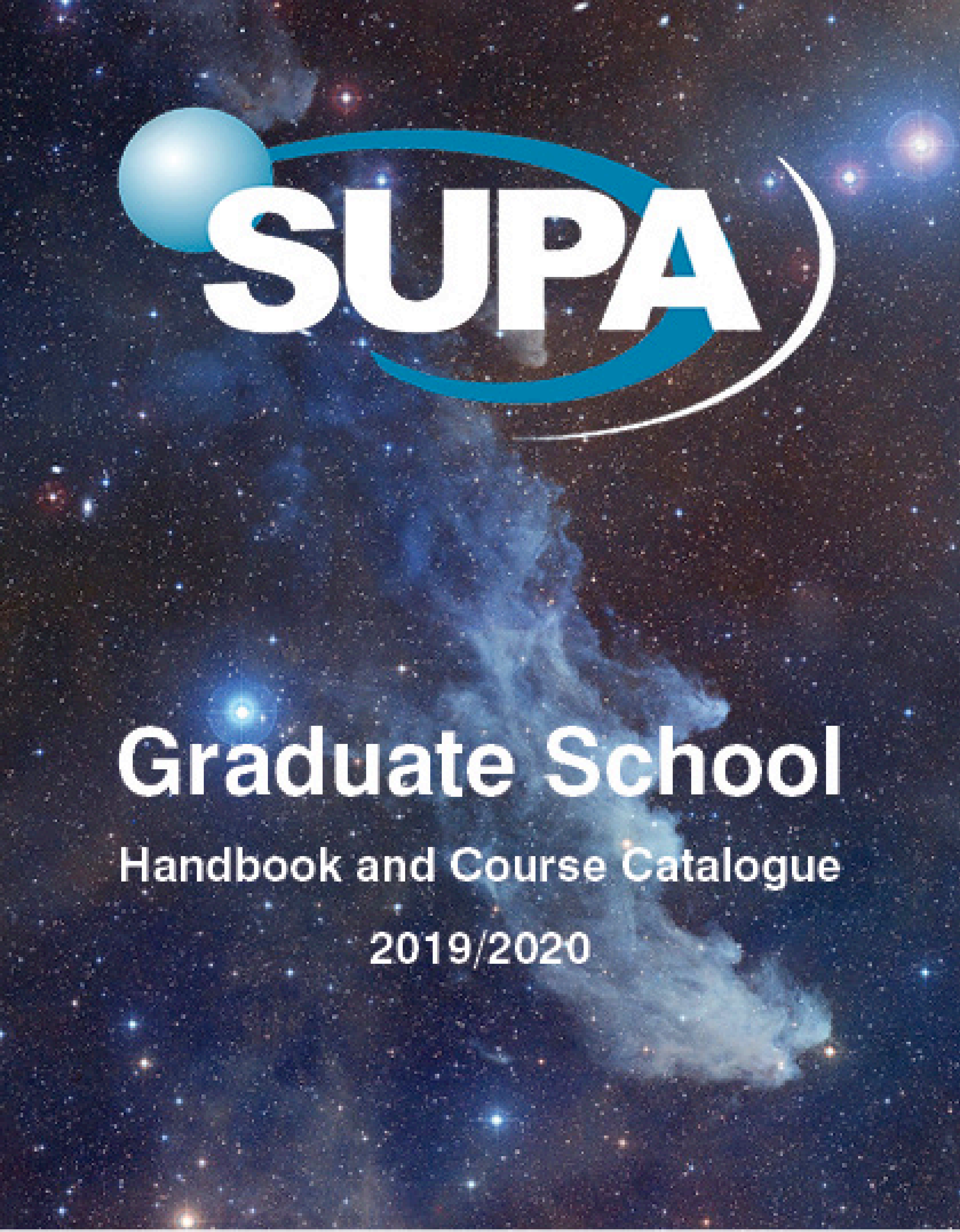
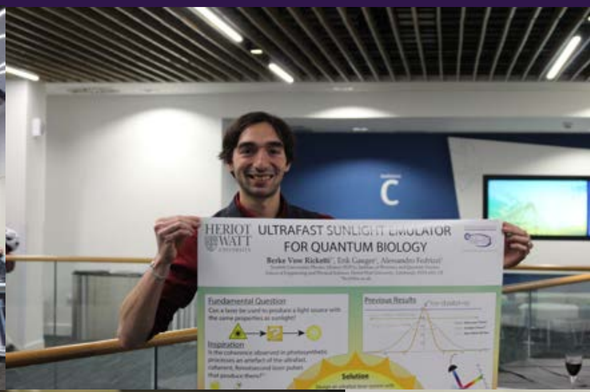


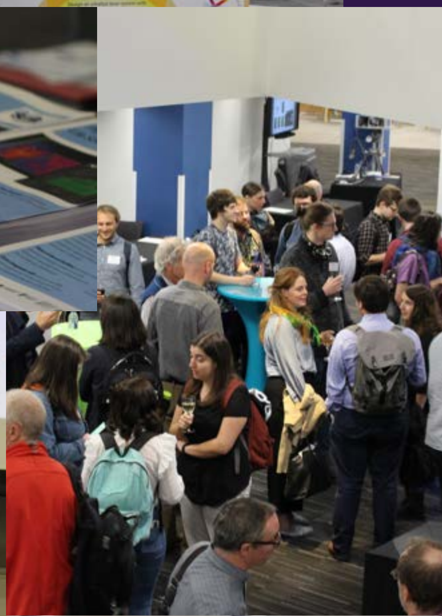
SUPA

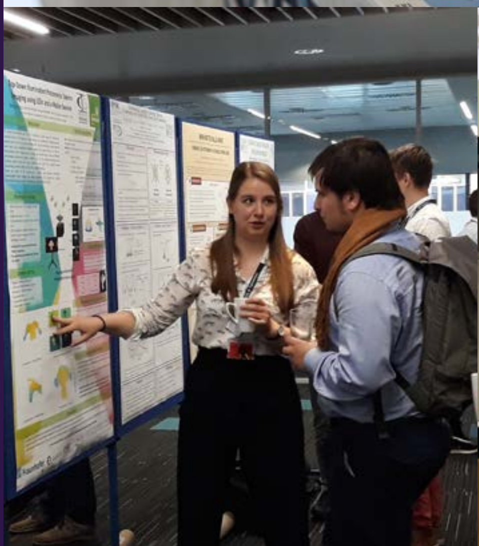
Graduate School

Handbook and Course Catalogue

2019/2020


HERIOT WATT
ULTRAFAST SUNLIGHT EMULATOR
FOR QUANTUM BIOLOGY






THE UNIVERSITY of EDINBURGH
University of Dundee
University of Glasgow
HERIOT WATT UNIVERSITY

Welcome to the SUPA Graduate School 2019/20

Dear Researchers

Welcome to the SUPA Graduate School 2019/20.

SUPA is a pan-Scotland strategic alliance for research and graduate training in Physics. Eight major universities work in partnership to create the SUPA Graduate School which offers postgraduate research students world class research opportunities, expert supervision, links to national and international facilities, advanced specialist courses, professional development training, networks, industry engagement, outreach, exchanges and placements, careers and other events, which all draw upon the knowledge and experience of the whole physics community across Scotland and beyond. This collaborative approach ensures that the SUPA Graduate School can offer the best possible opportunities for research students to acquire all of the skills needed to launch a successful career whether that be in academia, industry, enterprise or public and other sectors.

In the most recent UK wide research assessment exercise, REF2014, the 'research power' of SUPA combining quality and scale of activity was judged to have significantly exceeded that of Cambridge, Oxford, Imperial and UCL; U. Strathclyde was given the top 'grade point average' of any physics school and the joint PHYESTA submission from U. Edinburgh and U. St Andrews came 3rd equal in the UK. The 'impact' of Scottish physics research is extremely high.

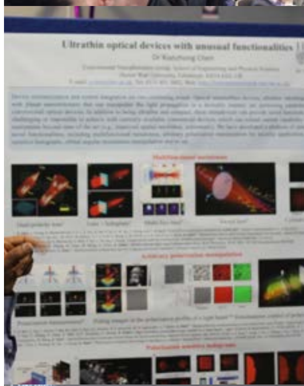
The SUPA Graduate School offers over 50 advanced courses, mostly delivered via the SUPA video network, as well as other events and training opportunities. Please take maximum advantage of the training offered. The SUPA Graduate School always strives to provide education and training at the highest international level in physics as well as the broader skills needed to establish you in a successful career.

I am delighted that you have chosen to pursue your post-graduate studies in Scotland, welcome to our community, I wish you every success.

Alan Miller

Alan Miller

SUPA CEO



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Graduate School Committee

The SUPA Graduate School Committee (GSC) oversees the operation of the SUPA Graduate School in relation to courses, induction, career events, summer schools and support for physics based doctoral training centres. The SUPA CEO assumes the role of Director of the Graduate School. The GSC assists the CEO in fulfilling the aims and objectives of the Graduate School.

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Course List

	Course Name	Code	Host	Delivery Mode	Hours	Semes-ter	Page
Astronomy and Space Sciencess	Advanced Data Analysis Astronomy	AAA	ST A	VC	27	1	8
	Gravitational Wave Detection	GWD	GLA	VC	16	1	8
	Astrophysical Plasmas	APL	GLA	VC	10	2	9
	Astrobiology and the Search for Life	ASL	EDI	VC	20	2	9
	SUPA Observing Course	OBS	ST A	VC&F2F	10	2	9
	The Sun's Atmosphere	TSA	GLA	VC	17	2	9
Condensed Matter and Material Sciences	Advanced Statistical Physics	ASP	EDI	VC	22	1	10
	Introduction to Computational Chemistry	CCH	ST A	VC	9	1	10
	Open Quantum Systems	OQS	HW	VC	14	1	10
	Quantum Field Theory	QFT	ST A	VC	30	1	11
	Modern Topics in Condensed Matter Physics	TOP	ST A	VC	35	1	11
	Maths Primer	PRI	HW	VC	6	1	11
	Geometry and Physics of Soft Condensed Matter	GPSM	EDI	VC	20	1	11
	Chaikin & Lubensky's Principles of Condensed Matter	CLP	EDI	VC	25	2	11
	Electronic Structure Theory	EST	EDI	VC&F2F	20	2	11
	Electron Microscopy	ELM	ST A	VC	10	2	12
	Matrix Product States and Tensor Networks	MPS	STRA	VC	24	2	12
	Quantum Materials and Devices Theory	QMDT	HW	VC	20	2	12
	Non-Equilibrium Statistical Mechanics	NSM	EDI	VC	14	2	12
	Quantum Magnetism and Phase Transitions	QMPT	ST A	VC	18	2	12
	Response Functions	RFN	ST A	VC	12	2	13
	Quantum Materials and Devices Experimental	QMDE	HW	VC	20	2	13
	Introduction to Soft Condensed Matter	SCM	HW	VC	20	2	13
Energy	Solar Power	SPR	ST A	F2F	14	1	14
	Laser Driven Plasma Acceleration	LDP	STRA	VC	16	2	14
Nuclear and Plasma Physics	Accelerators	ACC	STRA	VC	8	1	15
	Biomedical Applications of Lasers, Beams and Radiation	BAL	STRA	VC	12	1	15
	Plasma Physics	PPH	STRA	VC	12	1	15
	Quarks and Hardron Spectroscopy	QHS	GLA	VC	8	2	16
	Laser Driven Plasma Acceleration	LDP	STRA	VC	16	2	16
	Astrophysical Plasmas	APL	GLA	VC	10	2	16
	Nuclear Instrumentation	NIN	EDI	VC	4	2	16
	Nuclear Reaction Theory and Nuclear Forces	NRT	EDI	VC	6	2	16

Course List

	Course Name	Code	Host	Delivery Mode	Hours	Semes-ter	Page No
Particle Physics	Accelerators	ACC	STRA	VC	8	1	17
	Detectors	DET	GLA/EDI	VC&F2F	16	1	17
	Quantum Field Theory - Particle Physics	QPP	EDI	F2F	20	1	17
	Advanced Statistical Physics	ASP	EDI	VC	22	1	17
	Relativistic Quantum Field Theory	RQF	GLA	F2F	20	1	18
	Collider Physics	COP	GLA/EDI	VC&F2F	18	2	18
	Discussion Classes	DCL	GLA/EDI	VC	8	2	18
	Flavour Physics	FLA	EDI	VC	14	2	18
	Lattice QCD	LAT	GLA	VC	6	2	18
	Quarks and Hadron Spectroscopy	QHS	GLA	VC	8	2	18
	Gauge Theory in Particle Physics	GAT	EDI	F2F	40	2	19
Photonics	Polymers and Liquid Crystals	PLC	ST A	DIST	13	1	20
	Maths Primer	PRI	HW	VC	6	1	20
	Experimental Atomic and Quantum Optics	EAQ	STRA	F2F	20	1	20
	Nanophotonics	NAN	ST A	VC	27	1	20
	Quantum Technology – Experimental Techniques	QTE	STRA	VC	12	1	21
	Concepts in Signal and Image Processing	CSI	STRA	VC&F2F	22	1	21
	Semi-quantum Theory of Atom Light Interactions	STA	STRA	VC	24	2	21
	Ultrafast Photonics	UPH	HW	DIST	10	2	21
	Solid State Lasers	SSL	STRA	VC	14	2	21
	Quantum Technology – Theoretical Techniques	QTT	STRA	VC	18	2	22
Physics and Life Sciences	Biophotonics	BPH	ST A	VC	33	1	23
	Biomedical Applications of Lasers, Beams and Radiation	BAL	STRA	VC	12	1	23
	Introducing Biology to Physicists	IBP	DUN	VC	22	1	23
	Physics of Biological Evolution	PBE	EDI	VC	10	2	24
	Astrobiology and the Search for Life	ASL	Various	VC	20	2	24
	Biological Physics	BPS	EDI	VC	12	2	24
	Mathematical Modelling	MMD	ABD	VC	33	2	24
Professional Development	C+ +/- Object Orientated Programming	COO	GLA	VC&F2F	12	1	25
	Introductory Data Analysis	IDA	UWS	VC	6	1	25
	Maths Primer	PR	HW	VC	6	1	26
	FPGA Programming for Physicsists	FPP	STRA	VC	12	1	26
	Hands on Writing	HOW	EDI	F2F	15	2	26
	Software Carpentry	SWC	GLA	F2F	16	2	26
	Root	ROO	GLA	F2F	9	2	26
	Adavanced Data Analysis for the Physical Sciences	ADA	GLA	F2F	10	2	27
	Introduction to Python	PYT	GLA	VC&F2F	8	2	27
	Research Ventures	ENT	GLA	F2F	14	2	27
	Industry Skills	ISC	Various	VC	6	2	27
	From Zero to Draft in 8 Weeks	WRI	UWS	VC	12	2	27

Astronomy & Space Sciences

Theme Leader: Rita Tojeiro
University of St Andrews, rmftr@st-andrews.ac.uk

The Astronomy and Space Sciences courses cover a broad range of topics aimed at widening students' knowledge of the field. They range from advanced extensions of subjects covered at undergraduate level to the introduction of new interdisciplinary sciences. We recommend that students take a mixture of core material, advanced courses (usually 16-20 hours equivalent credit) and more general topics, including computing and data reduction modules, to gain a broad grounding in astronomical methods and modern research areas.

