiedemann, Particle Accelerator Physics, Springer, 2007 Jackson, Classical Electrodynamics, Wiley, 1999 Esarey, Schroeder and Leemans, Physics of laser-driven plasma-based electron accelerators, Rev. Mod. Phys. 81, 1229–1285 (2009)

Ratio of Experiment/Theory/Computation:	Exp:	0 %
	Theo:	50 %
	Comp:	50 %

Suitable for: MP, MPhys(P), MPhys(AP), MPhys(LPO).

Additional Comments: Knowledge in the following areas would be advantageous: wave propagation, Fourier theory; computer programming (C or similar). Anyone interested in taking up this project should contact the supervisors beforehand.

Safety Training Requirements: Contact the project Supervisor for further advice

Laser Pulse Amplification through Stimulated Raman Backscattering in Plasma

Project Supervisor: (1) Professor Dino Jaroszynski, (2) Dr Gregory Vieux

Project Description:

Stimulated Raman backscattering in plasma is an instability that could be controlled to develop a new type of laser amplifier. Plasma as a gain medium is attractive as it can withstand higher laser intensities compared to crystal. This project involves building and running an experiment where two counter-propagating beams interact in a plasma channel. The aim is to transfer energy from a long "pump" pulse to a short "probe" pulse. In this set-up, the plasma is not only the gain medium but is also used as an optical guide to increase the interaction length between the 2 beams. This project uses the high power laser from the TOPS laboratory which provides a rare opportunity to work with ultra-short, ultra-intense laser beams.

The student will become familiar with different fields of physics: laser physics, plasma physics, optic.

Reference :

Ratio of Experiment/Theory/Computation:	Exp:	80 %
	Theo:	10 %
	Comp:	10 %

Suitable for: AP, P, M&P, Phys(P), MPhys(AP).

Safety Training Requirements: Contact the project Supervisor for further advice

Capillary Discharge Waveguides for Laser-Plasma Interactions

Project Supervisors (Joint): (1) Professor Dino Jaroszynski, (2) Dr Mark Wiggins/ Dr Gregor Welsh

Project Description:

The project is part of the ALPHA-X project to harness plasma using high power lasers as compact radiation and particle sources. An intense 30 femtosecond duration laser pulse, with a peak power of more than 30 TW, is used to excite density waves in plasma. These perturbations in the plasma density can act as a non-linear optical medium to parametrically amplify laser pulses, or as a compact accelerator, where the extremely high electrostatic forces of charge separation can accelerate particles with unprecedented accelerating gradients, more than 1000 times larger than in a conventional accelerator. The plasma medium is a central component of these amplifiers and accelerators. In the project we will investigate the formation of stable plasma waveguides in a capillary formed by an electrical discharge. The capillary acts as a waveguide for the intense laser pulse, which allows the laser intensity to maintained over several centimetres thus allowing the length of the accelerator or amplifier to be extended beyond the diffraction (Rayleigh) length .

The project involves evaluating and characterising uniform, tapered and structured plasma waveguides. Both experimental and theoretical methods will be used, which will include valuable hands-on experience with high-voltage pulsed power supplies and plasma diagnostics systems in the TOPS laser laboratory. There will also be an opportunity to test the capillaries in the current Raman amplification and laser-driven wakefield accelerator experiments at Strathclyde. This is an opportunity to be involved in a ground breaking project.

References: Relevant papers will be provided

Ratio of Experiment/Theory/Computation:	Exp:	80 %
	Theo:	10 %
	Comp:	10 %

Suitable for: BSc of AP, P and LPO and MPhys of P, AP & Photonics.

