GRADUATE SCHOOL

CATALOGUE

2024 / 2025

SUPA Course Catalogue 2024/2025

The Scottish Universities Physics Alliance, SUPA, is a collaboration of eight Physics departments across Scotland. The SUPA Graduate School shares teaching across these institutions. Upon enrolling for post-graduate studies in a SUPA university, you are automatically admitted to the SUPA Graduate School.

This catalogue contains information about how SUPA functions as well as current courses offered by SUPA.

General information about how to register, join courses and get credit for non-SUPA courses is on pages 4-7.

A list of courses appears on pages 9-11, while longer course descriptions can be found on pages 12 - 33.

Each course description contains helpful information about the course. For example, the Status indicates if the course will be offered this year. Some courses are offered only in alternate years, and some courses may be temporarily suspended. Please check the status of a course to find out if it will be available this year.

At the bottom of each course description there is a link to the relevant my.supa course page. The link takes you to the registration page for the course.

Details for many Term 2 courses are not finalized at the beginning of Term 1. Please check back as we will post new information when it is available. The catalogue is updated multiple times during the year.

SUPA courses can be shared in various ways. Some of them are held in the SUPA classrooms, which are listed on page 5. These rooms are linked by Zoom. Participants can join these classes in their local SUPA classroom or can join these zoom calls anywhere, using a personal device.

Many courses are shared outside the SUPA classrooms. Information about how to join a course will be posted on the my.supa page for the course.

Students are strongly encouraged to attend courses live, as they happen. Interacting with the lecturer and other students during class time has been shown to have a positive impact on student learning.

For any questions or concerns, please contact supacentral@glasgow.ac.uk.

Welcome to SUPA!

The SUPA Team

Table of Contents

SUPA Graduate School

Welcome to Graduate Studies at SUPA!

Here we will describe the courses offered by SUPA, how to register for courses, and how to join courses. SUPA also recognizes courses from other institutions. We will describe the courses that are recognized and how to get credit for non-SUPA courses.

SUPA courses fall into two categories, Specialist and Professional Development. Specialist courses are closely related to a student's research interests, while Professional Development courses appeal to students in a range of research areas.

Doctoral students are expected to take a total of 40 hours of Specialist courses and 20 hours of Professional Development in the first two years of their studies. For example, a student might take a 24 credit course in their first year, and a 16 credit course in their second year. Your home university may have their own requirements that supersede SUPA's expectations.

Students may fulfil their course requirements through courses offered outside SUPA. This is true for both Specialist and Professional Development courses. Students must discuss their course selections with their supervisors. Courses taken prior to enrolment in a PhD will not count toward PhD course requirements.

Student performance will be recorded by SUPA Central and information may be provided to departments via the Graduate School Committee and the Executive Committee for student progression.

Specialist Courses

Frequently, students take courses within their research theme. However, students are encouraged to take the courses most relevant to their work, regardless of theme. Specialist courses are listed by theme on pages 12 – 29.

All specialist courses are assessed. Students must pass the assessment in order to get credit for the course. Courses are assessed by various methods. 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 a course.

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 as a non-assessed student in order to audit courses. Students 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.

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.

Professional Development courses will have an informal or ongoing assessment. These courses are listed on pages 30-33.

My.SUPA and Course Enrolment

My.SUPA (http://my.supa.ac.uk) is an online space for managing your SUPA activities. New students need to register with My.SUPA before they can enrol for courses. This is a quick, semi-automated process:

- 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 do not yet have a university email address, use the best address for contacting you. Please change the email address on your account to your university email as soon as possible.

Detailed instructions on registration

Course Enrolment

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. When 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 opens in September. Enrolment for Semester 2 opens in December. Enrolment will typically stay open until the end of the first week of the course, 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.

After you have enroled for a course, you will be able to check the course page on My.SUPA for information such as lecture notes and updates. During the enrolment period, students usually can access a limited portion of the course materials. The remaining course materials will become available to enrolled students once registration is closed.

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

During the enrolment period, students may change their enrolment status between being assessed and non-assessed, (auditing). To make these changes, first withdraw from the course on My.SUPA and then enrol again with the new status.

If you have difficulty changing your enrolment status after enrolment has closed, contact admin@supa.ac.uk and notify the course coordinator.

To withdraw from a SUPA course, 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.

We strongly encourage you to check My.SUPA course pages regularly as this is the main method for sharing course information. On the my.supa course page, you can share messages with everyone in the course by using the News Forum. Messages posted on the News Forum will be sent to you via the email address you provided to SUPA.

My.SUPA Support

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

Course Delivery

SUPA courses are delivered in a variety of ways, such as through videoconferencing, face to face, and distance learning. The course description will explain how the course is shared.

Videoconferencing

Many SUPA courses are taught via videoconferencing. In some cases, students go to the local SUPA classroom to attend the course. Students may also join classes from a personal computer or other device. Links to lectures will be shared through the my.supa course pages.

SUPA Graduate School

Joining from the SUPA classrooms

Starting Up

- SUPA classes usually begin at five minutes past the hour and last 55 minutes.
- Turn on the projectors, (using a remote control), or screens, (using the power switch), at the front of the room.
- Tap the touch-screen monitor on the front desk to wake it. If it has been turned off, press the power switch on the lower right side.
- A list of upcoming lectures will appear on the monitor. Touch the item on the monitor to join the call.
- The controls on the monitor are the same as for a zoom call. However, the control bar disappears if the monitor has not been touched recently. If you do not see the zoom controls, try tapping the screen to make them visible.
- For most people joining the call, Speaker view is recommended. The lecturer may prefer Gallery view. These options can be selected from the touch-screen monitor as in a zoom call.

Shutting Down

- SUPA lecture calls end on the hour.
- To end a call before the hour, press Leave Meeting from the touch-screen monitor at the front of the room.
- Please switch off the projectors or screens at the front of the room. Please do not turn off the touch-screen monitor. As you leave, please turn off the room lights and make sure the door is locked.
- Assistance available during calls.

Booking the SUPA classrooms, the SUPA Timetable

The SUPA classrooms are primarily used to deliver SUPA courses. However, they are also used for research meetings, seminars, interviews and visitor lectures.

If you are planning a meeting or event and would like to use the SUPA classrooms, please consult the timetable, and contact SUPA: admin@supa.ac.uk The classrooms can also be used for local meetings such as research group meetings.

SUPA Classroom locations

Aberdeen — No classroom. Students should join calls from a personal device.

Dundee - Classroom is not currently connected. Students should join calls from a personal device and are welcome to meet in the classroom.
Ewing Building Basement
Door Code Required
Tel: +44 (0)138 238 4695

Edinburgh
James Clerk Maxwell Building Room 1301
Door Code Required
Seats 27 people
Contact: SOPA Helpdesk
Tel: +44 (0)131 650 5900
Email: sopa-helpdesk@ed.ac.uk

Glasgow
Kelvin Building Room 255a
Door Code Required
Seats 25 people
Contact: SUPA
Email: supacentral@glasgow.ac.uk

Heriot-Watt—Classroom is not currently connected. Students should join calls from a personal device and are welcome to meet in the classroom.
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
Door Code Required
Seats 32 people
Contact: Timothy Briggs, Leanore Ferrans, Jamie McLaugh
Physics-itsupport@strath.ac.uk, JA 8.28
Tel: +44 (0)141 548 3376

UWS—Classroom is not currently connected. Students should join calls from a personal device and are welcome to meet in the classroom.
Henry Building Room F.318
Door Code Required
Contact: Tom Caddell
Tel: +44 (0)141 848 3550
Email: tom.caddell@uws.ac.uk

Face to Face

Courses that are taught Face to Face, listed as F2F, are taught with participants together in one room. Students and lecturers attend in person. 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. A Face to Face course that spans a number of days in succession may 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 not enough time to travel on the day of the event. Consult the lecturer if you are uncertain about start and end times. There is a simple, online form to request travel funds. You must apply for travel funds and receive confirmation from SUPA before you travel.