Each course is self-contained, although background reading or another SUPA course may be recommended to bring students from various backgrounds up to speed. Students from other theme areas are very welcome to take Astronomy and Space Sciences courses, with particular modules likely to be of interest for Life Sciences and Plasma Physics students, but they should remember that a basic understanding of astronomy and astronomical terms will be assumed by course lecturers.

A typical programme, building to the core requirement of 40 hours of Technical Courses might include:

- A SUPA technical Astronomy course (these generally constitute 16-20 hours)
- A technical SUPA course in another field or a second Astronomy course
- Non-SUPA courses as appropriate (e.g. for students changing specialities)
- Summer Schools in Astronomy and Space Physics

Students should note that certain Astronomy courses are only run biennially. Each student must consult their PhD supervisor to construct a suitable programme before registering, and students are encouraged not to over-register. The 40 hour course requirement is taken over the first and second years, although students from all years can take extra subjects for interest.

Semester 1

Advanced Data Analysis - Astronomy (SUPAAAA)

Lecturer: Keith Horne

Institution: St Andrews

Delivery: Video Conference

Hours Equivalent Credit: 27

Assessment: Any 3 of 2 Homework sets and 2 Data Analysis Projects.

This is a final year undergraduate course organised by the University of St Andrews

Course Summary

This module develops an understanding of basic concepts and offers practical experience with the techniques of quantitative data analysis. Beginning with fundamental concepts of probability theory and random variables, practical techniques are developed for using quantitative observational data to answer questions and test hypotheses about models of the physical world. The methods are illustrated by applications to the analysis of time series, imaging, spectroscopy, and tomography data sets. Students develop their computer programming skills, acquire a data analysis toolkit, and gain practical experience by analysing real data sets.

Gravitational Wave Detection (SUPAGWD)

Lecturer: Martin Hendry

Institution: Glasgow

Delivery: Video Conference

Hours Equivalent Credit: 16

Assessment: Essay and Oral Examination

Course Summary

This course is for students interested in the physics of gravitational wave detection. Starting from the fundamentals of Einstein's General Theory of Relativity, the wave nature of weak field spacetime curvature perturbations will be derived in the transverse traceless gauge. Interactions of gravitational radiation with matter will be explored, leading to the basic principles of gravitational wave detectors. A full description of currently operating detectors will include instrumental noise sources, such as thermal, seismic, optical, and the standard quantum limit. Current topics discussed will include squeezing, and other non-classical light techniques for reducing optical noise in interferometric systems.

Astrophysical sources of gravitational waves will be discussed, including expectations for source strengths from coalescing compact binary systems, pulsars, etc. together with a discussion of the data analysis techniques that are required for signal extraction and parameter estimation. An update will be given on the new astrophysics that has been deduced from the gravitational wave signals so far observed, and the promise of future "multi-messenger astronomy" will be explored. Plans for future detectors on the ground and in space will also be presented.

Semester 2

Astrophysical Plasmas (SUPAAPL)

Lecturer: Lyndsay Fletcher, Eduard Kontar, Moira Jardine

Institution: Glasgow

Delivery: Video Conference

Hours Equivalent Credit: 10

Assessment: Online Quiz, worked examples, short essay

This is a biennial course which will run in 2019/20 but not run in 2020/21.

Course Summary

The course will give an overview of the physics of plasmas, and introduce applications in astrophysics. Beginning with basic definitions and ideas such as plasma waves and kinetic theory, the course will develop fundamental concepts in astrophysical plasma diagnostics, including cyclotron and synchrotron radiation, bremsstrahlung and recombination emission, wave-particle interactions and plasma emission (coherent and maser).

Magnetohydrodynamics will be studied as a tool for understanding dynamos, solar and solar-terrestrial environments, and magnetospheres. The course will conclude with topical lectures on plasmas in different astrophysical environments. Students are strongly advised to take the Semester 1 course on Plasma Physics in the Nuclear and Plasma Theme first.

Astrobiology and the Search for Life (SUPAASL)

Lecturer: Charles Cockell, et al

Institution: Various

Delivery: Video Conference

Hours Equivalent Credit: 20

Assessment: Exam

This course is cross-listed with the Physics and Life Sciences Theme.

Course Summary

This course looks into the origin, evolution and distribution of life in the Universe, broadly considered as 'astrobiology'. The objective of the course is to provide a perspective in geology, biology and chemistry at an introductory level.

SUPA Observing Course (SUPAOBS)

Lecturer: Aleks Scholz

Institution: St Andrews

Delivery : Video Conference and Face to Face

Hours Equivalent Credit: 10

Assessment: Mock observing proposal as homework

Course Summary

This course will enable PhD students to carry out astronomical observations with large telescopes. The course includes 5 lectures on the basics of professional observations, given by observatory director Dr. Aleks Scholz. This core will be complemented by 5 lectures on specialised observing techniques, given by staff members in St Andrews. The course will include observing training with the James Gregory Telescope in St Andrews. Each group will be assigned a week of the semester for nighttime observations under the supervision of Dr. Aleks Scholz. For students outside St Andrews the practical training is organised as residential course in 1-2 weeks of the semester.

The Sun's Atmosphere (SUPATSA)

Lecturer: Nicolas Labrosse

Institution: Glasgow

Delivery: Video Conference

Hours Equivalent Credit: 17

Assessment: 50% oral exam, 50% report on computer-based project

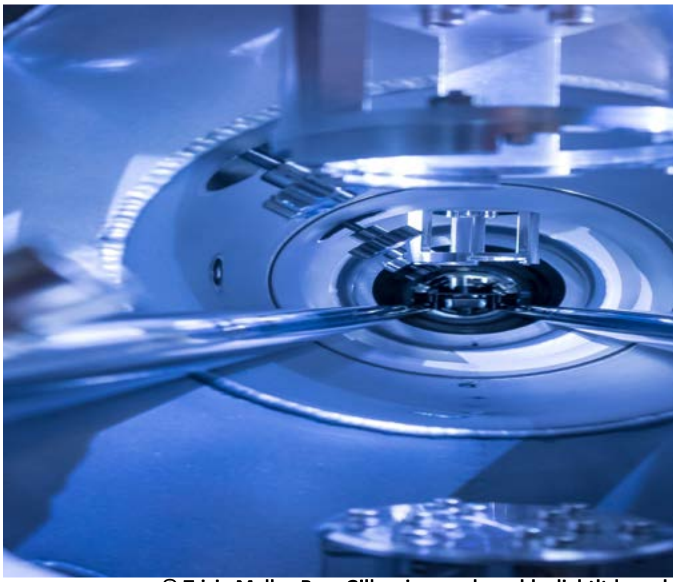
Course Summary

This course provides a comprehensive introduction to the physical processes at work in the solar atmosphere, and to the principles and practice of research in the physics of the solar atmosphere. It is compulsory for all students enrolled on the MSc in Astrophysics, and optional for all students on the MSc in Theoretical Physics. Its aims are:

- To develop the students' knowledge of emission processes of electromagnetic radiation; plasma physics; instrumentation; data analysis; theory and modelling – all in the context of the study of the solar atmosphere.
- To offer initial training in solar physics research which will be useful for students interested in pursuing a career in astrophysics or theoretical astrophysics

Condensed Matter & Material Sciences

Theme Leader: Stephen McVitie
University of Glasgow, Stephen.McVitie@glasgow.ac.uk



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Condensed Matter and Materials Sciences (CMMS) is a diverse subject covering many different specialities and attracts PhD students arriving from a wide range of backgrounds with different balances of theoretical and practical training. The program of study is therefore tailored individually for each student, in consultation with his or her PhD supervisor. The overall range and level of courses offered aim to introduce students to subject areas outside the immediate confine of their thesis research, as well as providing more specialist knowledge directly relevant to each dissertation. It is envisaged that during the first two years of study every student will complete a minimum of two physics-content courses, at least one summer school, plus at least one module covering transferable skills. A typical program will comprise the following elements:

CMMS courses organised by SUPA: These are either graduate specific or advanced masters courses made available to all centres over the SUPA videoconferencing network. Courses offered are listed below and form the backbone of the CMMS graduate school programme.

Core courses organised by SUPA: Those of particular interest to CMMS students include Advanced Data Analysis and courses in different programming languages such as C++ and Python.

Non-SUPA courses as appropriate (e.g. for students changing specialities)

Summer Schools: Examples of appropriate summer schools include ‘Physics by the Lake’ for those with an interest in theory and HERCULES (Grenoble, France) for those doing research involving neutron and X-ray scattering at central facilities.

Professional Development modules

Courses offered by other themes

Semester 1

Advanced Statistical Physics (SUPAASP)

Lecturer: Luigi Del Debbio

Institution: Edinburgh

Delivery: Video Conference

Hours Equivalent Credit: 22

Assessment: Hand-in exercises

This is a final year undergraduate course organised by the University of Edinburgh

Course Summary

In this course we will discuss equilibrium phase transition, of the first and second order, by using the Ising and the Gaussian models as examples. We will first review some basic concepts in statistical physics, then study critical phenomena. Phase transitions will be analysed first via mean field theory, then via the renormalisation group (RG), in real space. We will conclude with some discussion of the dynamics of the approach to equilibrium

Introduction to Computational Chemistry (SUPACCH)

Lecturer: Herbert Fruchtl

Institution: St Andrews

Delivery: Video Conference

Hours Equivalent Credit: 9

Assessment: Continuous assessment through assignments

Course Summary

The course will provide an introduction to practical computational chemistry techniques. The focus is on an introduction to the current state-of-the-art computational chemistry codes together with the theory behind the methods. Ab initio, DFT and classical methods, as well as cheminformatics, will be introduced along with how they are used in practice by researchers in Scotland.

Open Quantum Systems (SUPAOQS)

Lecturer: To be Confirmed

Institution: Heriot-Watt

Delivery: Video Conference

Hours Equivalent Credit: 14

Assessment: Continuous Assessment based on tutorials

This is a biennial course which not run in 2019/20

Course Summary

The course focuses on the dynamics of quantum systems interacting with their surroundings. Due to the inevitable interaction between a quantum system and its environment peculiar quantum features such as the existence of quantum superpositions and entangled states are quickly destroyed. Starting from a microscopic model, we will derive an equation of motion, the so called master equation, describing the dynamics of a quantum system in the presence of an environment. We will then examine the properties of the dynamics of an open quantum system as described by the master equation and explore two aspects of both fundamental and applicative importance in physics: First we will consider the fragility of quantum superpositions (e.g. Schrödinger cats) and entanglement under the influence of a quantum environment since controlling or suppressing environmental perturbations is essential for future quantum technologies. Then we will discuss how the fact that every quantum system is inevitably connected to an environment can be invoked to (at least partly) explain the quantum-classical border.

Quantum Field Theory (SUPAQFT)

Lecturer: Jonathan Keeling

Institution: St Andrews

Delivery: Video Conference

Hours Equivalent Credit: 30

Assessment: Continuous Assessment

This is a final year undergraduate course organised by the University of St Andrews.

Course Summary

Quantum field theory combines classical field theory with quantum mechanics and provides analytical tools to understand many-particle and relativistic quantum systems. This course aims to introduce the ideas and techniques of quantum field theory. I will use examples drawn mainly from condensed matter physics to illustrate the ideas and application of quantum field theory.

Modern Topics in Condensed Matter Physics (SUPATOP)

Lecturer: Phil King, Peter Wahl

Institution: St Andrews

Delivery: Video Conference

Hours Equivalent Credit: 35

Assessment: Problem Sheets, Presentations, Essay

This is a final year undergraduate course organised by the University of St Andrews.