Safety Training Requirements: Contact the project Supervisor for further advice

Radiotherapy using Beams from Laser-plasma Accelerators

Project Supervisors: (1) Professor Dino Jaroszynski, (2) Silvia Cipiccia

Project Description:

Gamma rays are the most common form of radiation used in radio-therapy to treat cancer. However, another option exist: particle beams are also very effective forms of treatment. Heavy particles such as protons and carbon ions have the advantage that they deposit their dose in a very localised region in the body and thus can be used to destroy tumours while sparing healthy tissue. Unfortunately, accelerating these heavier particles is very expensive, with costs exceeding £300m for a facility. 20 MeV electrons from radiotherapy accelerators are often used for treating superficial tumours located within a few centimetres of the skin. However, by increasing the energy of the electrons to more than 100 MeV, beams can penetrate the whole body and become an effective form of radiotherapy. In this project we will utilise electron beams from a laser-plasma wakefield accelerator at Strathclyde (part of the ALPHA-X project) to study their therapeutic effect. A model system, using real cells, will be investigated using electron beams with energies between 100 MeV and 200 MeV to establish the effectiveness of the modality. The project will also involve investigating the dose distribution in a so called "phantom" that mimics biological matter making up the body. The project will involve both experimental methods and the use of simulation tools such as GEANT4 to study the interaction of energetic particles with matter. The student will have the opportunity to collaborate extensively with both radiobiologists and physicists, thus making the project very cross-disciplinary. This is an opportunity to be involved in a ground-breaking project.

References: L. Papiez, et al., “Very high energy electrons (50-250 MeV) and radiation therapy”. *Technology in cancer research treatment*, *1*(2), 105-110 (2002). C Yeboah, et al., "Optimization of intensity-modulated very high energy (50-250 MeV) electron therapy." *Physics in Medicine and Biology*, *47*(8), 1285-1301. (2002). http://www.ncbi.nlm.nih.gov/pubmed/12030556 T. Fuchs et al.,“Treatment planning for laser-accelerated very-high energy electrons”, Phys. Med. Biol. 54 (2009) 3315-3328 Y Glinec et al., “Radiotherapy with laser-plasma accelerators: Monte Carlo simulation of dose deposited by an experimental quasimonoenergetic electron beam”. *Med Phys.* **33** 155 (2006) O Rigaud, et al., (2010) “Exploring ultrashort high-energy electron-induced damage in human carcinoma cells”, *Cell Death and Disease* **1**, e73

Ratio of Experiment/Theory/Computation:	Exp:	80 %
	Theo:	10 %
	Comp:	10 %

Suitable for: BSc of AP, P and LPO and MPhys of P, AP & Photonics.

Safety Training Requirements: Contact the project Supervisor for further advice

Laser-driven Ion Acceleration

Project Supervisors: (1) Professor Paul McKenna, (2) Dr David Carroll

Project Description:

The interaction of intense laser pulses with matter is opening up new frontiers in physics via the production of extreme pressures, temperatures and intense electric and magnetic fields. This is leading to the use of high power laser radiation for exploring the properties of hot dense matter, the production of high energy particles and radiation, and the development of schemes to generate energy by inertial confinement fusion. The possibility of using high power lasers to generate high-quality beams of energetic ions is attracting global interest. In particular, laser-based ion acceleration schemes may lead to compact and relatively low-cost sources which can be used in science, medicine and industry.

The project involves an investigation of multi-MeV ion acceleration driven by ultraintense laser-plasma interactions and has two components. The first involves an analysis of existing experimental data obtained using the Vulcan petawatt laser at the UK's Central Laser Facility. This will be performed using existing analysis software tools written in Matlab. The second part of the project involves designing and developing new ion diagnostic techniques using charged particle optics software.

The project will provide the student with a background in the physics of high power laser-based sources of ions, diagnostic techniques and in the simulation and modelling of experimental results.

Key Reference (if applicable):

Ratio of Experiment/Theory/Computation: Exp: 0 %
Theo: 20 %
Comp: 80 %

Suitability: BSc: AP/P/LPO/MP

Additional comments:

Safety Training Requirements: None

The Institute of Photonics

Optical Colorimetry for Multiple Heavy Metal Detection

Project Supervisors (1): Dr David Burns, (2) Dr John-Mark Hopkins

Additional supervision will be offered by Dr Christine Davidson (Chemistry) and Dr Helen Keenan (Civil Engineering) as required

Project Description:

This project, in collaboration with the Chemistry and Civil Engineering departments, will investigate colorimetric analysis of stained heavy metal detectors. This study underpins the development of a field deployable, hand-held, test and measurement apparatus to sense the presence of heavy metal contamination of soil.