The accommodation allowance is up to £80 per night. Any expenses over £80 must be justified in your claim form. When claiming reimbursement, follow the procedures for claiming expenses at your university. 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.

Acccess

If you have any difficulty accessing course materials, including lectures, or if lectures do not appear to be running as scheduled, please contact admin@supa.ac.uk.

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. When a course is full students will be added to a wait list.

Course Credit

The credit for each course is included in the course description.

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.

Individual and Extenuating Circumstances

Students may have unique, individual circumstances that affect their studies. For example, students with dyslexia may need additional time to complete exams. If you require any additional support in completing assessments, please contact the course lecturer who will follow guidelines established by the host university.

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 evidence of these unforeseen events as soon as possible. The Graduate School Committee will review cases individually.

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.

Professional Development courses may be provided by a University, Research Council, VITAE or other organisations. Students are encouraged to take these opportunities with their supervisor's agreement.

Getting Credit for Non-SUPA Courses

A student will need to submit information about the course in order for it to be added to their SUPA record. For both professional development and specialist courses, students should complete the non-SUPA course form. The information needed is slightly different for the professional development and specialist courses and this is indicated on the form.

For **Professional Development** courses, the student's full name, the course name, date of completion, course description, course provider and number of credits are needed on the form.

For **Specialist** courses, students must submit all the information requested for Professional Development courses **and** additional information. The additional information required depends on whether the course was marked or unmarked.

Marked courses: These include master's and bachelor's level modules. The ideal arrangement is that the course coordinator arrange an assessment for the student. Even if postgraduate students are not typically assessed, the course coordinator may have a method for assessing them and students should consult the course coordinator about this. Students are not expected to register on the course through the host university. Instead, the course coordinator should email the student's marks to admin@supa.ac.uk, making it clear whether the student passed. All non-SUPA courses and marks will be reviewed by the GSC. The GSC cannot organise assessment for non-SUPA courses.

Unmarked courses: SUPA recognises that National and International Summer schools are valuable learning experiences even though they typically do not include an assessment. In these cases, and in any non-SUPA specialist course that cannot arrange an assessment, students must write a reflection on the course. The reflection may be up to 4000 words and should be submitted through the non-SUPA course form linked above. The reflection should include a brief (<200 word) overview of the course content. Please then explore how the course content relates to the research questions you are trying to answer in your own work. If that is not possible, then please discuss the content you found most valuable. The written reflection became a requirement in September 2020. Courses taken before September 2020 do not require a written reflection.

The number of hours awarded for a course is based on the contact hours or the total length of the lectures, in hours. In all cases, for a single non-SUPA Specialist course, students can earn at most 20 hours of credit. Please note that this limit of 20 hours was put in place for students beginning in 2020/21. In previous years, the credit limit for a single non-SUPA course was 30 hours. Students who began their studies prior to 2020/21 will be allowed to claim up to 30 hours of credit for a single non-SUPA course.

Frequently Asked Questions

Is there a timetable for the SUPA courses?

The SUPA timetable can be found here.

How do I use the videoconferencing equipment?

Please see pages 4-5 of this handbook. If you have difficulties, please contact the local support listed on page 5 or contact SUPA.

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.

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?

Please contact the SUPA Office at admin@supa.ac.uk.

How can I contact my lecturer?

On the My.SUPA course page, in the 'Course Description' area, the lecturer's name will appear as a link that allows you to send them an email.

What if I am unable to attend a SUPA lecture?

If you enrol on a SUPA course, you are expected to attend the lectures at the time they are given. 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, page 8, you can find the names of all SUPA Graduate School Committee representatives. Please feel free to contact your local representative about SUPA.

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.

SUPA pays for transportation to the Annual Gathering from within Scotland. Attendees do not need to apply for this funding in advance. However, please check if group travel arrangements have been made for your university. For example, if a bus has been hired for people at your university to travel to the Annual Gathering, you should not plan to travel separately and be reimbursed. Extenuating circumstances will be considered.

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.

SUPA Contacts

SUPA

Graduate School Coordinator
Linda Hadfield
Email: coordinator@supa.ac.uk

SUPA Administration Team
227 Kelvin Building
University of Glasgow
GLASGOW
G12 8QQ
Email: admin@supa.ac.uk

SUPA Webmaster
Sean Farrell
Tel: +44 (0)131 451 3048
Email: sean.farrell@supa.ac.uk

SUPA Operations Manager
Linda Hadfield
Email: Linda.Hadfield@supa.ac.uk

Graduate School Committee

The SUPA Graduate School Committee (GSC) members help to manage SUPA activities and communication with students within their own university.

University of Aberdeen
Ekkehard Ullner
Email: e.ullner@abdn.ac.uk

University of Dundee
Andrei Pisliakov
Email: apisliakov@dundee.ac.uk

University of Edinburgh
Mark Williams
Email: m.williams@ed.ac.uk

University of Glasgow
Ilk Siong Heng
Email: Ik.Heng@glasgow.ac.uk

Heriot-Watt University
Mohammed F. Saleh
Email: M.Saleh@hw.ac.uk

University of St Andrews
Vivienne Wild
Email: vw8@st-andrews.ac.uk

University of Strathclyde
Gordon Robb
Email: g.r.m.robb@strath.ac.uk

University of the West of Scotland
John F. Smith
Email: john.f.smith@uws.ac.uk

EPSRC/STFC Centres for Doctoral Training

Applied Photonics
Director: Prof. Derryck Reid
Web: cdtphotonics.hw.ac.uk
Email: engd@hw.ac.uk
Tel: +44 (0)131 451 8245

Soft Matter and Functional Interfaces
Deputy Director: Prof. Wilson Poon
Web: www.dur.ac.uk/soft.matter/soficdt
Email: sofi.cdt@durham.ac.uk
Tel: +44 (0)191 3342133

The Scottish Data-Intensive Science Triangle
Director: Prof. Andy Lawrence
Web: www.scotdist.ac.uk
Email: al@roe.ac.uk
Tel: +44 (0)131 6688346

Course List

Course Name	Code	Host	Delivery Mode	Hours	Semes-ter	Page No
Astronomy and Space Sciences						
Advanced Data Analysis Astronomy	**AAA**	St Andrews	VC	27	1	12
Gravitational Wave Detection	**GWD**	Glasgow	VC	16	1	12
Astrophysical Plasmas	**APL**	Glasgow	VC	10	2	13
Astrobiology and the Search for Life	**ASL**	Various	VC	20	2	13
SUPA Observing Course	**OBS**	St Andrews	VC	15	2	13
Condensed Matter and Material Sciences						
Advanced Statistical Physics	**ASP**	Edinburgh	Zoom	22	1	14
Introduction to Computational Chemistry	**CCH**	St Andrews	VC	9	1	14
Quantum Field Theory	**QFT**	St Andrews	VC	30	1	15
Geometry and Physics of Soft Condensed Matter	**GPSM**	Edinburgh	VC	20	1	15
Modern Topics in Condensed Matter Physics	**TOP**	St Andrews	VC	35	1	15
Quantum Mechanics for Scientists and Engineers, Discussion	**QMSE**	Glasgow	Zoom	18	1	15
Chaikin & Lubensky's Principles of Condensed Matter	**CLP**	Edinburgh	VC	25	2	16
Electronic Structure Theory	**EST**	Edinburgh	VC	20	2	16
Electron Microscopy	**ELM**	St Andrews	VC	10	2	16
Non-Equilibrium Statistical Mechanics	**NSM**	Edinburgh	VC	12	2	17
Quantum Magnetism and Quantum Phase Transitions	**QMPT**	St Andrews	VC	18	2	17
Response Functions	**RFN**	St Andrews	VC	12	2	17
Soft Condensed Matter Physics	**SCM**	Edinburgh	VC	16	2	17
Energy						
Solar Power	**SPR**	St Andrews	F2F	14	2	18
Laser Driven Plasma Acceleration	**LDP**	Strathclyde	VC	16	2	18
Nuclear Physics						
Nuclear Instrumentation	**NIN**	Edinburgh	VC	6	2	19
Quarks and Hadron Spectroscopy	**QHS**	Glasgow	VC	8	2	19