Course Summary

The aim of this module is to give an introduction to a variety of modern topics of condensed matter physics that can be realised at the surfaces of materials and in low-dimensional solids. As well as surface properties and probes, we will cover the introductory concepts of topologically non-trivial materials – states of matter that are not characterised by spontaneous symmetry breaking but rather by a distinct topological order of the underlying electronic system. This has recently come to prominence in condensed matter physics with the realisation that seemingly conventional band insulators come in topologically trivial and non-trivial classes, the latter being known as topological insulators. This course will cover the underlying principles and introductory theory of these exotic states of matter, will introduce the probes necessary to investigate them and their application in the study of other quantum materials, and will provide a survey of the current state of experimental results in this new and rapidly evolving field.

Maths Primer (SUPAPRI)

Lecturer: Patrik Öhberg

Institution: Heriot-Watt

Delivery: Video Conference

Hours Equivalent Credit: 6 (Professional Development Credits)

Assessment: Continuous Assessment

Course Summary

The course will be in the form of a maths primer intended for beginning PhD students in condensed matter, solid state and photonics. The topics which will be covered include: Matrix diagonalisation, functional derivatives, complex integration and residues, Fourier transforms, and a discussion on different notations which the students will encounter during their studies.

Geometry and Physics of Soft Condensed Matter (SUPAGPSM)

Lecturer: Davide Marenduzzo

Institution: Edinburgh

Delivery: Video Conference

Hours Equivalent Credit: 20

Assessment: Problem Sheets

This is an advanced undergraduate course at the University of Edinburgh. This is a biennial course which will not run in 2019/20 but will run in 2020/2021.

Course Summary

In this course, we explore how to build theories for complex fluids; we will often be taking examples from the world of biology. The focus of the course will be to emphasise generic features in order to build up a repertoire of theoretical tools that are widely applicable to analyse a diversity of soft materials. Topics covered may vary from year to year depending on the specialisms of the staff involved but will include:

- Physics and nonequilibrium thermodynamics of binary mixtures
- Symmetries and phases of liquid crystals
- Topological defects in liquid crystals
- Hydrodynamic theories of complex fluids
- Topological properties of DNA: knots and supercoiling

Semester 2

Chaikin and Lubensky's Principles of Condensed Matter (SUPACLP)

Lecturer: Alexander Morozov

Institution: Edinburgh

Delivery: Video Conference

Hours Equivalent Credit: 25

Assessment: Continuous Assessment

This is a biennial course which will not run in 2019/20 but will run in 2020/21.

Course Summary

This course will primarily involve a combination of directed reading and face-to-face discussion meetings by the participants on topics chosen from Chapters 1-6 of the graduate text 'Principles of Condensed Matter Physics' by P. Chaikin and T. Lubensky (Cambridge University Press). Assessment will be based on performance in both the student discussions and selected problems.

Electronic Structure Theory (SUPAEST)

Lecturer: Andreas Hermann

Institution: Edinburgh

Delivery: Video Conference and Face to Face

Hours Equivalent Credit: 20

Assessment: Problem Sheets, Project

This is a biennial course which will run in 2019/20 but will not run in 2020/21

Course Summary

This course will introduce the methods and approaches used in parameter-free descriptions of the electronic structure of materials, which aim to solve the quantum mechanical many-electron problem. We will discuss underlying ground state theories, such as wave-function based correlation methods and density functional theory, and their implementations in high-performance computing environments. We will study how to use the linear response ansatz and many-body perturbation theory to extract excited state information from those calculations, and thus accurately simulate spectroscopic and inelastic scattering experiments. Assignments will involve calculations on realistic materials on the UK's national supercomputer

Electron Microscopy (SUPAELM)

Lecturer: Wuzong Zhou

Institution: St Andrews

Delivery: Video Conference

Hours Equivalent Credit: 10

Assessment: Exercises.

Course Summary

This is a ScotCHEM course available to all SUPA and ScotCHEM students. It is a biennial course and will run in 2019/20, but will not run in 2020/21.

The course will introduce the basic principles of electron microscopy and discuss several commonly used techniques for microstructural analysis of solid state materials. Lectures are given on:

- Introduction, interaction of electrons with the solid
- Scanning electron microscopy
- Energy dispersive X-ray spectroscopy
- Electron diffraction
- High resolution transmission electron microscopic imaging

Matrix Product States and Tensor Networks (SUPAMPS)

Lecturer: Luca Tagliacozzo

Institution: Strathclyde

Delivery: Video Conference

Hours Equivalent Credit: 24

Assessment: Continuous assessment: marked exercises and a final presentation

This is a biennial course that will not run in 2019/20 but will run in 2020/21.

Course Summary

The course will provide an overview of the field of matrix product and tensor network approaches to many systems.

Everything around us is a many-body system, from the quantum vacuum proved by high-energy accelerators, to a material studied in a laboratory, to complex systems like us, living organisms. The richness and beauty of our world is indeed a result of a variety of collective emerging phenomena obtained by combining together a large number of few basic constituents. The difficulty in understanding the emergence arises as a consequence of the exponential complexity of many body systems in the number of their constituents. Tensor networks provide a novel theoretical and computational framework to analyse collective emergence in many body systems.

Quantum Materials and Devices Theory (SUPAQMDT)

Lecturer: Ian Galbraith

Institution: Heriot-Watt

Delivery: Video Conference

Hours Equivalent Credit: 20

Assessment: Problem Sheets and Literature Review

Course Summary

This course will focus on the theoretical description of quantum materials and related devices where the small size plays a crucial role in determining their properties and behaviours. The fundamental aim is to provide the students with a working knowledge of contemporary theoretical nanophysics. The course explains how nanophysical phenomena can be understood and how predictions for behaviour can be made.

Non-Equilibrium Statistical Mechanics (SUPANSM)

Lecturer: Martin Evans

Institution: Edinburgh

Delivery: Video Conference

Hours Equivalent Credit: 14

Assessment: Project

This is a biennial course and will not run in 2019/20, but will run in 2020/21.

Course Summary

The course explores the theory of systems out of equilibrium, be they relaxing to equilibrium or held out of equilibrium by external agencies. The lectures fall into two parts. The first 8 lectures or so cover core techniques and ideas in non-equilibrium statistical mechanics, and are given by Martin Evans. The remaining lectures cover specialist topics and will be given by guest lecturers to be announced.

Quantum Magnetism and Phase Transitions (SUPAQMPT)

Lecturer: Bernd Braunecker, Jonathan Keeling

Institution: St Andrews

Delivery: Video Conference

Hours Equivalent Credit: 18

Assessment: Continuous Assessment

This is a bienniel course which will run in 2019/20, but will not run in 2020/21.

Course Summary

These lecturers cover two closely related themes: models of magnetism, and quantum phase transitions. The two parts are strongly linked in that many of the models we will introduce to describe magnetism turn out to be paradigmatic models of quantum phase transitions. The course is intended to be relevant not just for those working on traditional solid state systems, but also those working on cold atom physics, where many of the same models and questions are also relevant.

Response Functions (MBQT 2) (SUPARFN)

Lecturer: Brendon Lovett

Institution: St Andrews

Delivery: Video Conference

Hours Equivalent Credit: 12

Assessment: Two assessed problem sheets

This is a biennial course. It will not run in 2019/20 but will run in 2020/21.

CM-CDT students should note that Quantum Field Theory is a pre-requisite for this course

Course Summary

Response functions and Green's functions provide a powerful mathematical language in which to describe the physics of many-body quantum systems. This course is a short introduction to them.

Quantum Materials and Devices Experimental (SUPAQMDE)

Lecturer: Christian Bonato

Institution: Heriot-Watt

Delivery: Video Conference

Hours Equivalent Credit: 20

Assessment: Problem sheets and literature review

Course Summary

This course will focus on how to experimentally realize and probe quantum materials and related devices where the small size plays a crucial role in determining their properties and behaviours. The fundamental aim is to provide the students with a working knowledge of contemporary experimental nanophysics. The course explains how nanostructures can be fabricated for desired outcomes and how the physical phenomena such as quantization and quantum coherence can be probed.

Introduction to Soft Condensed Matter (SUPASCM)

Lecturer: Ian Galbraith

Institution: Heriot-Watt

Delivery: Video Conference

Hours Equivalent Credit: 20

Assessment: Problem Sheets

Course Summary

Our technological age is enabled by stuff - carbon fibre, steel, concrete, high efficiency glass, sapphire coatings, toothpaste, silicon wafers, plastics, dental implants, bullet proof vests, non-stick pans, Gore-Tex, liquid crystals, car tyres, detergents ... Big bucks and world domination from mastery of stuff!

Soft condensed matter (SCM) relates to states of matter which are neither crystalline nor simple liquids, including, most of our bodies (we are soft machines!), and plastic materials such as polymers.

This course provides an introduction to the behaviour and underlying physics of such materials emphasising where universal behaviour, driven at length scales between the quantum and macroscopic occur.

Energy

Theme Leader: Paul Clegg
University of Edinburgh, Paul.Clegg@ed.ac.uk

Our courses relate to two major aspects of the theme's activities: solar and nuclear power. They are designed to be accessible to all Energy Theme students – so that nuclear students could take the solar power course and vice versa. In addition to these courses, students are encouraged to select courses relevant to their interests and projects from other themes (particularly Condensed Matter and Materials Sciences, Photonics and Nuclear and Plasma Physics).

Semester 1

Solar Power (SUPASPR)

Lecturer: Ifor Samuel et al

Institution: St Andrews

Delivery: Face to Face

Hours Equivalent Credit: 14

Assessment: Problem Sheets and reports on laboratory experiments.

This course is biennial. It will run in 2019/20 but not in 2020/21.

This is a final year undergraduate course organised by the University of St Andrews.

Course Summary

This course will provide an introduction to solar photovoltaics (PV). Lectures will introduce the problem of energy supply, and the amount of solar power potentially available. The general principles of PV will be covered, followed by lectures on a range of current and future PV technologies: crystalline, polycrystalline and amorphous silicon, thin film inorganic semiconductors, and organic semiconductor PV. Three lab sessions will enable students to explore key ideas in the lectures.

This is an intensive two-day course, using a range of invited lecturers from SUPA institutions.

Semester 2

Laser Driven Plasma Acceleration (SUPALDP)

Lecturer: Dino Jaroszynski, Paul McKenna

Institution: Strathclyde

Delivery: Video Conference

Hours Equivalent Credit: 16

Assessment: Continuous Assessment

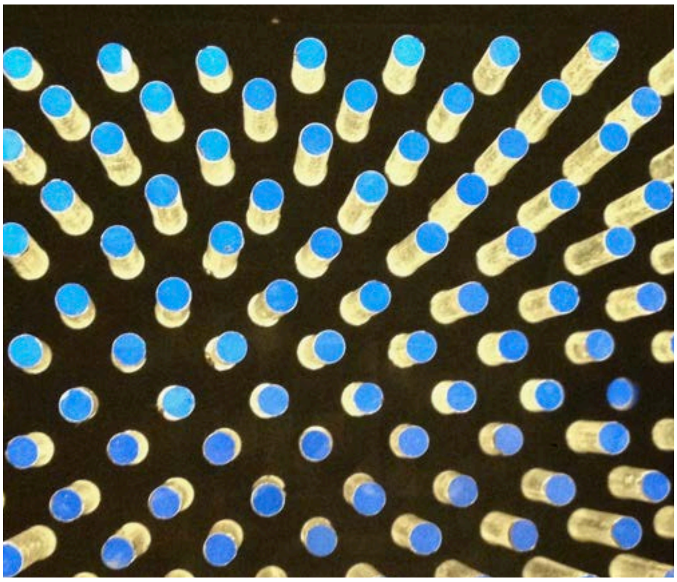
This is a final year undergraduate course organised by the University of Strathclyde. This course is cross listed with the Nuclear and Plasma Physics Theme.

Course Summary

This course will address the topical research in laser plasma interactions, laser-plasma acceleration and plasma-based radiation sources. It will be divided into four connected parts starting with a thorough but brief introduction to the main theoretical concepts of laser-plasma interactions. The second and third parts will address the interaction of intense laser pulses with under-dense and over-dense plasma respectively, with particular emphasis on laser-plasma acceleration, absorption, propagation, electron transport, plasma waves, shock waves, radiation mechanisms, non-linear optics of plasma etc. The fourth part will introduce students to the main concepts of free-electron lasers, which are important tools for scientists investigating the structure of matter. Students will proceed quickly from basic concepts to advanced and current applications such as compact radiation and particle sources,inertial fusion energy, fast ignition etc. They will gain a good introduction to laser-plasma interactions, which will provide a good basis for postgraduate research in this area.

Nuclear & Plasma Physics

Theme Leader: David Ireland
University of Glasgow, David.Ireland@glasgow.ac.uk



University of Glasgow/Lynkeos

The Nuclear and Plasma Physics (NPP) theme covers a wide range of subject areas, including a number of different specialities. Depending on their individual backgrounds and areas of research, PhD students will be required to attend a different set of SUPA courses. The decision on which courses to include should be made in consultation with the student's PhD supervisor. Typically, a two year course program will include:

- Specific NPP lectures taken from the course list
- Core skills classes, such as C++ Programming and Data Analysis, where appropriate
- Transferable skills courses such as an Entrepreneurship course

Where the number of courses taken exceeds the minimum requirement, students and their supervisors should agree on which courses should contribute towards the overall assessment. There are several Doctoral Training Centres that are part of NPP. PhDs in these Centres are usually four years in duration, where the whole of the first year is dedicated to formal courses and mini-projects. Students will normally decide on their PhD topic at the end of the first year.