The detection of multiple metal contaminants at the same time in a simple device is a goal of this research.

Key Reference (if applicable): http://en.wikipedia.org/wiki/Colorimetry

Ratio of Experiment/Theory/Computation: Exp: 50 %
Theo: 40 %
Comp: 10 %

Suitability: 12 421 MSci: P/AP/Phot/ PVS* BSc: AP/P/LPO/MP

12 521 MSci PMF/Bio**

*For MSci P/AP/Phot/PVS students the project should be designed to last for two years

**For MSci PMF/Bio students the project will commence January 2012.

Additional comments: The scope of this project can be adjusted to accommodate the different degree levels

Safety Training Requirements: Standard Laser Laboratory Safety Training

Compact, Integrated Pump Sources for Ultrashort Pulse Lasers

Project Supervisors (1): Dr John-Mark Hopkins, (2) Dr David Burns

Project Description:

The project will focus on the configuration, design, characterisation, optimisation and utilisation of an optical module for pumping ultrashort pulse lasers. The module will comprise an arrangement of diffraction limited semiconductor lasers designed for compactness, stability and maximum transmission. The project will involve the specification and characterisation of the components, the design and fabrication of the pump module and the employment of the module to pump an ultrashort pulse oscillator.

Key Reference (if applicable): Optics Express, Vol. 17 Issue 16, pp.14374-14388 (2009)

Ratio of Experiment/Theory/Computation:	Exp:	75 %
	Theo:	15 %
	Comp:	10 %

Suitability: 12 421 MSci: P/AP/Phot/ PVS* BSc: AP/P/LPO/MP
12 521 MSci PMF/Bio**

*For MSci P/AP/Phot/PVS students the project should be designed to last for two years
**For MSci PMF/Bio students the project will commence January 2012.

Additional comments: The project would be suitable for a range of students and can be tailored to accommodate the different degree levels

Safety Training Requirements: Standard Laser Laboratory Safety Training

Microstructured Microchip Semiconductor Disk Lasers

Project Supervisors: (1) Dr Stephane Calvez, (2) Dr Alan Kemp

Project Description:

Semiconductor Disk lasers also known as Vertical External Cavity Surface Emitting Lasers form a new family of lasers that capitalise on a semiconductor gain section for wavelength versatility and an (air-gap) external cavity to obtain high-power high-beam-quality emission. Recently, to improve manufacturability, we have been studying new versions, called microchip SDLs, where the cavity is made of a sub-millimeter-long solid material instead of air, creating lasers which are more robust as they no longer require cavity alignment. If high power operation was obtained, the laser beam quality degraded compared to their air-space cavity counterparts. This project aims to experimentally investigate the use of micro-structures to address the latter drawback.

Key Reference (if applicable): S. Calvez et al, Laser Photonics Reviews, 3 (5), 407 (2009)
N. Laurand et al, "Microlensed microchip VECSELs", Optics Express, 15, 9341 (2007)

Ratio of Experiment/Theory/Computation:		
	Exp	85 %
	Theo	10 %
	Comp	5 %

Suitable for : MPhys and BSc AP, P, LPO

Additional Comments: Basic knowledge of Laser Physics.

Safety Training Requirements: Contact the project Supervisor for further advice

Allocated Projects (Fifth Year students)