Course List

Course Name	Code	Host	Delivery Mode	Hours	Semes-ter	Page No
Particle Physics						
Detectors	**DET**	GLA and EDI	VC	16	1	20
Advanced Statistical Physics	**ASP**	Edinburgh	Zoom	22	1	20
Relativistic Quantum Field Theory	**RQF**	Glasgow	F2F	20	1	20
Collider Physics	**COP**	GLA and EDI	VC and F2F	18	2	21
Flavour Physics	**FLA**	Glasgow	VC	16	2	21
Lattice QCD	**LAT**	Glasgow	VC	6	2	21
Quarks and Hadron Spectroscopy	**QHS**	Glasgow	VC	8	2	21
Photonics						
Nanophotonics	**NAN**	St Andrews	VC	27	1	22
Introduction to Practical Experimental Optics and Microscopy	**EOM**	Glasgow	F2F	15	1	22
Semi Quantum Theory of Atom Light Interactions	**STA**	Strathclyde	VC	24	2	23
Ultrafast Photonics	**UPH**	Heriot-Watt	DIST	10	2	23
Physics and Life Sciences						
Biophotonics	**BPH**	St Andrews	VC	27	1	24
Introducing Biology to Physicists	**IBP**	Dundee	VC	22	1	24
Introduction to Practical Experimental Optics and Microscopy	**EOM**	Glasgow	F2F	15	1	24
Astrobiology and the Search for Life	**ASL**	Edinburgh	VC	20	2	25
Biological Physics	**BPS**	Edinburgh	DIST	12	2	25
Physics Education Research						
Foundations	**PERF**	Various	ZOOM	11	2	26
Foundations Part II	**PERT**	Various	ZOOM	10	2	26
Plasma Physics						
Plasma Physics	**PPH**	Strathclyde	VC	12	1	27
Laser Driven Plasma Acceleration	**LDP**	Strathclyde	VC	16	2	27
Astrophysical Plasmas	**APL**	Glasgow	VC	10	2	27
Quantum Technologies						
Quantum Mechanics for Scientists and Engineers, Discussion	**QMSE**	Glasgow	Zoom	18	1	28
Theoretical Foundations of Quantum Technologies	**TFQ**	Strathclyde	VC	20	1	28
Quantum Devices	**QMD**	Heriot-Watt	VC	24	2	29
Physical Systems for Quantum Technologies	**PSQ**	Strathclyde	VC	20	2	29

Course List

Course Name	Code	Host	Delivery Mode	Hours	Semes-ter	Page No
Professional Development						
C+/- Object Orientated Programming	**COO**	Remote	VC	12	1	30
Maths Primer	**PRI**	Heriot-Watt	VC	6	1	31
FPGA Programming for Physicists	**FPP**	Strathclyde	VC	12	1	31
Introduction to Machine Learning	**IML**	Dundee	VC	30	1	31
Power Hour of Writing	**PHW**	TBD	VC	TBD	1	31
Software Carpentry	**SWC**	Glasgow	F2F	16	1	32
Introductory Data Analysis	**IDA**	West of Scotland	VC	6	2	32
ROOT	**ROO**	Glasgow	F2F	9	2	32
Mathematical Modelling	**MMD**	Aberdeen	VC	33	2	32
Advanced Data Analysis for the Physical Sciences	**ADA**	Glasgow	F2F	14	2	32
Industry Skills	**ISC**	SUPA	DIST	5	2	33
Introduction to Python	**PYT**	Glasgow	VC, F2F	8	2	33
Presenting Your Research	**PYR**	GLA and EDI	Hybrid	12	2	33

Astronomy and Space Sciences

Theme Leader: Aurora Sicilia Aguilar, University of Dundee

Photo: TNG (Telescopio Nazionale Galileo) Dome, La Palma, Canary Islands

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 (eg for students changing specialities).
- Summer Schools in Astronomy and Space Physics

Students should note that certain Astronomy courses only run biennially. Each student must consult their PhD supervisor to contract 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)

Status: Offered 2024/25

Lecturer: Juan Hernandez Santisteban

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 hypothesis about models of the physical world. Students develop their computer programming skills, build a data analysis toolkit, and gain practical experience by analysing real data sets. The two projects involve periodogram analysis of quasi-periodic oscillations in the HST light curve of an eclipsing dwarf nova, and a cross-correlation radial velocity analysis and mass estimation for a black hole binary, based on spectra from the Keck 10m telescope.

SUPAAAA

Gravitational Wave Detection (SUPAGWD)

Status: Offered in 2024/25

Lecturer: Mulitple; Course Organiser: To be confirmed

Institution: Glasgow

Delivery: Videoconference

Hours Equivalent Credit: 16

Assessment: Two sets of problem exercises plus Oral Examination

Course Work Students are expected to spend 100 hours on this course.

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.

SUPAGWD

Astronomy and Space Sciences

Semester 2

Astrophysical Plasmas (SUPAAPL)

Status: This is a biennial course. It is not offered in 2024/25 but is expected in 2025/26.

Lecturer: Lyndsay Fletcher

Institution: Glasgow

Delivery: Video Conference

Hours Equivalent Credit: 10

Assessment: Online Quiz, worked examples, short essay

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.

SUPAAPL

Astrobiology and the Search for Life (SUPAASL)

Status: Offered in 2024/25

Themes: This course is also listed in the Physics and Life Sciences theme

Lecturer: Charles Cockell, et al

Institution: Various

Delivery: Online

Hours Equivalent Credit: 20

Assessment: Exam

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).

SUPAASL

SUPA Observing Course (SUPAOBS)

Status: Offered in 2024/25

Lecturer: Aleks Scholz

Institution: St Andrews

Delivery: Online

Hours Equivalent Credit: 15

Assessment: Mock observing proposal as homework

Coursework: Students should expect to spend 20 hours on this course

Course Summary

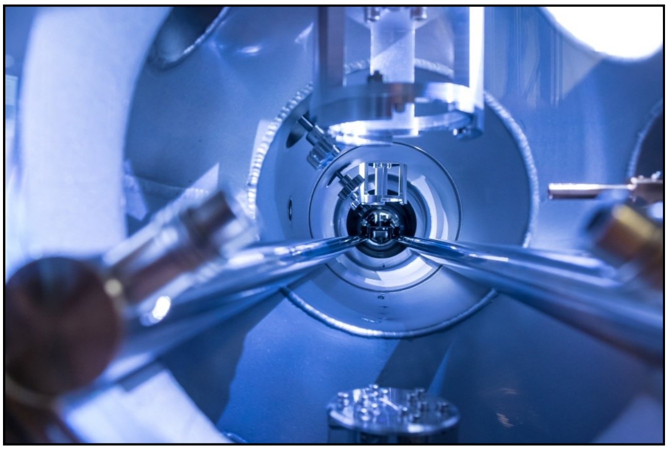
The course includes 5 lectures on the basics of professional observations, given by observatory director Dr. Aleks Scholz. This will be complemented by 5 lectures on specialised observing techniques, given by St Andrews staff members.

Students will be offered an exclusive tour of the James Gregory Telescope in St Andrews, on a voluntary basis. We will also have observing sessions using telescopes in St Andrews that students can join remotely.