Semester 1

Accelerators (SUPAACC)

Lecturer: Dino Jaroszynski, M Wiggins, B Ersfeld, G Vieux

Institution: Strathclyde

Delivery: Video Conference

Hours Equivalent Credit: 8

Assessment: Continuous Assessment

This course is cross listed with the Particle Physics Theme

Course Summary

Particle accelerators are a valuable tool in probing high-energy physics (up to the Large Hadron Collider at CERN) that is vital in helping us to understand the universe. They also have a wealth of more down-to-earth societal applications such as radiotherapy machines for treating cancer. This course gives a concise introduction to the field of conventional accelerators that use radio-frequency or microwave radiation in order to accelerate charged particles (electrons, protons, ions) to high energy.

Biomedical Applications of Lasers, Beams and Radiation (SUPABAL)

Lecturer: Bernhard Hidding, Grace Gloria Manahan

Institution: Strathclyde

Delivery: Video Conference

Hours Equivalent Credit: 12

Assessment: Continuous Assessment

This course is cross listed with the Physics and Life Sciences theme.

Course Summary

Lasers, particle beams and radiation such as x-rays are essential instruments for imaging, drug research and treatment in life sciences. The course would address both established and cutting edge radiation generation methods for a variety of biomedical applications, as well as occurrence of radiation in nature and their effects. Then, the mechanisms of interaction of the different types of radiation on the nuclear, atomic, molecular, cell and system level (e.g. the patient) are discussed. Finally, fundamentals and progress in biomedical applications such as x-ray radiography, magnetic resonance tomography (MRT), positron emission tomography (PET), electron microscopy and other radiology imaging techniques, radiation-assisted drug R&D as well as laser surgery, cancer radiotherapy with photons, electrons, protons, neutrons and ions, and other treatment techniques will be covered. Next to providing an overview on the physics behind these techniques, the course will also include practical considerations and is intended to facilitate and support interdisciplinary research projects and collaborative applications.

Plasma Physics (SUPAPPH)

Lecturer: Adrian Cross, Kevin Ronald, Bengt Eliasson, Declan Diver

Institution: Strathclyde

Delivery: Video Conference

Hours Equivalent Credit: 12

Assessment: Multiple Choice Exam and Continuous Assessment

Course Summary

This course will address fundamental concepts in plasmas, from plasma creation from a neutral gas through to full ionization. Basic plasma timescales and length scales will be derived, such as the plasma, cyclotron and collision frequencies, skin depth, sheath extent and Larmor radius. Waves and instabilities in fully ionized (and magnetized) fluid and kinetic plasmas will also be addressed. The many natural and man-made types of plasma and their applications will be outlined and in particular magnetically confined plasmas will be discussed with examples, including tokamaks.

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Nuclear & Plasma Physics

Semester 2

Quarks and Hadron Spectroscopy (SUPAQHS)

Lecturer: Bryan McKinnon, Derek Glazier

Institution: Glasgow

Delivery: Video Conference

Hours Equivalent Credit: 8

Assessment: Continuous Assessment

This course is cross listed with the Particle Physics Theme

Course Summary

The course will cover the following topics: Introduction to fundamentals of QCD, why are models necessary when you've got QCD, quark model predictions of hadronic states, properties of the nucleon and its resonances, "missing" baryonic resonances, pentaquarks - salutory lesson or crucial discovery, experimental techniques, partial wave analysis, the search for exotic states: hybrid mesons, glueballs.

Laser Driven Plasma Acceleration (SUPALDP)

Lecturer: Dino Jaroszynski, Paul McKenna

Institution: Strathclyde

Delivery: Video Conference

Hours Equivalent Credit: 16

Assessment: Continuous Assessment

This is a final year undergraduate course organised by the University of Strathclyde. This course is cross listed with the Energy Theme.

Course Summary

This course will address the topical research in laser plasma interactions, laser-plasma acceleration and plasma based radiation sources. It will be divided into four connected parts starting with a thorough but brief introduction to the main theoretical concepts of laser-plasma interactions. The second and third parts will address the interaction of intense laser pulses with under-dense and over-dense plasma respectively, with particular emphasis on laser-plasma acceleration, absorption, propagation, electron transport, plasma waves, shock waves, radiation mechanisms, non-linear optics of plasma etc. The fourth part will introduce students to the main concepts of free-electron lasers, which are important tools for scientists investigating the structure of matter. Students will proceed quickly from basic concepts to advanced and current applications such as compact radiation and particle sources, inertial fusion energy, fast ignition etc. They will gain a good introduction to laser-plasma interactions, which will provide a good basis for postgraduate research in this area.

Astrophysical Plasmas (SUPAAPL)

Lecturer: Lyndsay Fletcher, Eduard Kontar, Moira Jardine

Institution: Glasgow

Delivery: Video Conference

Hours Equivalent Credit: 10

Assessment: Online Quiz, worked examples, short essay

This is a biennial course. It will run in 2019/20 but will not run in 2020/21.

Course Summary

The course will give an overview of the physics of plasmas, and introduce applications in astrophysics. Beginning with basic definitions and ideas such as plasma waves and kinetic theory, the course will develop fundamental concepts in astrophysical plasma diagnostics, including cyclotron and synchrotron radiation, bremsstrahlung and recombination emission, wave-particle interactions and plasma emission (coherent and maser). Magnetohydrodynamics will be studied as a tool for understanding dynamos, solar and solar-terrestrial environments, and magnetospheres. The course will conclude with topical lectures on plasmas in different astrophysical environments. Students are strongly advised to take the Semester 1 course on Plasma Physics in the Nuclear and Plasma Theme first.

Nuclear Instrumentation (SUPANIN)

Lecturer: Tom Davinson

Institution: Edinburgh

Delivery: Video Conference

Hours Equivalent Credit: 4

Assessment: Continuous Assessment

Course Summary

The objective of this short course of lectures is to provide students with an insight into state-of-the-art of nuclear instrumentation technology and techniques - particular emphasis will be given to topics either not found, or not well-covered, in the standard textbooks. Topics will include: noise, interference, grounding and other black arts, the origins of detector energy and time resolution, ASICS, data acquisition and analysis, and digital signal processing.

Nuclear Reaction Theory and Nuclear Forces (SUPANRT)

Lecturer: To be Confirmed

Institution: Edinburgh

Delivery: Video Conference

Hours Equivalent Credit: 6

Assessment: Questionnaire/Quiz

This is a biennial course which will not run in 2019/20.

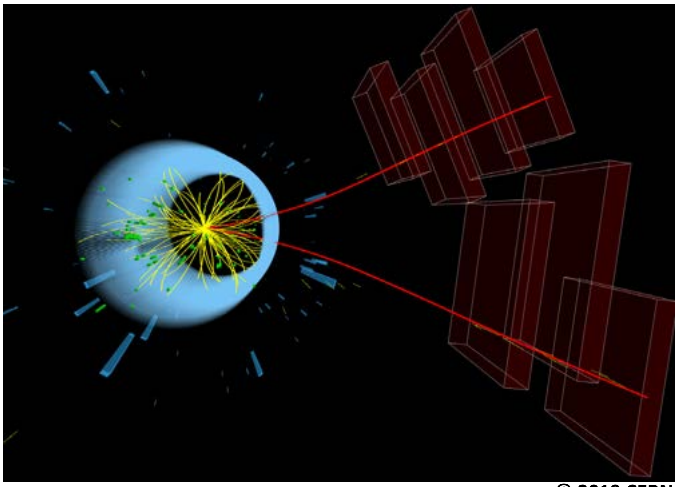
Course Summary

This course will assume an undergraduate level knowledge of nuclear physics and quantum mechanics and will describe various theoretical descriptions of nuclei and nuclear reactions at a level relevant to a postgraduate experimental physicist. The course will introduce students to the theoretical formalisms commonly encountered in the field of nuclear and hadron physics.

The students will understand basic models of nuclear structure (liquid drop model and Fermi gas model), be able to explain the origin of nuclear shapes and excitation modes, be able to outline the theoretical description of the Nucleon-Nucleon potential from boson field theory, be able to understand the terms used to parameterise phenomenological NN potentials, show understanding of the role of three-nucleon forces in the nucleus, outline the theoretical formalism for describing elastic and inelastic scattering reactions, understand the classification of reactions as compound, direct or pre-equilibrium, show understanding of the process of partial wave analysis and phase shifts in reaction theory, understand the reaction theories describing fission and fusion and their application in nuclear energy generation.

Particle Physics

Theme Leader: Victoria Martin
University of Edinburgh, Victoria.Martin@ed.ac.uk



The SUPA Graduate School runs an extensive programme of Particle Physics courses to provide new graduate students with the necessary skills required to carry out research. The Particle Physics courses are divided into categories corresponding to whether the student is undertaking theoretical or experimental research areas. Students should discuss with their supervisor which optional courses they should attend.

Semester 1

Accelerators (SUPAACC)

Lecturer: Dino Jaroszynski, Mark Wiggins, Bernhard Ersfeld, Gregory Vieux

Institution: Strathclyde

Delivery: Video Conference

Hours Equivalent Credit: 8

Assessment: Continuous Assessment

This course is cross-listed with the Nuclear & Plasma Theme.

Course Summary

Particle accelerators are a valuable tool in probing high-energy physics (up to the Large Hadron Collider at CERN) that is vital to help us understand the universe. They also have a wealth of more down-to-earth societal applications such as radiotherapy machines for treating cancer. This course gives a concise introduction to the field of conventional accelerators that use radio-frequency or microwave radiation in order to accelerate charged particles (electrons, protons, ions) to high energy.

Detectors (SUPADET)

Lecturer: Stephan Eisenhardt, Richard Bates, Andrew Blue

Institution: Glasgow & Edinburgh

Delivery: Video Conference and Face to Face

Hours Equivalent Credit: 16 (11 lectures, 1x2hr lab & 1x3hr Lab)

Assessment: Assignment sheets

Course Summary

The course will give a comprehensive overview on the many techniques and technologies utilised in the building of particle physics detectors. The series of 11 hours of video lectures is complemented by 5 hours of residential laboratory sessions. The course is self-contained and requires no prior knowledge of the field. Students will be assessed using problem sheets.

Quantum Field Theory Particle Physics (SUPAQPP)

Lecturer: Richard Ball and Luigi Del Debbio

Institution: Edinburgh

Delivery: Face to Face

Hours Equivalent Credit: 20

Assessment: Written Exam 80 %, Coursework 20 %

Joint Master’s and PhD course delivered by face to face lectures at the University of Edinburgh. (Non-Edinburgh students are welcome to attend the lectures in Edinburgh in person.)

Course Summary

This course is an introduction to perturbative relativistic quantum field theory, for scalars, fermions, and gauge fields, in both the canonical and path integral formulations

The course begins with a review of relativistic wave equations. It introduces the Lagrangian formulation for classical fields and then discusses the canonical quantisation of free fields with spins 0, 1/2 and 1. An outline is given of perturbation theory for interacting fields and Feynman diagram methods for Quantum Electrodynamics are introduced. The course also introduces path integral methods in quantum field theory. This gives a better understanding of the quantisation of gauge theories and forms an essential tool for the understanding and development of the ‘standard model’ of particle physics. Topics include: Path integral formalism, Feynman rules, LSZ formalism, loop diagrams and regularisation and renormalization of divergencies.

Advanced Statistical Physics (SUPAASP)

Lecturer: Luigi Del Debbio

Institution: Edinburgh

Delivery: Video Conference

Hours Equivalent Credit: 22

Assessment: Hand-in exercises

This is a final year undergraduate course organised by the University of Edinburgh.

Course Summary

In this course we will discuss equilibrium phase transition, of the first and second order, by using the Ising and the Gaussian models as examples. We will first review some basic concepts in statistical physics, then study critical phenomena. Phase transitions will be analysed first via mean field theory, then via the renormalisation group (RG), in real space. We will conclude with some discussion of the dynamics of the approach to equilibrium.

Particle Physics

Relativistic Quantum Field Theory (SUPARQF)

Lecturer: Christoph Englert

Institution: Glasgow

Delivery: Face to Face

Hours Equivalent Credit: 20

Assessment: Open book exam

Joint Master's & PhD course

Course Summary

The course will cover the following topics: classical Lagrangian field theory, Lorentz covariance of relativistic field equations, quantisation of the Klein- Gordon, Dirac and electromagnetic fields, interacting fields, Feynman diagrams, S-matrix expansion and calculating all lowest order scattering amplitudes and cross sections in Quantum Electrodynamics (QED).

Semester 2

Collider Physics (SUPACOP)

Lecturer: Christos Leonidopoulos, Mark Owen, Tony Doyle

Institution: Edinburgh & Glasgow

Delivery: Video Conference and Face to Face

Hours Equivalent Credit: 18 (16 lectures & 2 tutorials)

Assessment: Problem sets (40%), Literature Review (60%)

Course Summary

The SUPACOP lectures provide the common core for all particle physics students in semester 2. The course covers three main subject areas:

- Electroweak and Higgs Physics
- QCD
- Beyond the Standard Model (BSM) Physics (including Supersymmetry)

The objective of the course is to provide a general overview of theoretical, phenomenological and experimental aspects of electroweak theory, QCD and BSM physics, concentrating on the most influential and/or recent measurements from colliders.