Project Name	*Supervisors*	*Student Name*
A laser system for laser cooling of Rubidium atoms	Prof. E. Riis & Dr A. Arnold	Sheena Barclay
Laser Pulse Amplification Through Stimulated Raman Backscattering in Plasma	Dr. G. Vieux & Prof. D. Jaroszynski	Garry Cameron
Energy Transfer as a Nanoscale Ruler	Dr Yu Chen & Dr. O. Rolinski	Martin Gorman
Sweep Frequency Microwave Pulse Compression using a Helically Corrugated Waveguide	Dr. W. He, Dr. K. Ronald & Dr. A.W. Cross	Jonathan Lang
Complex Patterns in Media Displaying Electromagnetically Induced Transparency	Prof. G-L Oppo & Dr. G.R.M. Robb	Duncan McArthur
A two-species vacuum system for Bose-Einstein condensation and degenerate Fermi gases	Prof. E. Riis & Dr A. Arnold	Matthew Quinn
Modelling the Electromagnetic Response of Nano and Micro Particles	Dr. F. Papoff & Dr. B. Hourahine	Jonathan Ward
Portable Optical Instrumentation for Accurate Non-invasive Measurement and Quantification of Inflammation in Rheumatoid Arthritis	Dr. G. McConnell & Dr. O. Millington	David Whiteside
Nonlinear Optics of Quantum Dot Samples	Dr. T. Ackemann & Prof. E. Riis	Mark McGhee

Appendices

Safety induction training record for Undergraduate students undertaking project work

This form **MUST** be completed by student and supervisor and returned **before** student enters a laboratory and by 30th November 2011 at the **latest.**

1) I have read and understood the '*Local rules for the Safe Use of Lasers*' (available from

the SPIDER document store: docStore >> Physics >> ❑

safety - Laser Information >> all >> Local Rules) **N/A** ❑

Others: ……………………………………………………………………

………………………………………………………………………….

2) I have attended the following safety training lectures:

Physics Laser Safety ❑ **N/A** ❑

Others: …………………………………………………………………..

………………………………………………………………………….

3) I have received an induction in the use of the local safety systems and access controls in rooms:

………………………………………………………………………….

4) I have received an induction in operating the following devices and/or instrumentation (e.g. laser)

…………………………………………………………………………..

…………………………………………………………………………..

5) received an induction in the following techniques:
Laser beam alignment procedures ❑ **N/A** ❑

Others: ………………………………………………………………….

…………………………………………………………………

Signature of student: .... Date: ....

Name (print): ....

Signature of supervisor: .... Date: ....

Name (print) ....

Please return this completed form to Lynn Gilmour JA 8.33

Project allocation request form 2011

(To be returned by the student to Students Office 8th floor JA by 12 noon 30/09/11)

Student Name: **Student Number:**

Project title:		
Supervisor's signature: **Supervisor's name:**		**This project has been discussed by us, and we have agreed that it is appropriate for the student to undertake the work.**
Student's signature:		
Preference:		**For student to choose on completion of the form**

Project title:		
Supervisor's signature: **Supervisor's name:**		**This project has been discussed by us, and we have agreed that it is appropriate for the student to undertake the work.**
Student's signature:		
Preference:		**For student to choose on completion of the form**

Project title:		
Supervisor's signature: **Supervisor's name:**		**This project has been discussed by us, and we have agreed that it is appropriate for the student to undertake the work.**
Student's signature:		
Preference:		**For student to choose on completion of the form**

Vote on when you would like to take your viva exam. Select from one of the options below:

- Week of 30th April 2012 (revision week, before exam diet)
- Week of 21st May 2012 (third week of exam diet)

Note: where several allocation request forms are submitted for the same project, I will choose the successful student by lot.

Projects allocated will be announced by Marionanne McLaren on Tuesday the 5th of October 2011 – *Kevin O'Donnell*

Project Timetables

Project 12 421

Taken in 4th year by MSci Physics, MSci Applied Physics, MSci Photonics, MSci Physics with Visual Simulation, BSc Physics, BSc Applied Physics, BSc Laser Physics and Optoelectronics and BSc Mathematics and Physics students

20th September 2011 Project booklet to students

Students will receive project booklet and project request slips. The project booklet will contain details of projects offered, notes on safety training and a warning on the detection of plagiarism.

20th September 2011 – 30th September 2011 Students choose projects

Students should visit supervisors and draw up a shortlist of 3 potential projects in order of preference from 1 to 3. Each project request must be signed and dated by both the student and the supervisor and submitted to the student office, JA8.30 (Marionanne McLaren).