SUPAOBS

Condensed Matter and Material Sciences

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



Centre for Designer Quantum Materials © Tricia Malley Ross Gillespie www.broaddaylightltd.co.uk

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 programme 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 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.

Semester 1

Advanced Statistical Physics (SUPAASP)

Status: Offered in 2024/25

Themes: This course is also listed in the Particle physics theme.

Lecturer: Davide Michieletto and Tyler Shendruk

Institution: Edinburgh

Delivery: Zoom

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 transitions, of 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 renormalization group (RG), in real space. Momentum space approaches will be briefly discussed. We will conclude with a study of stochastic dynamics and the approach to equilibrium and we will discuss nonequilibrium dynamics and nonequilibrium phase transitions.

SUPAASP

Introduction to Computational Chemistry (SUPACCH)

Status: Offered in 2024/25

Lecturer: Herbert Fruchtl

Institution: St Andrews / ScotCHEM

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 for molecular systems, solids and surfaces, as well as cheminformatics, will be introduced along with how they are used in practice by researchers in Scotland.

SUPACCH

Condensed Matter & Material Sciences

Quantum Field Theory (SUPAQFT)

Status: Offered in 2024/25

Lecturer: Jonathan Keeling and Bernd Braunecker

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.

SUPAQFT

Geometry and Physics of Soft Condensed Matter (SUPAGPSM)

Status: This is a biennial course which will run in 2024/25 but is not expected in 2025/26.

Lecturer: Davide Marenduzzo

Institution: Edinburgh

Delivery: Video Conference

Hours Equivalent Credit: 20

Assessment: Problem Sheets

CDT students from St Andrews are not assessed, others are assessed through problem sheets.

This is an advanced undergraduate course at the University of Edinburgh.

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

SUPAGPSM

Modern Topics in Condensed Matter Physics (SUPATOP)

Status: Offered in 2024/2025

Lecturer: Peter Wahl, Bernd Braunecker

Institution: St Andrews

Delivery: By video, with lecture recordings made available

Hours Equivalent Credit: 35

Assessment: Problem Sheets, Presentations, Computational Exercises

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

Course work Students are expected to spend 150 hours on this course over the term.

Course Summary

The aim of this module is to give an introduction to a variety of contemporary topics of condensed matter physics research. Topics covered in this module include topology, Fermi liquid theory, electronic properties of surfaces and low-dimensional solids, and many body problems in condensed matter physics. This course will cover the underlying principles and introductory theory of these 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 evolving field. The module consists of a series of 21 lectures covering these topics and includes practical computational examples to develop a numerical approach to solving physics problems and a journal club session where students present a research paper.

SUPATOP

Quantum Mechanics for Scientists and Engineers, Discussion (SUPAQMSE)

Status: Offered in 2024/25

Lecturer: Niclas Westerberg

Institution: Glasgow

Delivery: Zoom meetings, with recorded lectures

Hours Equivalent Credit: 18

Assessment: Weekly tutorials, where 1 question each week is selected as a marked hand-in exercise (marked at a pass/fail level).

Course work: Students will spend about 55 hours on this course, including lectures

Course Summary: In this course, we will study quantum mechanics at a level suitable as an introduction to the subject or as a refresher. The aim is to end the course with a working understanding of typical problems and techniques. The course will consist of two weekly sessions, supplemented by online lectures and material by David Miller and relevant books, where we go through important concepts and solve some exercises, respectively.

SUPAQMSE

Professional Development: Many students in the Condensed Matter Theme take the Maths Primer course, SUPAPRI, for professional development credits. The Maths Primer course is listed in the professional development section, page 30.

SUPAPRI

Condensed Matter & Material Sciences

Semester 2

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

Status: Not Yet Confirmed. This is a biennial course which may run in 2024/25 but is not expected in 2025/26.

Lecturer: Alexander Morozov

Institution: Edinburgh

Delivery: Video Conference

Hours Equivalent Credit: 25

Assessment: Continuous Assessment

Course Summary

This course will primarily involve a combination of directed reading and discussions 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.

SUPACLP

Electronic Structure Theory (SUPAEST)

Status: This is a biennial course that will not run in 2024/25 but is expected in 2025/26.

Lecturer: Elton Santos

Institution: Edinburgh

Delivery: Video Conference and Face to Face

Hours Equivalent Credit: 20

Assessment: Problem Sheets, Project

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 .

SUPAEST

Electron Microscopy (ELM)

Status: To be determined

Lecturer: Wuzong Zhou

Institution: St Andrews / ScotCHEM

Delivery: Video Conference

Hours Equivalent Credit: 10

Assessment: Exercises

Course Summary

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
- Selected area electron diffraction
- High resolution transmission electron microscopic imaging

SUPAELM

Condensed Matter & Material Sciences

Semester 2

Non-Equilibrium Statistical Mechanics (SUPANSM)

Status: This is a biennial course which will run in 2024/25 but is not expected in 2025/26.

Lecturer: Tyler Shendruk

Institution: Edinburgh

Delivery: Video Conference

Hours Equivalent Credit: 12

Assessment: Project

Course Work: In addition to lectures, students are expected to spend 10 hours doing individual course work.

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 half of the lectures cover core techniques and ideas in non-equilibrium statistical mechanics. The remaining lectures cover specialist and current topics of research. This course is assessed by means of peer-to-peer teaching, with each student presenting lectures on course content.

SUPANSM

Quantum Magnetism and Quantum Phase Transitions (SUPAQMPT)

Status: This is a biennial course. It is not offered in 2024/25, but is expected in 2025/26

Lecturer: Bernd Braunecker, Jonathan Keeling

Institution: St Andrews

Delivery: Video Conference

Hours Equivalent Credit: 18

Assessment: Continuous Assessment

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.

SUPAQMPT

Response Functions MBQ2 (SUPARFN)

Status: Not offered in 2024/25, may return in 2025/26

Lecturer: To be determined

Institution: St Andrews

Delivery: Video Conference

Hours Equivalent Credit: 13

Assessment: Two assessed problem sheets

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 Field Theory is a pre-requisite for this course

SUPARFN

Soft Condensed Matter Physics (SUPASCM)

Status: Offered in 2024/25

Lecturer: Patrik Pietzonka

Institution: Edinburgh

Delivery: Video Conference

Hours Equivalent Credit: 16

Assessment: Course work 50%, Exam 50%

Course Work: Students are expected to spend 72 hours on independent work for this course.

Course Summary Soft Condensed Matter Physics studies complex fluids in which intermediate level structures with length scale between small molecules and the macroscopic world exist: colloidal particles, polymers, and aggregates spontaneously formed by soap-like (surfactant) molecules. This course emphasises the generic features of these systems (most importantly, Brownian motion), and develops simple models to account for their behaviour. It will also look at how the principle of soft matter physics can give insight into biological problems.

SUPASCM

Energy

Theme Leader: Job Thijssen
University of Edinburgh, j.h.j.thijssen@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

No courses are currently offered in Semester 1

Semester 2

Solar Power (SUPASPR)

Status: This is a biennial course. It is not offered in 2024/25, but is expected in 2025/26. Typically, the course is scheduled in January.

Lecturer: Ifor Samuel et al

Institution: St Andrews

Delivery: Face to Face

Hours Equivalent Credit: 14

Assessment: Problem Sheets and reports on laboratory experiments

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. Unfortunately, SUPA cannot pay for students travel and accommodation costs for this course. Students should consult their supervisor about sources of funding.