Discussion Classes (SUPADCL)

Lecturer: Aidan Robson, Matthew Needham

Institution: Glasgow/Edinburgh

Delivery: Video Conference

Hours Equivalent Credit: 8

Assessment: Presentation

Course Summary

This course provides students with an opportunity to investigate current topics of interest relating to current Particle Physics research, and to present them. Presentations are recorded and participants receive staff and peer feedback.

Flavour Physics (SUPAFLA)

Lecturer: Matthew Needham

Institution: Edinburgh

Delivery: Video Conference

Hours Equivalent Credit: 14 (12 lectures & 2 practical)

Assessment: Continuous Assessment

This course includes two lab sessions based in Edinburgh which students will be required to attend in person.

Course Summary

Flavour Physics attempts to answer some of the most profound open questions in modern physics, such as how do we understand the pattern of masses in the Standard Model and what is the origin of CP violation. This introduction to Flavour Physics consists of two parts, dealing separately with Flavour Physics of the quark and lepton sectors.

Lattice QCD (SUPALAT)

Lecturer: Christine Davies

Institution: Glasgow

Delivery: Video Conference

Hours Equivalent Credit: 6

Assessment: Project

Course Summary

The course will provide an introduction into the methods of lattice QCD. In particular, we will discuss gluon actions, algorithms, quarks on the lattice, algorithms for that, how to do a lattice calculation, systematic errors and recent results.

Quarks and Hadron Spectroscopy (SUPAQHS)

Lecturer: Bryan McKinnon, Derek Glazier

Institution: Glasgow

Delivery: Video Conference

Hours Equivalent Credit: 8

Assessment: Continuous Assessment

This course is cross listed with the Nuclear & Plasma Theme

Course Summary

The course will cover the following topics: Introduction to fundamentals of QCD, why are models necessary when you've got QCD, quark model predictions of hadronic states, properties of the nucleon and its resonances, "missing" baryonic resonances, pentaquarks - salutory lesson or crucial discovery, experimental techniques, partial wave analysis, the search for exotic states: hybrid mesons, glueballs.

Particle Physics

Gauge Theory in Particle Physics (SUPAGAT)

Lecturer: Peter Boyle, Einan Gardi

Institution: Edinburgh

Delivery: Face to Face

Hours Equivalent Credit: 40

Assessment: Take home exam

Joint Master's and PhD course delivered by face-to-face lectures at the University of Edinburgh. (Non-Edinburgh students are welcome to attend the lectures in person in Edinburgh.)

Course Summary

This course provides a comprehensive treatment of the field theoretical approach to the Standard Model of particle physics; it is taught in two parallel threads.

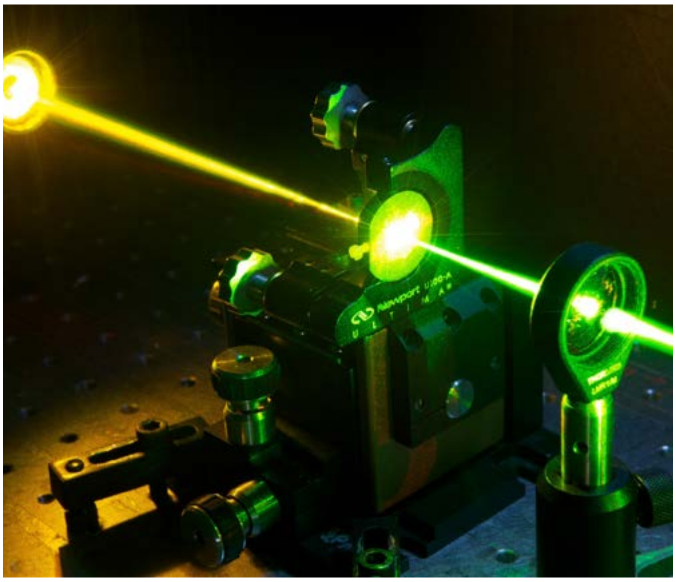
The QED and QCD thread begins with path integral quantisation and renormalisation of Quantum Electrodynamics (QED). It then moves on to a detailed study of Quantum Chromodynamics (QCD), beginning with quantisation, Feynman rules and renormalisation, and then applying a wide range of topics in modern perturbative QCD to collider physics, including deep inelastic scattering and Higgs production.

The electroweak physics and lattice field theory thread focuses on the field theoretical construction and application of the standard model of particle physics, including the Goldstone theorem and the Higgs mechanism, weak decays and flavour physics. Further focus is on detailed calculations in perturbation theory and comparison with experiment. The final part of the course provides an introduction to non-perturbative methods via lattice field theory.

Each thread will have two hours of lectures and two hours of tutorial workshops every week, giving a total of 40 lecture hours and 40 tutorial hours. Students are expected to engage with the material presented in lectures by working through and discussing weekly formative problem sheets in the tutorial sessions. There will be a total of 4 summative hand-ins, which will be marked and individual written feedback provided on each. Individual feedback will also be administered verbally during tutorial sessions.

Photonics

Theme Leaders: Jennifer Hastie,
University of Strathclyde, Jennifer.Hastie@strath.ac.uk
and Robert Thomson
Heriot-Watt University, R.R.Thomson@hw.ac.uk



The programme offered within the Photonics Theme involves a selection of lecture courses which we hope will be of interest to you. Additionally there are opportunities to take part in some distance learning courses. It may also be useful for you to look at courses offered through other themes, especially Condensed Matter and Material Physics and the Core courses. Students are also encouraged to attend Photonics related seminars hosted across Scotland.

Semester 1

Polymers and Liquid Crystals (SUPAPLC)

Lecturer: Graham Turnbull

Institution: St Andrews

Delivery: Distance Learning

Hours Equivalent Credit: 13

Assessment: Continuous Assessment

This course is bienniel and will not run in 2019/20.

Course Summary

This module is delivered in a self-directed distance learning format, through the my.SUPA course pages, there are no face-to-face lectures. This module describes the materials science and device physics that underpins modern display technologies. The syllabus includes an overview of types of displays and characterisation of display properties. The module then focuses on two contemporary display technologies: liquid crystal displays and organic semiconductor (OLED) displays.

Maths Primer (SUPAPRI)

Lecturer: Patrik Öhberg

Institution: Heriot-Watt

Delivery: Video Conference

Hours Equivalent Credit: 6 (Professional Development Credits)

Assessment: Continuous Assessment

Course Summary

The course will be in the form of a maths primer intended for beginning PhD students in condensed matter, solid state and photonics. The topics which will be covered include: Matrix diagonalisation, functional derivatives, complex integration and residues, Fourier transforms, and a discussion on different notations which the students will encounter during their studies.

Experimental Atomic & Quantum Optics (SUPAEAQ)

Lecturer: Paul Griffin, Jonathan Prichard

Institution: Strathclyde

Delivery: Face to Face

Hours Equivalent Credit: 20

Assessment: Continuous Assessment

Course Summary

The course will provide graduate-level training focused on providing the core knowledge needed for early career researchers and is designed to complement material covered in other courses such as SUPASTA. There is an emphasis on self-teaching, with the guidance of having clearly identified relevant reference materials to use as a starting point, and on learning basic coding skills for practical computing in the lab. The course will cover Atomic Structure, Atoms in Magnetic Field, Atom-Light Interactions, Interactions in Hot Atomic Media, Optical Dipole Trapping, Laser Cooling, Atomic Metrology, Data Analysis, and Experimental Electronics.

Nanophotonics (SUPANAN)

Lecturer: Andrea Di Falco, Wiliam Whelan-Curtin

Institution: St Andrews

Delivery: Video Conferrence

Hours Equivalent Credit: 27

Assessment: Tutorials and Exam

Course Summary

Nanophotonics deals with structured materials on the nanoscale for the manipulation of light. Photonic crystals and plasmonic metamaterials are hot topics in contemporary photonics. The properties of these materials can be designed to a significant extent via their structure. Many of the properties of these nanostructured materials can be understood from their dispersion diagram or optical bandstructure, which is a core tool that will be explored in the module. Familiar concepts such as optical waveguides and cavities, multilayer mirrors and interference effects will be used to explain more complex features such as slow light propagation and high Q cavaties in photonic crystal waveguides, Propagating and localised plasmons will be explained and will include the novel effects of super-lensing and advanced phase control in metamaterials.

Photonics

Quantum Technology - Experimental Techniques (SUPAQTE)

Lecturer: Stefan Kuhr

Institution: Strathclyde, Glasgow, Heriot-Watt

Delivery: Video Conference

Hours Equivalent Credit: 12

Assessment: Essay

Course Summary

This course will provide an introduction to Quantum Technologies with a focus on experimental techniques and platforms. The course will start with an overview of experimental techniques in Quantum Technology, aimed to give a conceptual understanding of the key areas: Quantum Measurement and Sensing, Quantum Computation and Quantum Simulation, and Quantum Communications and Networks. In the field of Quantum Computing we will cover ion traps and the underlying physics, as well as superconducting qubits and platforms. For the latter, we will present various types of quantum circuits, control and readout techniques, nanofabrication and electronic hardware, and highlight current development towards realization of quantum advantage in computing. In Quantum Communication and Networks, we will provide an overview of state-of-the-art protocols, photonic platforms and experimental techniques. As an example for Quantum Simulation platforms, we will cover ultracold atoms in optical lattices and Rydberg arrays. We will also provide an introduction to Quantum Sensing and Metrology, by explaining the workings of atomic clocks, magnetometers and interferometers.

Concepts in Signal and Image Processing (SUPACSI)

Lecturer: Vladimir Stankovic and Jinchang Ren

Institution: Strathclyde

Delivery: Video Conference, Face to Face and Distance Learning

Hours Equivalent Credit: 22

Assessment: Lab Worksheets, Group Project

Course Summary

This course is for students in the EPSRC CDT in Industry-Inspired Photonic Imaging, Sensing and Analysis. This course introduces aspects of both signal and image processing with a greater emphasis on image coding, processing and compression.

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Semester 2

Semi-quantum Theory of Atom Light Interactions (SUPASTA)

Lecturer: Gian-Luca Oppo

Institution: Strathclyde

Delivery: Video Conference

Hours Equivalent Credit: 24

Assessment: Essay (60%) and Presentation (40%)

Course Summary

The course is beneficial to students interested in the interaction of laser light with atoms and materials. It provides useful theoretical and numerical skills that have become basics in many research fields in quantum optics, photonics, quantum information processes, light-matter interaction and their applications. Topics covered include: second quantization, raising and lowering operators, density matrix approach, the Lindblad form of decay rates, two and three level atoms, Rabi oscillations, electromagnetically induced transparency, coherent population trapping, enhanced refractive indices, slow light, sub-natural line widths, self-focusing, spatial solitons during propagation, light-matter interaction in optical cavities, Maxwell-Bloch equations, optical bistability, cavity solitons, parametric down-conversion and optical parametric oscillators.

Ultrafast Photonics (SUPAUPH)

Lecturer: Derryck Reid

Institution: Heriot-Watt

Delivery: Distance Learning

Hours Equivalent Credit: 10

Assessment: Online Assessment

This is a Distance Learning Course.

Course Summary

This is a short distance learning course operated by Heriot-Watt University via their Vision virtual learning environment. It has a formal accredited value of 5 SCQF credits. To complete the course students must carry out an online assessment using the Vision system, which means they must first register for an account. Details for doing this appear on the mysupa page.

Solid-State Lasers (SUPASSL)

Lecturer: Alan Kemp

Institution: Strathclyde

Delivery: Video Conference

Hours Equivalent Credit: 14

Assessment: Assessed tutorial assignment

Course Summary

An introduction to the physics, engineering, and thermal management of solid-state lasers, in particular diode-pumped solid-state lasers. Topics covered include: the underlying science and properties of lasers, eg energy levels, stimulated emission, population inversion, gain, threshold and slope efficiency; laser rate equations; common solid-state laser designs, including gain media, optical pumping schemes, operational modes (continuous wave, tuneable and pulsed); approaches to and modelling of thermal management in solid-state and semiconductor lasers; and laser case studies, including semiconductor disk lasers (VECSELs), and the uses of diamond in lasers.