12 Noon 30th September 2011 Last date for submission of Project choice form to JA8.30 (Marionanne McLaren)

5th October 2011 Project allocations announced at 12 noon. Official start of Projects

17th October 2011 Literature review complete

Students submit literature survey for project (which will usually take the form of the Final Report's introductory chapter.)

30th January 2012 – 3rd February 2012 Mock viva voce examinations

The mock viva voce examination will give students a formative experience of a viva voce examination. The performance in the mock viva voce examination will not count towards the final assessment of the project.

28th March 2012 Project Talks 1-5 pm in parallel Sessions

Each student will be given a 15-minute slot. The expectation is that students will talk about their project for 10 minutes and then be questioned by the audience for 5 minutes.

16th April 2012 Project reports submitted

Project reports to be submitted as PDF format through MyPlace and then passed through Turnitin for plagiarism detection.

To be arranged Viva week

Students will be given the choice of when the Project viva will be scheduled.

Project 12 521

Taken by 4th year students on either the MSci Biophysics or MSci Physics and Mathematical Finance degrees. This project runs over both 4th and 5th year of the degree.

20th September 2011 Project booklet to students

Students will receive project booklet and project request slips. The project booklet will contain details of projects offered, notes on safety training and a warning on the detection of plagiarism.

20th September 2011 – 30th September 2011 Students choose projects

Students should visit supervisors and draw up a shortlist of 3 potential projects in order of preference from 1 to 3. Each project request must be signed and dated by both the student and the supervisor and submitted to the student office, JA8.30 (Marionanne McLaren).

12 Noon 30th September 2011 Last date for submission of Project choice form to JA8.30 (Marionanne McLaren)

5th October 2011 Project allocations announced at 12 noon.

17th October 2011 Literature review complete

Students submit literature survey for project (which will usually take the form of the Final Report's introductory chapter.)

30th January 2012 Official start of Projects

30th January 2013* Project reports submitted

Project reports to be submitted as PDF format through MyPlace and then passed through Turnitin for plagiarism detection.

30th March 2013* Project Talks 1-5 pm in parallel Sessions

Each student will be given a 15-minute slot. The expectation is that students will talk about their project for 10 minutes and then be questioned by the audience for 5 minutes.

To be arranged Viva week

Students will be given the choice of when the Project viva will be scheduled.

***Date is provisional and will be confirmed in next year's Student Handbook.**

Project Information for Continuing 5th Year Students

Project 12 520

Taken in 5th year by MSci Physics, MSci Applied Physics, MSci Photonics, MSci Physics with Visual Simulation students. The expectation is that students will continue with the project started in 4th year.

30th January 2012 – 3rd February 2012 Mock viva voce examinations

The mock viva voce examination will give students a formative experience of a viva voce examination. The performance in the mock viva voce examination will not count towards the final assessment of the project.

28th March 2012 Project Talks 1-5 pm in parallel Sessions

Each student will be given a 15-minute slot. The expectation is that students will talk about their project for 10 minutes and then be questioned by the audience for 5 minutes.

16th April 2012 Project reports submitted

Project reports to be submitted as PDF format through MyPlace and then passed through Turnitin for plagiarism detection.

To be arranged Viva week

Students will be given the choice of when the Project viva will be scheduled.

Project 12 521

Taken by students on either the MSci Biophysics or MSci Physics and Mathematical Finance degrees

30th January 2012 – 3rd February 2012 Mock viva voce examinations

The mock viva voce examination will give students a formative experience of a viva voce examination. The performance in the mock viva voce examination will not count towards the final assessment of the project.

17th February 2012 Project reports submitted

Project reports to be submitted as PDF format through MyPlace and then passed through Turnitin for plagiarism detection.

1st March 2012 Project Viva

28th March 2012 Project Talks 1-5 pm in parallel Sessions

Each student will be given a 15-minute slot. The expectation is that students will talk about their project for 10 minutes and then be questioned by the audience for 5 minutes.

Index of Project Titles

NANOSCIENCE

INSTITUTE OF PHOTONICS