SUPASPR

Laser Driven Plasma Acceleration (SUPALDP)

Status: Offered in 2024/25

Lecturer: Dino Jaroszynski, Paul McKenna, Zheng-Ming Sheng, Bernhard Ersfeld

Institution: Strathclyde

Delivery: Video Conference

Hours Equivalent Credit: 16

Assessment: Continuous Assessment

This is a final year undergraduate course. This course is cross listed with the Plasma physics theme

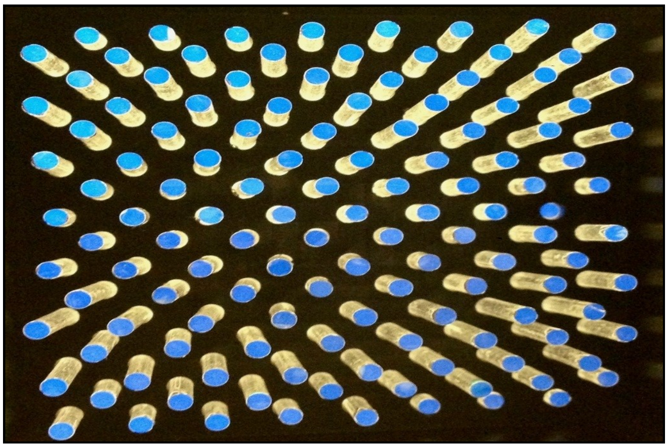
Course Summary

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.

SUPALDP

Nuclear Physics

Theme Leader: David O'Donnell, University of the West of Scotland



POM Matrix, Muon Imaging System, University of Glasgow/Lynkeos Technology

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

No courses are currently offered in Semester 1

Semester 2

Nuclear Instrumentation (SUPANIN)

Status: Offered in 2024/25

Lecturer: Tom Davinson

Institution: Edinburgh

Delivery: Video Conference

Hours Equivalent Credit: 6

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.

SUPANIN

Quarks and Hadron Spectroscopy (SUPAQHS)

Status: Offered in 2024/25

Lecturer: Oliver Jevons

Institution: Glasgow

Delivery: VC

Hours Equivalent Credit: 8

Assessment: Final exam, of approximately 2 hours

This course is cross listed with the Particle Physics theme.

Coursework: Approximately 1 hour per week in addition to lectures

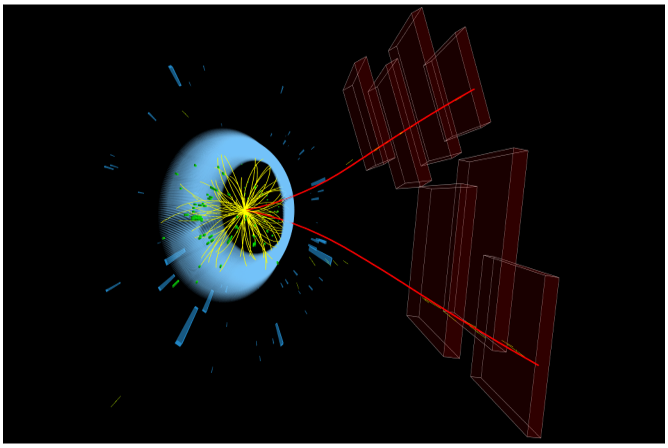
Course Summary

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.

SUPAQHS

Particle Physics

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



A candidate Bs meson decays into two muons, © CERN 2019

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. All experimental particle physics students should take all of the following core courses: Detector Physics, Collider Physics, Flavour Physics & Presenting Your Research, unless there is a good academic reason to make a different choice and in consultation with their supervisor.

Semester 1

Detectors (SUPADET)

Status: Offered in 2024/25

Lecturer: Kenneth Wraight, Dima Maneuski, Stephan Eisenhardt, Richard Bates, Andrew Blue

Institution: Glasgow and Edinburgh

Delivery: Video Conference

Hours Equivalent Credit: 16

11 lectures, 1x2hr lab & 1x3 hr 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.

SUPADET

Advanced Statistical Physics (SUPAASP)

Status: Offered in 2024/25

Themes: Also listed in Condensed Matter and Material Sciences

Lecturer: Davide Michieletto, Tyler Shendruk

Institution: Edinburgh

Delivery: Zoom

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. Momentum space approaches will be briefly discussed. We will conclude with a study of stochastic dynamics and the approach to equilibrium and we will discuss nonequilibrium dynamics and nonequilibrium phase transitions.

SUPAASP

Relativistic Quantum Field Theory (SUPARQF)

Status: Not Offered through SUPA in 2024/25

Lecturer: Sophie Renner

Institution: Glasgow

Delivery: Locally only

Hours Equivalent Credit: 20

Assessment: Open Book Exam

Local Master's 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).

This course is no longer shared through SUPA. Students who want to take this course can attend in person and apply for credit as they would for a non-SUPA course. See page 6 on applying for non-SUPA credit.

SUPA students may want to take courses at the Higgs Centre for Theoretical Physics. Please check their events calendar for seminars, short courses and summer schools. If interested, please apply for travel funding.

Particle Physics

Semester 2

Collider Physics (SUPACOP)

Status: Offered in 2024/25

Lecturer: Giuseppe Callea, Liza Mijovic

Institution: Glasgow and Edinburgh

Delivery: Video Conference and Face to Face

Hours Equivalent Credit: 18 (9 Lectures of 2 hours each)

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

Coursework: An assignment in 2 parts, requiring approximately 2 to 3 hours per week of individual work

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.

SUPACOP

Flavour Physics (SUPAFLA)

Status: To be confirmed

Lecturer: Mark Whitehead and Phillip Lichtfield

Institution: Glasgow

Delivery: Video Conference

Hours Equivalent Credit: 16

Assessment: Continuous Assessment

Coursework: 5 hours of work per week, or 50 hours total

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.

SUPAFLA

Lattice QCD (SUPALAT)

Status: To be confirmed

Lecturer: Brian Colquhoun

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.

SUPALAT

Quarks and Hadron Spectroscopy (SUPAQHS)

Status: Offered in 2024/25

Lecturer: Oliver Jevons

Institution: Glasgow

Delivery: VC

Hours Equivalent Credit: 8

Assessment: Final exam, of approximately 2 hours

This course is cross listed with the Nuclear & Plasma theme

Course work: Approximately 1 hour per week in addition to lectures

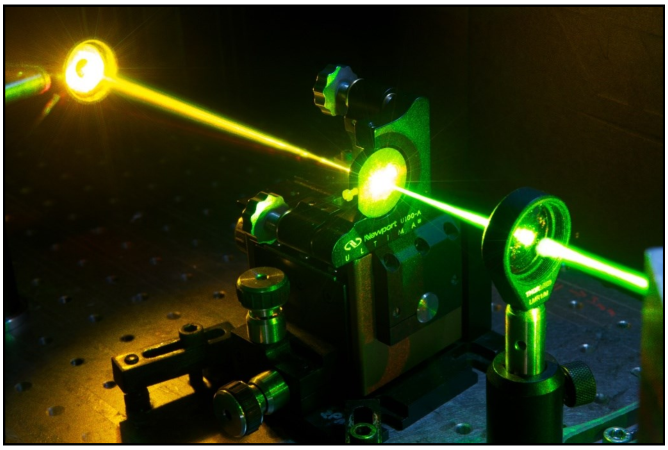
Course Summary

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.

SUPAQHS

Photonics

Theme Leader: Robert Thomson,
Heriot-Watt University, R.R.Thomson@hw.ac.uk



A diamond microlens Raman laser being pumped by a green laser. Image courtesy of Prof Alan Kemp, University of Strathclyde.

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

Nanophotonics (SUPANAN)

Status: Offered in 2024/25

Lecturer: Andrea Di Falco and William Whelan-Curtin

Institution: St Andrews

Delivery: Video Conference

Hours Equivalent Credit: 27

Assessment: Tutorials and Exam

Coursework: Students are expected to spend 30 hours on lecturers and tutorials and 120 hours on guided independent study.

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 cavities 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.