Quantum Technologies - Theoretical Techniques (SUPAQTT)

Lecturer: John Jeffers and Andrew Daley

Institution: Strathclyde

Delivery: Video Conference

Hours Equivalent Credit: 18

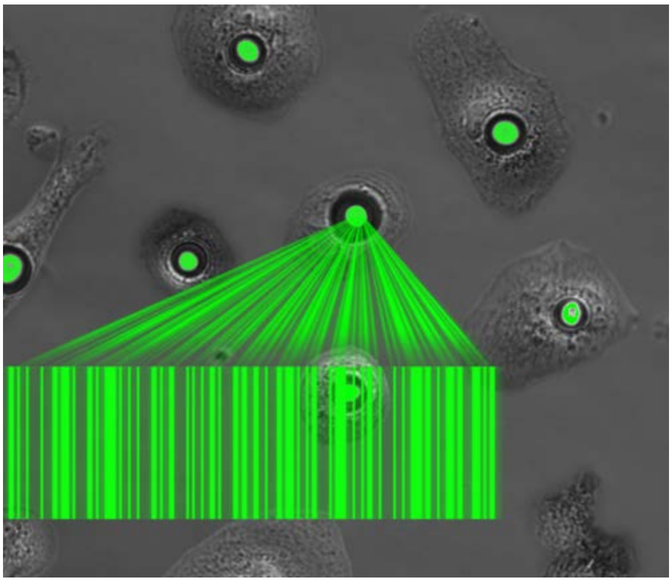
Assessment: Essay

Course Summary

The course will provide important theoretical techniques relevant to Quantum Technologies. Part I - Basic Photonic Quantum Optics: Field quantisation, single-mode fields and quantum states, beam splitters and interferometers, non-classical light and its generation. Part II - Interacting Systems of Cold Atoms: Microscopic description of interacting cold atoms from first principles (pseudopotentials for two-particle scattering; second-quantised field operator Hamiltonian), introduction of approximate methods to treat cold atoms (Bogliubov theory; classical fields and Gross-Pitaevskii equation) and cold atoms in optical lattices (Hubbard models and corresponding phase diagrams). Part III - Quantum Information: Topics will include basic formalism of quantum theory, Hilbert spaces, tensor products, quantum dynamics, measurement, basic protocols for quantum teleportation, cryptography and non-locality; basics of quantum algorithms: Deutsch-Jozsa, Simon, Grover, and Shor's factorization. Quantum error correction, quantum entanglement and LOCC conversion.

Physics & Life Sciences

Theme Leaders: Gail McConnell
University of Strathclyde, G.McConnell@strath.ac.uk



The Theme of Physics and Life Sciences (PaLS) covers a large breadth of both physical and life sciences. As students come from a wide range of backgrounds and experiences, and are pursuing diverse PhD projects, the exact courses to be taken should be discussed with the student's individual supervisor. Students are also invited to select relevant courses from any of the themes or to take appropriate and relevant non-SUPA courses within their home institution, but it is essential that the appropriate assessment (in the form of examination, written assignment or oral assignment) be discussed and agreed with the PaLS Theme Leader (Gail McConnell) in advance.

Semester 1

Biophotonics (SUPABIP)

Lecturer: Kishan Dholakia Carlos Penedo-Esteiro, Malte Gather

Institution: St Andrews

Delivery: Video Conference

Hours Equivalent Credit: 33

Assessment: Attendance, news and views article, assessed problem sheet

This is a final year undergraduate course organised by University of St Andrews.

Course Summary

The module will expose students to the exciting opportunities offered by applying photonics methods and technology to biomedical imaging, sensing and detection. A rudimentary biological background will be provided where needed. Topics include fluorescence microscopy and assays including time-resolved applications, super-resolution imaging, optical tweezers for cell sorting and DNA manipulation, single molecule studies, photodynamic therapy, lab-on-a-chip concepts and bio-MEMS.

Biomedical Applications of Lasers, Beams and Radiation (SUPABAL)

Lecturer: Bernhard Hidding, Grace Gloria Manahan

Institution: Strathclyde

Delivery: Video Conference

Hours Equivalent Credit: 12

Assessment: Continuous Assessment

Course Summary

Lasers, particle beams and radiation such as x-rays are essential instruments for imaging, drug research and treatment in life sciences. The course would address both established and cutting edge radiation generation methods for a variety of biomedical applications, as well as occurrence of radiation in nature and their effects. Then, the mechanisms of interaction of the different types of radiation on the nuclear, atomic, molecular, cell and system level (e.g. the patient) are discussed. Finally, fundamentals and progress in biomedical applications such as x-ray radiography, magnetic resonance tomography (MRT), positron emission tomography (PET), electron microscopy and other radiology imaging techniques, radiation-assisted drug R&D as well as laser surgery, cancer radiotherapy with photons, electrons, protons, neutrons and ions, and other treatment techniques will be covered. Next to providing an overview on the physics behind these techniques, the course will also include practical considerations and is intended to facilitate and support interdisciplinary research projects and collaborative applications.

Introducing Biology to Physicists (SUPAIBP)

Lecturer: Ulrich Zachariae

Institution: Dundee

Delivery: Video Conference

Hours Equivalent Credit: 22

This is an undergraduate course run by the University of Dundee.

Course Summary

An overview of fundamental areas of biology for students with little biology background, emphasizing evolution, connections between length and time scales in biology, and the potential role of physics to inform biology at all of these different scales. Introduction: what is life?, Darwin's theory of evolution, Mendelian genetics, tree of life, basics of prokaryotic cells, basics of eukaryotic cells. Biochemistry and molecular biology: structure and functions of proteins, structure of DNA, DNA replication, transcription, translation, protein folding. Cell biology: membrane structure, membrane transport, metabolism and mitochondria, cytoskeleton, cell cycle. Multicellular organisms: germ cells, fertilisation, development. Populations: introduction to ecology, population genetics and evolution.

Semester 2

Physics of Biological Evolution (SUPAPBE)

Lecturer: Bartek Waclaw

Institution: Edinburgh

Delivery: Video Conference

Hours Equivalent Credit: 10

Assessment: Problem Sheets

This is a biennial course which will not run in 2019/20, but will run in 2020/21

Course Summary

The course will discuss the basics of biological evolution and examples of physicists' contributions to it. The emphasis will be on problems that can either be solved by the methods of statistical/quantum physics, or those investigated by researchers who considered themselves to be physicists.

Astrobiology and the Search for Life (SUPAASL)

Lecturer: Charles Cockell, et al

Institution: various

Delivery: Video Conference

Hours Equivalent Credit: 20

Assessment: Online multiple-choice test

This course is cross listed with the Astronomy and Space Sciences Theme.

Course Summary

This course looks into the origin, evolution and distribution of life in the Universe, broadly considered as 'astrobiology'. The objective of the course is to provide a perspective in geology, biology and chemistry at an introductory level. The course will include lectures on the limits and conditions for life on Earth through time and how these may apply elsewhere in the universe. The course looks at the current scientific approaches used to address the hypothesis of life elsewhere in the Universe. The subjects discussed include: the formation of planetary systems and the conditions required for habitability, detection methods for extrasolar planets, the diversity of known exoplanet systems, the origin of life, evidence for earliest life on Earth, the geological and biological history of the Earth, conditions past and present on Mars and the icy moons of the giant planets, and finally the Search for Extra-Terrestrial Intelligence (SETI).

Biological Physics (SUPABPS)

Lecturer: Simon Titmuss, Rosalind Allen

Institution: Edinburgh

Delivery: Video Conference

Hours Equivalent Credit: 12

Assessment: Written Assessment

This is a level 11 undergraduate course organised by the University of Edinburgh. It would provide a physics-based introduction to Biological Physics for students who have not taken such a course as undergraduates. This course will be taught to SUPA students as a Distance Learning course.

Course Summary

There is an increased research effort in the school devoted to problems at the interface between biology and physics. There is also increasing recognition that physics can provide a very real - and very valuable - insight into the behaviour of complex biological systems, and that a physical approach to biological problems can provide a new way of looking at the world. This course will introduce the students to the basics of biological systems, and then provide examples of how familiar physical principles (thermodynamics, statistical mechanics) underlie complex biological phenomena. This course will introduce you to the wonders of biology: the organisms, cells, and molecules that make up the living world. We will demonstrate the power of physical concepts to understand and make powerful predictions about biological systems, from the folding of a protein into a unique three-dimensional structure within a reasonable timeframe, through the motions of proteins to drive biological processes, to the locomotion of bacterial cells. The physical concepts will be substantially familiar, but their applications will be novel. Where possible, examples will be drawn from the recent scientific literature.

Mathematical Modelling (SUPAMMD)

Lecturer: Marco Thiel

Institution: Aberdeen

Delivery: Video Conference

Hours Equivalent Credit: 33

Assessment: Manuscript in form of 4 page paper; description of modelling project.

This is a final year undergraduate course organised by the University of Aberdeen.

Course Summary

This course shows you how to develop mathematical descriptions of phenomena. We use mathematical techniques to describe a large variety of "real-world" systems: spreading of infectious diseases, onset of war, opinion formation, social systems, reliability of a space craft, patterns on the fur of animals (morphogenesis), formation of galaxies, traffic jams and others. This course boosts your employability and teaches tools that are highly relevant for almost every researcher.

Professional Development

All SUPA students are required to complete 20 hours of Professional Development Training during the first two years of their PhD studies. SUPA Professional Development Training Courses are listed on the following pages. However, students may also participate in Professional Development Training run by their local departments and universities or run by Vitae (a UK-wide organisation sponsoring Skills Training) or their Research Councils.

Please note that enrolment for Professional Development Training is often run separately from enrolment procedures for Specialist Courses. Information about enrolment procedures for each course will be posted on My.SUPA course areas and announced to all students via email. If you have any questions about enrolment for SUPA Professional Development Training Courses, please email **admin@supa.ac.uk**.

Information about Professional Development courses run by Vitae and individual universities can be found at the following websites:

Vitae: vitae.ac.uk/events

University of Aberdeen:

abdn.ac.uk/pgrs

University of Dundee: dundee.ac.uk/opd

University of Edinburgh:

ed.ac.uk/institute-academic-development

University of Glasgow:

myglasgow/ris/researcherdevelopment/

Heriot-Watt University:

hw.ac.uk/services/research-futures.htm

University of St Andrews:

st-andrews.ac.uk/capod/students/pgresearch/

University of Strathclyde: strath.ac.uk/theresearcherdevelopmentprogramme

University of the West of Scotland:

uws.ac.uk/about-uws/academic-life/uws-academy

Semester 1

C++/Object Oriented Programming (SUPACOO)

Lecturer: Federica Fabbri

Institution: Glasgow

Delivery: Video Conference and Face to Face

Hours Equivalent Credit: 12 (4 x 1hour lectures and 4x2hr tutorials)

Assessment: Continuous Assessment

This course includes four lab sessions based in Glasgow which students will need to attend in person. This course has priority booking for Particle Physics students. Please refer to the timetable and visit the My.SUPA course area for more information.

Course Summary

This course introduces C++ via four pairs of lecture and computer lab. The computer lab gives you access to a Linux environment with C++ compiler and an Emacs or Vim text editors. As it sometimes slows when many people connect at the same time, you are encouraged to bring your own laptop with Linux or Mac OS to work directly in your day to day work environment.

The topics covered are the basic C++ that needs to get you going in your research. However, object-oriented notions, such as classes and inheritance, will not be covered in this introductory C++. The topics covered include: basic C++ syntax; standard C++ data types (bool, float, char, etc); standard C++ streams (cout, cin, error, etc); standard C++ operators (==, &&, %, etc); conditionals and loops (if, for, while, switch, case, etc); standard templated library types (string, vector, map, list, stringstream, etc); pointers and references; functions; overloading functions; passing argument to a function by reference; templated functions; how to compile your code as an executable or a shared library to be used by another piece of code; how to convert one data type to another data type; how to compute the time it takes to run your code; how to pass arguments at the command line.

Introductory Data Analysis (SUPAIDA)

Lecturer: Carlos Garcia Nuñez

Institution: UWS

Delivery: Video Conference

Hours Equivalent Credit: 6

Assessment: Continuous Assessment

Course Summary

This course provides an introduction to uncertainty in measurement. Topics will include: random error and relation to statistics; probability distributionsand their properties; calculation and estimation of uncertainty; least squares model; applications of data analysis.

Professional Development

Maths Primer (SUPAPRI)

Lecturer: Patrik Öhberg

Delivery: Video Conference

Institution: Heriot-Watt

Hours Equivalent Credit: 6

Assessment: Continuous Assessment

Course Summary

The course will be in the form of a maths primer intended for beginning PhD students in condensed matter, solid state and photonics. The topics which will be covered include: Matrix diagonalisation, functional derivatives, complex integration and residues, Fourier transforms, and a discussion on different notations which the students will encounter during their studies.

FPGA Programming for Physicists (SUPAFPP)

Lecturer: Johannes Hernsdorf

Institution: Strathclyde

Delivery: Video Conference

Hours Equivalent Credit: 12

Course Summary

Field programmable gate arrays (FPGAs) are configurable digital electronic devices capable of providing high-speed, low-latency and controlled latency digital interfaces to experiments. For example, FPGAs have been used in fluorescence lifetime measurements, various imaging methods, detection of photon correlations, gravitational wave detectors, and gravimeters. This course will equip students with the basic knowledge of how to interface physics experiments to digital electronics, and how to program FPGAs. An introduction to hardware description languages (HDLs) is given on the example of Verilog. HDLs are fundamentally different from computer programming languages and understanding them is crucial for the use of FPGAs. After completion, participants will be able to integrate FPGAs into their own experiments, create simple FPGA configurations, understand common problems and strategies to overcome them, and be aware of resources to help extend these skills

Semester 2

Hands on Writing: How to Master Scientific Academic Writing (SUPAHOW)

Lecturer: Marialuisa Aliotta

Institution: Edinburgh

Delivery: Face to Face

Hours Equivalent Credit: 15

This course is available online.

This course is offered as a Face to Face option for second and third year students only; attendance on this course will be restricted to 32 places.

Course Summary

The course is specifically tailored to PhD students in scientific disciplines. It will provide practical tools and strategies to help students understand key elements of good scientific writing. The course will cover the 5 steps of the writing process, from pre-writing to proofreading, and will focus on the structure and style of good academic writing. The course runs as a three-day residential workshop and will provide plenty of opportunities for students to develop and hone effective writing skills. Topics covered will include: purpose and structure of different sections (Introduction, Methodology, Data analysis and Results, Discussion and Conclusions, Abstract); use of language and grammar (parallel sentences, appropriate tenses, sentence coordination); supporting materials (figures and tables, bibliography, appendices).