SUPANAN

Introduction to Practical Experimental Optics and Microscopy (SUPAEOM)

Status: Offered in 2024/25

Theme: Also listed in Physics and Life Sciences

Lecturer: Jonathan Taylor

Institution: Glasgow

Delivery: In person, practical lab

Hours Equivalent Credit: 15

Assessment: Continuous assessment via informal presentation

Course Summary
This course is aimed at students with a grounding in optical theory but seeking to expand their lab skills in optics and imaging. It covers:

-basic design, construction and precision alignment of experiments from kit optical components (e.g. Thorlabs components)

-understanding of microscope objective lenses and their properties for optical experiments

- hands-on use of a variety of microscope and camera systems

- understanding of camera properties such as read noise, and selection of optimal camera technology

- designing and constructing with laser safety in mind

SUPAEOM

Professional Development: Many students in the Photonics Theme take the Maths Primer course, SUPAPRI, for professional development credits. The Maths Primer course is listed in the professional development section, page 31.

SUPAPRI

Photonics

Semester 2

Semi-quantum Theory of Atom Light Interactions (SUPASTA)

Status: Not offered in 2024/25. May return in 2025/26

Lecturer: Gian-Luca Oppo

Institution: Strathclyde

Delivery: Video Conference

Hours Equivalent Credit: 24

Assessment: Essay (60%) and Presentation (40%)
Coursework: Attendance during the first 6 weeks of SUPASTA is compulsory for SUPA students. The assessment is an essay on recent research topics closely connected to the course material.

The remaining 4 weeks are available to the SUPA students but are NOT compulsory. The final 4 weeks cover material that can expand the choice of the essay topics if desired by the SUPA students.

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.

SUPASTA

Ultrafast Photonics (SUPAUPH)

Status: Offered in 2024/25

Registration deadline 5 January 2024

Lecturer: Derryck Reid

Institution: Heriot-Watt

Delivery: Distance Learning

Hours Equivalent Credit: 10

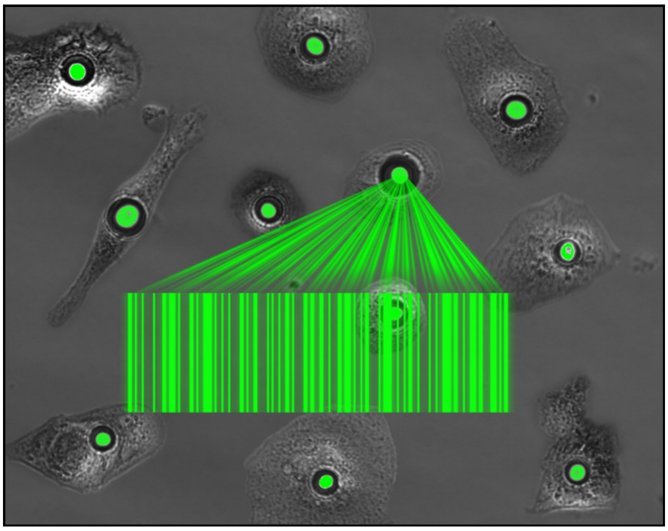
Assessment: Online Assessment

Course Summary
This is a short distance learning course operated by Heriot-Watt University via their Canvas 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 Canvas system, which means they must first apply for an account. Details for doing this appear on the UPH my.SUPA page. SUPA students must first register on my.SUPA by Friday 5 January, 2024, after which they will receive Canvas log-in details. Registration will be closed after this deadline.

SUPAUPH

Physics & Life Sciences

Theme Leader: Stuart Reid
University of Strathclyde



Barcode-type tag of a cell for non-contact tracking of cells. Malte Gather and Marcel Schubert, University of St Andrews.

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.

Semester 1

Biophotonics (SUPABPH)

Status: Offered in 2024/2025

Lecturer: Carlos Penedo-Esteiro

Institution: St Andrews

Delivery: Video Conference

Hours Equivalent Credit: 27

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

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

Coursework Students are expected to spend 27 hours on lectures and 115 hours on independent work.

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, optogenetics and methods to measure forces in biology.

SUPABPH

Introducing Biology to Physicists (SUPAIBP)

Status: Offered in 2024/25

Lecturer: Andrei Pisliakov

Institution: Dundee

Delivery: Video Conference, Recorded lectures with interactive tutorials

Hours Equivalent Credit: 22

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

Assessment: Mainly, an essay at the end of term with short quizzes during the term

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.

SUPAIBP

Introduction to Practical Experimental Optics and Microscopy (SUPAEOM)

Status: Offered in 2024/25

Lecturer: Jonathan Taylor

Institution: Glasgow

Delivery: In person, practical lab

Hours Equivalent Credit: 15

Assessment: Continuous assessment via informal presentation

Course Summary
This course is aimed at students with a grounding in optical theory but seeking to expand their lab skills in optics and imaging. It covers:

-basic design, construction and precision alignment of experiments from kit optical components (e.g. Thorlabs components)

-understanding of microscope objective lenses and their properties for optical experiments

- hands-on use of a variety of microscope and camera systems

- understanding of camera properties such as read noise, and selection of optimal camera technology

- designing and constructing with laser safety in mind

SUPA EOM

Physics & Life Sciences

Semester 2

Astrobiology and the Search for Life (SUPAASL)

Status: Offered in 2024/25

Lecturer: Charles Cockell, et al

Institution: Various

Delivery: Online

Hours Equivalent Credit: 20

Assessment: Exam

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).

SUPAASL

Biological Physics (SUPABPS)

Status: Offered in 2024/25

Lecturer: Chris Brackley and Gavin Melaugh

Institution: Edinburgh

Delivery: Distance Learning

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.

Coursework: Students will spend 10—20 hours on self-directed coursework. If students choose a subject that they are already very familiar with, they may need less time to complete the report. Students write a report based around any biological physics journal article they choose. That will involve a literature search and background reading, so how long it takes depends on how familiar students already are with the topic. Students are free to do something relevant to their PhD project.

Course Summary

Physics can provide a very real - and very valuable - insight into the behaviour of complex biological systems and 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.

SUPABPS

Professional Development: Many students in the Physics and Life Sciences theme take the Mathematical Modelling course, SUPAMMD, for professional development credits. The Mathematical Modelling course is listed in the professional development section, page 31.

SUPAMMD

Physics Education Research

Theme Leaders:

Nicolas Labrosse, University of Glasgow

Anna Wood, University of Edinburgh

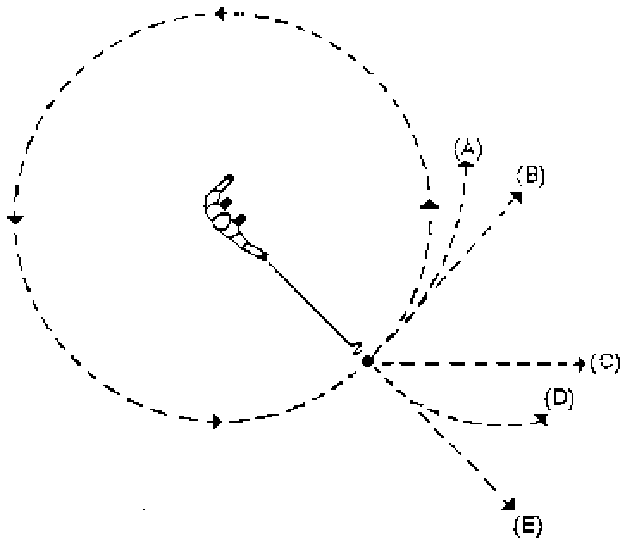


Image from the Force Concept Inventory, Arizona State University

Foundations Part II (SUPAPERT)

Status: This course is biennial. It is offered in 2024/25, but is not expected in 2025/26.

Lecturer: Hadfield, Galloway, Sneddon, Vaughn

Institution: Various

Delivery: Live Zoom discussions

Hours Equivalent Credit: 10

Assessment: Weekly written summaries and an annotated bibliography for the end of term

Course Summary This course is more focused than Foundations, however students in all themes are welcome and there are no prerequisites. Students will have the opportunity to choose papers that interest them and lead the discussion.

Semester 1

No courses are currently offered in Semester 1

Semester 2

Foundations (SUPAPERF)

Status: This course is biennial. It is not offered in 2024/25 but is expected in 2025/26

Lecturer: Hadfield, Galloway, Sneddon, Vaughn

Institution: Various

Delivery: Live Zoom discussions

Hours Equivalent Credit: 10

Assessment: Weekly written summaries and an annotated bibliography for the end of term

Course Summary: This course is for SUPA students who are interested in physics education research. Students in all themes are welcome. This course helps students become familiar with a broad range of Physics Education Research topics. Students read and discuss a new paper each week. Students will write a short summary or reflection on the paper each week for assessment. Class time will be spent discussing the content of the reading. Readings will include research papers and texts.

Plasma Physics

Theme Leader: Declan Diver, University of Glasgow

Image: SUPA Annual Gathering

Semester 1

Plasma Physics (SUPAPPH)

Status: Offered in 2024/25

Lecturer: K. Ronald, B. Eliasson, D. 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.

SUPAPPH

Semester 2

Laser Driven Plasma Acceleration (SUPALDP)

Status: Offered in 2024/25

Lecturer: Dino Jaroszynski, Paul McKenna, Zheng-Ming Sheng and Bernhard Ersfeld

Institution: Strathclyde

Delivery: Video Conference

Hours Equivalent Credit: 16

Assessment: Continuous Assessment

This is a final year undergraduate course. 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.

SUPALDP

Astrophysical Plasmas (SUPAAPL)

Status: This is a biennial course. It is not offered in 2024/25 but is expected in 2025/26.

Lecturer: Lyndsay Fletcher

Institution: Glasgow

Delivery: Video Conference

Hours Equivalent Credit: 10

Assessment: Online Quiz, worked examples, short essay

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.

SUPAAPL

Quantum Technologies

Theme Leaders:

Sonja Franke-Arnold, University of Glasgow

John Jeffers, University of Strathclyde

Image: SUPA Annual Gathering

Semester 1

Quantum Mechanics for Scientists and Engineers, Discussion (SUPAQMSE)

Status: Offered in 2024/25

Lecturer: Niclas Westerberg

Institution: Glasgow

Delivery: Zoom meetings, with recorded lectures

Hours Equivalent Credit: 18

Assessment: Weekly tutorials, where 1 question each week is selected as a marked hand-in exercise (marked at a pass/fail level).

Course work: Students will spend about 55 hours on this course, including lectures

Course Summary: In this course, we will study quantum mechanics at a level suitable as an introduction to the subject or as a refresher. The aim is to end the course with a working understanding of typical problems and techniques. The course will consist of two weekly sessions, supplemented by online lectures and material by David Miller and relevant books, where we go through important concepts and solve some exercises, respectively.

SUPAQMSE

Theoretical Foundations of Quantum Technologies (SUPATFQ)

Status: Offered in 2024/25

Lecturers: Jonathon Pritchard, (Heriot Watt), Sarah Croke (Glasgow), Ross Donaldson (Heriot-Watt), and John Jeffers (Strathclyde)

Institution: Strathclyde, Heriot Watt and Glasgow

Delivery: Video Conference

Hours Equivalent Credit: 20, 10 lectures of 2 hours each

Assessment: Problem sets and Essay

Course work: Students will spend about 50 hours total on this course, including lectures and assignments

Course Summary

This course will provide the background theory relevant to Quantum Technologies.

Part I (3 lectures, Jonathan Pritchard) – Basic Atomic Physics: Historical introduction to atomic physics, Angular momentum; Atomic structure; Atom-light interactions.

Part II (3 lectures, John Jeffers) – Basic Photonic Quantum Optics: Field quantisation, single-mode fields and quantum states; beam splitters and interferometers; non-classical light and its generation.

Part III (3 lectures, Sarah Croke) – Applications of Quantum Information: Quantum key distribution, Quantum sensing; Qubits, classical and quantum gates; introduction to quantum algorithms.

(This course was formerly called Quantum Technology - Theoretical Techniques.)

SUPATFQ

Quantum Technologies

Semester 2

Quantum Devices (SUPAQMD)

Status: Offered in 2024/25

Lecturer: Margherita Mazzera, Cristian Bonato

Institution: Heriot-Watt

Delivery: Video Conference

Hours Equivalent Credit: 24

Assessment: Problem Sheets (60%) and Final Oral Discussion (40%)

Course Work: Approximately 7 hours per week outside of class

Course Summary

This course introduces the techniques and approaches used to understand the physics of nanoscale materials and devices.
(1) Introduction to nanophysics, qubits and the density matrix formalism.
(2) Nanofabrication: Overview of the most common nanofabrication techniques and Nanostructure characterisation.
(3) Quantisation by confinement, effect of confinement on transport properties of solids, Effect of confinement on excitons, screening and energy renormalization.
(4) Spins in quantum mechanics, spin polarisation and readout, Nuclear spin baths , Applications to quantum sensing and quantum computing.
(5) Intro to superconductivity, macroscopic quantum model, London equation, Meissner effect, Josephson junctions, kinetic inductance.
Devices: kinetic inductance detectors, SQUIDs, SSPDs, superconducting qubits

SUPAQMD

Physical Systems for Quantum Technologies (SUPAPSQ)

Status: Offered in 2024/25

Lecturers: Paul Griffin, Sam Bayliss, Alessandro Fedrizzi, Martin Weides

Institution: Strathclyde / Glasgow / Heriot-Watt

Delivery: In-person / Video Conference

Hours Equivalent Credit: 20, 10 lectures of 2 hours each

Assessment: Problem sets and Essay

Course work: Students will spend about 50 hours total on this course, including lectures and assignments

Course Summary: This course will provide an introduction to physical systems and experimental techniques relevant to Quantum Technologies.

Part I (3 lectures, Paul Griffin) – Atoms: Laser cooling and atomic clocks; Atoms in optical lattices; Rydberg atoms in tweezers for quantum computation;

Part II (2 lectures, Sam Bayliss) Spin Qubits: Spin-light interfaces; Physical systems; Initialisation, readout and control of spin qubits; Applications to quantum sensing and quantum networks;

Part III (2 lectures, Alessandro Fedrizzi) – Photonics;

Part IV (2 lectures, Martin Weides) – Superconducting Qubits: Quantum circuits, materials and interfacing concepts.

SUPAPSQ

Professional Development

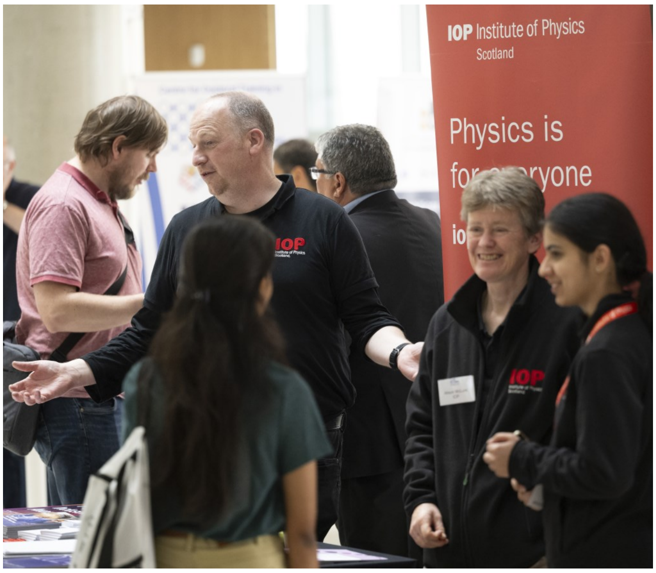


Image: The Institute of Physics at the SUPA Annual Gathering

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 in this section. In addition, 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 times for Professional Development Training are often different from Specialist Courses. Information about enrolment 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, please email admin@supa.ac.uk.