Software Carpentry (SUPASWC)

Lecturer: Norman Gray

Institution: Glasgow

Delivery: Face to Face

Hours Equivalent Credit: 16

Assessment: Continuous Assessment

Course Summary

Many researchers need to write (computer) code of some type or other, though typically as an auxiliary activity – researchers should not turn into ‘programmers’. It is useful for researchers to do that part of their work effectively, now and in the (transferrable) future. The Software Carpentry course (SWC) aims to instil pragmatic good practice in scientists.

ROOT (SUPAROO)

Lecturer: Ian Connelly

Institution: Glasgow

Delivery: Face to Face

Hours Equivalent Credit: 9 (3 x 3 hour Labs)

Assessment: Continuous Assessment

Course Summary

ROOT is a primary data analysis framework tool developed by CERN and used in experimental particle physics and, increasingly, many other fields. This course is based on hands-on sessions in which you will learn the basic features of ROOT, through to producing a publication-quality plot from raw data.

Professional Development

Advanced Data Analysis (SUPAADA)

Lecturer: Martin Hendry

Institution: Glasgow

Delivery: Face to Face

Hours Equivalent Credit: 10

Assessment: Series of multiple choice questions throughout lectures

Course Summary

This course will provide a comprehensive introduction to the principles and practice of advanced data analysis, with particular focus on their application within the physical sciences and on the (rapidly growing) use of Bayesian Inference methods.

Over the past few decades Bayesian inference methods, as a powerful tool for analyzing data, have been growing ever more common across a diverse range of fields of physics. Bayesian inference provides a natural framework in which to address key quantitative questions, constrain the parameters of physical models and measure how well competing models can describe the available data. They also provide an objective and straightforward framework in which to incorporate prior information about thosemodels, obtained e.g. from previous analyses or from theory. Moreover, recent advances in computational methods also offer simple algorithms in which to implement Bayesian methods – even with very large and complex data sets – on a standard desktop computer.

These lectures will give a comprehensive introduction to Bayesian inference methods. The lectures will include some practical exercises designed to introduce some useful codes and algorithms – as well as to showcase the vast array of online resources available to support the “virgin Bayesian” seek to apply these methods to their data.

Introduction to Python (SUPAPYT)

Lecturer: Michael Alexander

Institution: Glasgow

Delivery: Video Conference and Face to Face

Hours Equivalent Credit: 8 (4 lectures & 2x2hour tutorials)

Assessment: Assignment Problem

Course Summary

This course serves as a first introduction to the powerful, object-oriented scripting language Python, which combines ease of use with extensive functionality and simple extensibility. After completion, it’s intended that users will be familiar with the concepts and philosophy of Python, be able to use it to solve a wide range of everyday problems and be able to extend its functionality with user defined classes and modules for more specialised problems.

Research Ventures (SUPAENT)

Lecturer: Various

Institution: Glasgow

Delivery: Face to Face at a location to be determined

Hours Equivalent Credit: 2 days (14hours)

Schedule: June 2019

This course will be organised by the Researcher Development Department at the University of Glasgow.

Course Summary

This two-day course will provide an insight into the process of research commercialisation, starting a business, finding funding and self-employment.

Industry Skills (SUPAISC)

Lecturer: Various external speakers

Institution: Various

Delivery: Video Conference

Hours Equivalent Credit: 6

Course Summary

The SUPA industry skills course is delivered by representatives from industry and will focus on essential skills for future careers. NPL, Marks and Clerk, Optos, Thales, Coherent, Leonardo and Aridhia Informatics have been instrumental in the creation of this course. Topics covered in previous years have included Intellectual Property and Patents, Product Line Management, Risk Management, Decision Making Skills and Written Communication.

From Zero to Draft in 8 Weeks (WRI)

Lecturer: Stephanie Zihms

Institution: UWS

Delivery: Video Conference

Hours Equivalent Credit: 12

Course Summary

This course will support students through the process of writing a journal paper. Each week will follow the structure of a typical science journal paper – with time to network and discover different ways to write in your own time.

Participants are encouraged to meet outside the scheduled sessions to continue working on their paper.

SUPA Graduate School

Welcome to Graduate Studies at SUPA!

SUPA courses fall into two categories, Specialist courses and Professional Development courses. Doctoral students are required to take 40 hours of specialist courses and 20 hours of Professional Development during the first two years of their studies. Specialist courses relate closely to a student's research interests. Professional Development courses are valuable to students in a wide range of research areas. In both cases, students must enrol for any SUPA course they plan to attend. Students may also meet their course requirements through courses offered outside SUPA. Students must discuss their course selections with their advisors.

SUPA Specialist Courses

These courses are listed by theme on pages 8 – 24. Frequently, students take courses within their research theme. However, many research topics are interdisciplinary. Students are encouraged to take the courses most relevant to their work, regardless of theme.

All specialist courses are assessed. Students must pass the assessment in order to get credit for the course. Courses are assessed by various methods. These methods include continuous assessment, dissertations and oral examinations. The assessment for a specific course can be found in the course listing. Students are advised to check the type of assessment with the lecturer at the start of each course. The final assessment for courses will be on a 0-100 point scale, where the pass mark is 50. If a specific SUPA course is part of an undergraduate curriculum, the pass mark may vary.

Students may audit Specialist courses. This may be appropriate if students are interested in the topic and want to attend lectures but do not have time to complete the course work. Students need to enrol for courses that they audit. However, they do not receive credit for audited classes.

Some Specialist courses run biennially. They will be offered only once in two years. Please consider these schedules carefully when planning your courses.

SUPA Professional Development Courses

Professional Development is an important part of the graduate student experience. Professional development training can help students plan and manage their research projects and improve their writing and coding skills. Professional Development training may also broaden career options. These courses are listed at the end of the course list on pages 25-26. Assessment is not required for Professional Development courses.

Course Delivery

SUPA courses are unusual in that students may attend in different ways. The delivery method for a specific course is included in the course list and catalogue. These methods include Videoconferencing, Face to Face, and Distance Learning

Videoconferencing

Most SUPA courses are taught via videoconferencing. To attend, go to your local SUPA videoconference room

Aberdeen

Meston Building Room 302
Contact: Michael Chung
Tel: +44 (0)122 427 2750
Email: m.chung@abdn.ac.uk

Dundee

Ewing Building Basement
Contact: Gary Callon
Tel: +44 (0)138 238 4695
Email: g.j.callon@dundee.ac.uk

Edinburgh

James Clerk Maxwell Building Room 3301
Contact: SOPA Helpdesk
Tel: +44 (0)131 650 5900
Email: sopa-helpdesk@ed.ac.uk

Glasgow

Kelvin Building Room 255a
Contact: Andrew Fraser
Tel: +44 (0)141 330 6420
Email: andrew.fraser@glasgow.ac.uk

Heriot-Watt

Earl Mountbatten Building
Room EM1.27
Contact: Sean Farrell
Tel: +44 (0)131 451 3048
Email: s.j.farrell@hw.ac.uk

St Andrews

Physics and Astronomy Room 307
Contact: Ian Taylor
Tel: +44 (0)133 446 3141
Email: iat@st-andrews.ac.uk

Strathclyde

John Anderson Building Room 813
Contact: Timothy Briggs
Tel: +44 (0)141 548 3376

UWS

Henry Building
Room F.318
Contact: Tom Caddell
Tel: +44 (0)141 848 3550
Email: tom.caddell@uws.ac.uk

Starting Up

- SUPA videoconferences usually begin at five minutes past the hour and last 55 minutes.
- The call will be made automatically, so there is no need to dial in.
- If they are not on, use the remote or control switch to turn on the projectors or monitors.
- Initially, the SUPA rooms list will be appear on a screen or monitor. When the call starts, this will shift to the Participants Screen

Shutting Down

- SUPA lecture calls end on the hour.
- At the end of your lecture, please switch off the monitors or projectors using the remote control, turn off the room light and lock the door.
- To end a call before the hour press the red button on the Vidyo remote control.

Assistance during videoconferences is available from local technical support at each site. The Getting Started with Video Conferencing My.SUPA page can be found at http://my.supa.ac.uk/course/view.php?id=91.

Videoconference rooms are primarily used in SUPA to deliver courses, however, they are also used for other purposes such as research meetings, seminars, interviews and distinguished visitor lectures. More information on using SUPA videoconference facilities, including video tutorials, can be found in Getting Started with Video-Conferencing at: http://my.supa.ac.uk/

Making a Booking

SUPA videoconferences must be booked in advance by SUPA. If you are organising a meeting or event and would like to use the SUPA videoconference facilities, please visit the SUPA website and use the booking form to make a booking. http://www.supa.ac.uk/room_booking

Face to Face

Courses that are taught Face to Face, listed as F2F, are taught in a traditional way. Students and lecturers attend in person. These courses may include tutorials, labs, or discussion sessions. Depending on the location of the course, students may have to travel and possibly stay overnight. Some lectures that are presented through VC may have tutorials, labs or discussions that students must attend in person. These will be listed as both VC and F2F. Please consider these aspects when registering for a course. If a Face to Face course spans a number of days in succession, it will be listed as Residential.

Travel: If you are required to travel to attend a SUPA course, SUPA will reimburse travel expenses. SUPA will cover the cost of accommodation only if there is insufficient time to travel on the day of the event. Some courses will require overnight accommodation and you should consult the lecturer if you are in doubt regarding start and end times. The accommodation allowance is up to £80 per night. Any expenses over £80 must be justified in your claim form. Follow the procedures for claiming expenses at your university and ensure you complete the departmental travel claim form clearly stating SUPA and the course name.

Distance Learning Courses

Enrolling in Distance Learning courses will give you online access to recordings, notes, problem sheets and discussion forums. Students are expected to work independently, and participate in activities set by the course lecturer. Students will submit exercises and receive feedback. There are no live broadcasts of lectures.

Non-SUPA Courses

Students may complete their course requirements through courses offered outside SUPA. This applies to both Specialist and Professional Development courses. Examples of appropriate Specialist courses include Master's (MSci/MPhys/MSc) and Bachelor's courses. *Attendance at National and International Summer Schools designed for research students (e.g. those organised by doctoral training centres or SUSSP) is also encouraged.* All Specialist courses must be assessed. Professional Development courses may be provided by a University, Research Council, VITAE or other organisations. Students are encouraged to take these pportunities with their supervisor's agreement.

Getting Credit for Non-SUPA Courses

All non-SUPA courses and marks will be reviewed by the GSC. In order to get credit, the student's name, course name, date, course description, course provider and number of credits must be sent to admin@supa.ac.uk. If someone other than the advisor submits this information, the advisor must be copied in. For a single non-SUPA Specialist course, students can earn no more than 30 hours of credit. It is the student's responsibility to ensure the information submitted is correct.

For Specialist courses, the student's marks on the assessment must also be submitted. SUPA recognises that National and International Summer schools are valuable learning experiences even though they may not have an assessment. In these cases, a supervisor may devise an assessment for the student in order to meet SUPA's requirements. Students and advisors should agree on this arrangement before registering for a Specialist, non-SUPA course. The content and assessment should be comparable to a SUPA course of equivalent credit. All Specialist courses, including Bachelor's level modules, will only be accepted if the student has been assessed. The pass mark will be assumed to be 50%. The GSC cannot organise assessment for non-SUPA courses.

My.SUPA

Registering for My.SUPA and Course Enrolment

My.SUPA (http://my.supa.ac.uk) is an online space for managing all your SUPA-related activities. We strongly encourage you to check My.SUPA regularly as this is our main tool for contacting you with important information such as requirements for your lectures, changes to the course timetable and event announcements.

New students will need to register with My.SUPA before they enrol for courses. Registering for My.SUPA is a quick process that will not significantly delay your enrolment. To register:

- Go to http://my.supa.ac.uk
- Click 'Create a new account'
- Register using your university email address
- An email will be sent to you with a verification link. If you have any questions or problems email admin@supa.ac.uk.

Students must enrol for SUPA courses in order to attend or receive credit for them. To enrol, log on to My.SUPA (http://my.supa.ac.uk) and follow the instructions. Before you enrol for the first time, you will be informed about SUPA's videoconference recording policy and asked for your consent. (For more information about this policy, please email admin@supa.ac.uk.)

Enrolment for Semester 1 will open in September. Enrolment for Semester 2 will open in December. Enrolment will typically stay open until the end of the first week for short courses and the end of the second week for full semester courses. After the open enrolment period, late enrolment may be possible with the lecturer's permission. Once you have permission from the lecturer to enrol late, contact the SUPA Administration team at admin@supa.ac.uk.

Once you have enroled for a course you will be able to check the course area on My.SUPA for information such as lecture notes and changes to the course schedule. You will also be able to communicate with your classmates and lecturer(s) individually (through the 'People and Locations' tab) and as a group (by using the News Forum). Messages posted on the course area News Forum will be automatically sent to the email address you have provided to SUPA. During the enrolment period most course areas are available with limited access materials. All course materials will be made available to enrolled students once registration is closed.

Some courses close enrolment before the course start date. Details about enrolment closing will be in the course information page on My.SUPA.

To withdraw from a SUPA course while enrolment is open, go to the course page and click the 'Unenrol me from SUPA [XYZ]' link. If you are not going to complete a course, it is important to unenrol on My.SUPA. Otherwise, your SUPA transcript will include this course with a mark of 0.

During the enrolment period, students may change their enrolment status between being assessed and non-assessed, (auditing). This may be helpful for students who want to try a course before fully committing. To make these changes, first withdraw from the course on My.SUPA and then enrol again with the new status.

After enrolment has closed, it is no longer possible to unenrol or change enrolment status through My.SUPA. Instead, contact admin@supa.ac.uk and notify the course coordinator.

Course Availability

If a course is cancelled, students will be contacted to discuss alternatives. If a course is oversubscribed, students will be admitted in the order that they registered and students who registered later will be added to a wait list.

Course Credit

The credit for each course is included in the course listing and course description. Students can track the amount of credit they have earned by checking their profile on My.SUPA.

Extenuating Circumstances: If unforeseen circumstances, such as an illness, adversely affect a student, course instructors and SUPA management may have some flexibility in assigning credit. The student should inform their local Graduate School Committee member and provide documentary evidence of these unforeseen events as soon as possible. The Graduate School Committee will review cases individually.

Transcripts

You can track the number of course hours you have completed by viewing your online transcript in My.SUPA. To do so, log in to My.SUPA and click on your name in the upper right hand corner of the screen. (The link should say: You are logged in as [NAME]). This will take you to your user profile. Click on the 'Grades' tab to view your transcript. To obtain an official copy of your transcript certified by the Graduate School Coordinator, please email admin@supa.ac.uk.

Timetable, Calendar and Events

The latest version of the Graduate School Timetable and the SUPA Calendar can be found on the My.SUPA homepage. If you would like to advertise an event to others in SUPA please email admin@supa.ac.uk.

Further Training and Support

If you experience any difficulties while using My.SUPA, please email the SUPA Administration Office at admin@supa.ac.uk. To report errors on the site or to request technical help, please contact webmaster@supa.ac.uk.

Frequently Asked Questions

What is SUPA?

SUPA is the Scottish Universities Physics Alliance, a grouping of eight Physics departments across Scotland. The SUPA Graduate School facilitates shared learning across these institutions. After enrolling for post-graduate studies in a SUPA-member institution, you are automatically enrolled in the SUPA Graduate School and are subject to its academic policies.

Is there a timetable for the SUPA courses?

The SUPA timetable can be found on the My.SUPA website.

How do I use the videoconferencing equipment?

Information can be found in the Videoconferencing section of this handbook. If you have a specific issue, please contact your local Graduate School Committee representative or a member of local support. Training is available locally.

How do I obtain a My.SUPA password and username?

To obtain a My.SUPA login, please go to the My.SUPA portal (http://my.supa.ac.uk) and click on the 'Create a new account' link. Follow the instructions.

How do I reset my My.SUPA password or username?

You can reset them either by following the 'Lost Password?' link in the login box on the My.SUPA portal or by emailing **admin@supa.ac.uk.**

Who do I contact if I am having difficulty using My.SUPA to enrol (or unenrol) for courses?

If you encounter any difficulties while enrolling or unenrolling for courses on My.SUPA, please contact the SUPA Office at admin@supa.ac.uk.

How can I contact my lecturer?

On My.SUPA, you can find your lecturer's details in the 'People and Locations' or 'Course Description' area in the front page of the course area.

What if I am unable to attend a SUPA lecture?

If you enrol on a SUPA course, you are expected to attend the lectures. If you are ill or find you have a conflicting obligation, please inform your lecturer.

How can I obtain a copy of my SUPA transcript?

An electronic copy of your transcript is available on My.SUPA on the 'Grades' tab of your student profile. To obtain an official copy of your transcript certified by the SUPA Graduate School Co-ordinator, please write to the SUPA Office at admin@supa.ac.uk.

Who can I contact if I have a general question about the SUPA Graduate School?

Contact the SUPA Office at admin@supa.ac.uk

Who is my local SUPA representative?

On the contacts page of this handbook, you can find the names of all SUPA GSC representatives. Do not hesitate to contact them if you have any queries or issues regarding SUPA Graduate School.

I am organising an event, can SUPA help me promote it?

Yes. As long as you are a SUPA member and your event is relevant to those working in Physics in Scotland, SUPA is happy to help with promotion. Please email admin@supa.ac.uk with a succinct description of your event and electronic copies of any promotional materials (such as fliers or posters) that you may have, and SUPA will work with you to promote your event.

Can SUPA help me fund my participation in an event or course not organised by SUPA?

Unfortunately, SUPA only provides funding for SUPA-sponsored and SUPA-organised events. There is no funding available to attend Summer Schools or conferences that were not organised by SUPA.

Can I claim travel expenses from SUPA?

Yes, if the events or courses were organised by SUPA and students must travel in order to attend (such as a residential course). SUPA will cover reasonable costs, defined as: public transport or mileage on shared rides equivalent to public transport costs, meals or accommodation.

How do I claim back my expenses from a SUPA event?

To claim back expenses for a SUPA event, please submit a claim form to your local department's finance office, clearly stating the name of the SUPA event or course. Do not send claims to the SUPA administration team unless specifically instructed to do so.

The Researcher Development Framework

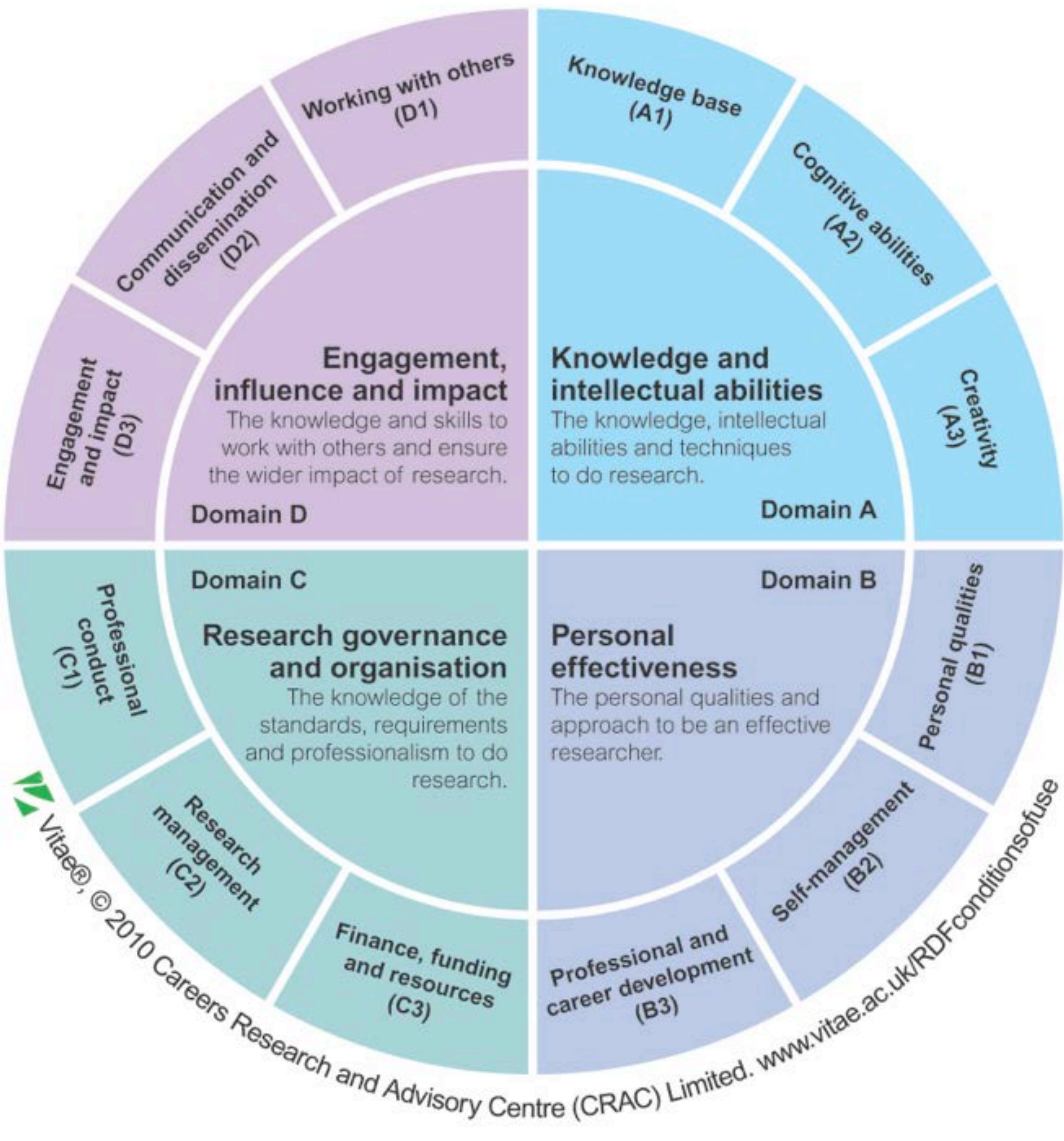
The Researcher Development Framework describes the knowledge, behaviours and attributes of researchers and encourages them to aspire to excellence through achieving higher levels of development. It will be invaluable for planning, promoting and supporting the personal, professional and career development of researchers in higher education.

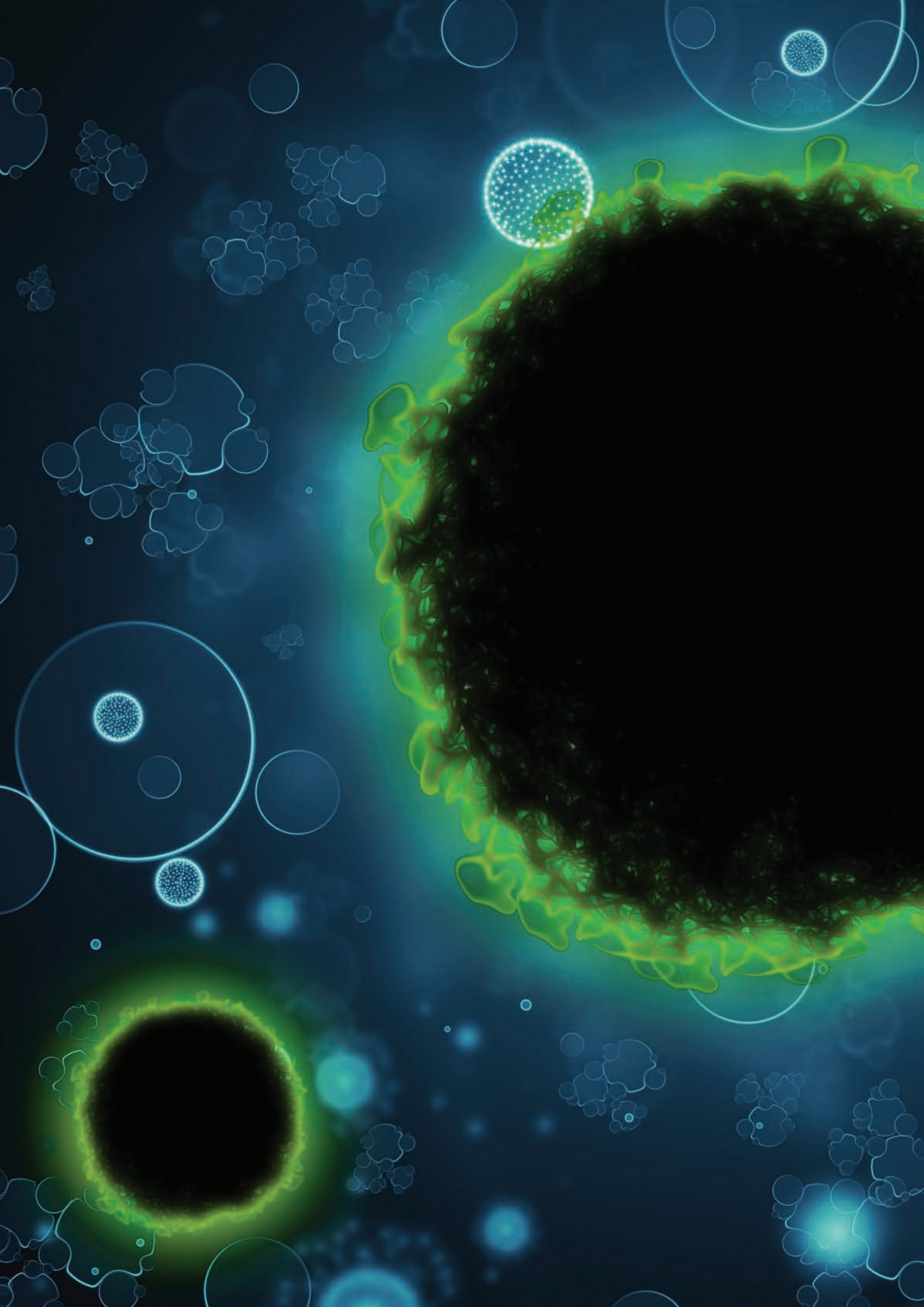
The Researcher Development Statement

The Researcher Development Statement sets out the knowledge, behaviours and attributes of effective and highly skilled researchers appropriate for a wide range of careers. Further information can be found online at: www.vitae.ac.uk/rdf

RDF Personal Development Planner

The Researcher Development Framework (RDF) has been incorporated into the professional Development Planner to allow researchers to identify the areas in the framework they want to develop further, create an action plan and record evidence of their progress. For further information visits: https://www.vitae.ac.uk/researchers-professional-development/about-the-viate-researcher-development-framework





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