Courses run by Vitae and individual universities can be found at the following websites:

Vitae: https://www.vitae.ac.uk/doing-research

University of Aberdeen: https://www.abdn.ac.uk/pgrs

University of Dundee: https://www.dundee.ac.uk/opd

University of Edinburgh:
https://www.ed.ac.uk/institute-academic-development

University of Glasgow:
https://www.gla.ac.uk/myglasgow/ris/researcherdevelopment/

Heriot-Watt University:
https://www.hw.ac.uk/services/research-futures.htm

University of St Andrews:
https://www.st-andrews.ac.uk/ceed/

University of Strathclyde:
https://www.strath.ac.uk/theresearcherdevelopmentprogramme/

University of the West of Scotland:
https://www.uws.ac.uk/about-uws/academic-life/uws-academy

Semester 1

C++/Object Oriented Programming (SUPACOO)

Status: Offered in 2024/25

Lecturer: Jonathan Jamieson

Institution: Glasgow

Delivery: Remote Video Conference

Hours Equivalent Credit: 12 (4 x 1 hour Lectures and 4 x 2 hour Tutorials)

Assessment: Continuous Assessment

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 lectures. Each lecture is paired with a computer lab. The course will be entirely remote so everyone is encouraged to use their own laptop with Linux or Mac OS to work directly in the day to day work environment. It's possible also to install a virtual machine/ Linux emulator on windows systems. If a personal/university computer with a C++ compiler installed is not available, there may be alternatives in the computer lab.

The topics covered are the basic C++ that you need to get going in your research. 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.

SUPACOO

Professional Development

Semester 1

Maths Primer (SUPAPRI)

Status: Offered in 2024/2025

Lecturer: Patrik Öhberg

Institution: Heriot-Watt

Delivery: Video Conference, Lectures are pre-recorded and class time is used for questions and discussion.

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.

SUPAPRI

FPGA Programming for Physicists (SUPAFPP)

Status: Offered in 2024/25

Lecturer: Johannes Hernsdorf

Institution: Strathclyde

Delivery: Video Conference

Hours Equivalent Credit: 12

Assessment: Continuous Assessment

Course Work: Students are expected to spend 2.5 hours per week on this course, in addition to lectures

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.

SUPAFPP

Introduction to Machine Learning (SUPAIML)

Status: To Be Determined

Lecturer: To Be Determined

Institution: Dundee

Delivery: Video Conference

Hours Equivalent Credit: 30 (10 x 3 hour labs)

Assessment: Continuous Assessment

Coursework:

Course Summary

In this module, you will learn basics of the theories behind modern machine learning techniques. During ten three-hour labs, you be asked to implement several key machine learning techniques and apply them to real-world problems, such as predicting house prices, recognition of handwriting, etc. This module can serve as a basis for preparing for a career in modern machine learning – a rapidly growing field of academic and industrial applications.
The module will cover:

Basics of probability theory and statistics used in machine learning.
- Linear regression
- Logistic regression
- Naïve Bayes models
- Support vector machines
- Deep neural networks
- Hopfield model

SUPAIML

Power Hour of Writing (SUPAPHW)

Status: To Be Determined

Lecturer: To Be Determined

Institution: To Be Determined

Delivery: Video Conference

Hours Equivalent Credit:

Assessment: Continuous

Course Summary

Students must have a writing project to work on and will spend most of the time working on their own writing.

A Power Hour of Writing (PHOW) is a short period of protected time which allows participants to focus on a project of their choice, strengthened by accountability and supported but a community of peers. Once a month we combine these Power Hours to create a day of focused work and community time.

This writing day is all about working at your pace and whatever tasks you need to focus on. No need to count words. You can structure the focus time to suit your style. The breaks are available for chatting and sharing, and provide an opportunity to meet other researchers, but you can also use them to recharge.

SUPAPHW

Professional Development

Semester 1

Software Carpentry (SUPASWC)

Status: Offered in 2024/25

Lecturer: Daniel Williams with 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. The course is practical, in the sense of describing how to work with specific tools, but we also make a point of discussing these in a wider context of good (reproducible!) scientific practice.

SUPASWC

Semester 2

Introductory Data Analysis (SUPAIDA)

Status: Offered in 2024/25

Lecturer: David O'Donnell

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 distributions and their properties; calculation and estimation of uncertainty; least squares model; applications of data analysis.

SUPAIDA

ROOT (SUPAROO)

Status: Offered in 2024/25

Lecturer: Marcos Miralles Lopez

Institution: Glasgow

Delivery: Face to Face

Hours Equivalent Credit: 9 (2 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.

SUPAROO

Semester 2

Mathematical Modelling (SUPAMMD)

Status: Offered in 2024/25

Lecturer: Marco Thiel

Institution: Aberdeen

Delivery: Video Conference

Hours Equivalent Credit: 33

Assessment: Informal assessment; This is a final year undergraduate course organised by the University of Aberdeen. While students at Aberdeen are assessed, those taking the course through SUPA will not be formally assessed but will receive feedback on their work.

Coursework: Over the term, students are expected to spend about 100 hours on coursework outside of lectures.

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.

SUPAMMD

Advanced Data Analysis for the Physical Sciences (SUPAADA)

Status: Offered in 2024/25

Lecturer: Ik Siong Heng

Institution: Glasgow

Delivery: Face to Face if possible, otherwise videoconferencing

Hours Equivalent Credit: 14

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 those models, 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.

SUPAADA

Professional Development

Semester 2

Industry Skills (SUPAISC)

Status: Offered 2024/25

Lecturer: Recorded Interviews and external speakers

Institution: SUPA

Delivery: DIST

Hours Equivalent Credit: 5

Assessment: Written summaries

Course Summary

This course gives students an opportunity to hear from professionals in a variety of roles, who have built their career on a PhD in physics. In recorded interviews, individuals describe their career path and their current work. Students choose 5 interviews from those available, listen to the interview and answer reflective questions about the interview. This flexible format can be completed at any time during the term.

The interviews are publicly available at The Way We Work, on the supa webpage. Students may want to investigate the interviews before registering on the course.

In addition to the recorded interviews, students may choose to attend a Careers Online at Lunchtime session and write reflections on these speakers instead.

SUPAISC

Introduction to Python (SUPAPYT)

Status: Offered in 2024/25

Lecturer: Albert Borbely

Institution: Glasgow

Delivery: Video Conference and Face to Face

Hours Equivalent Credit: 8 (One tutorial of 2 hours, and 2 of 3 hours)

Assessment: Assignment Problem

Course Summary

This is an introductory Python programming course where students are shown how to solve a wide range of problems. After completion students will be able to solve problems both using strictly native Python modules as well as make use of the extensive library of external Python modules.

This course is taught through practical lab sessions, primarily in person but also through zoom. Recorded lectures and slides are made available.

SUPAPYT

Presenting Your Research (SUPAPYR)

Status: Offered in 2024/25

Lecturer: Cheryl Patrik

Institution: Glasgow and Edinburgh

Delivery: Video Conference

Hours Equivalent Credit: 12

Assessment: Presentation

Course Summary

This highly-interactive course explores how to present your research effectively to achieve the results you want. We will investigate some communication techniques, and discuss how to tailor your presentations to suit your audience. We will also try a selection of design tools, and discuss how visual materials can aid or hinder your ability to communicate. Finally, all students will get an opportunity to present about their own research, or another topic of their choice. Participants will receive staff and peer feedback in a supportive, non-judgmental environment.

SUPAPYR

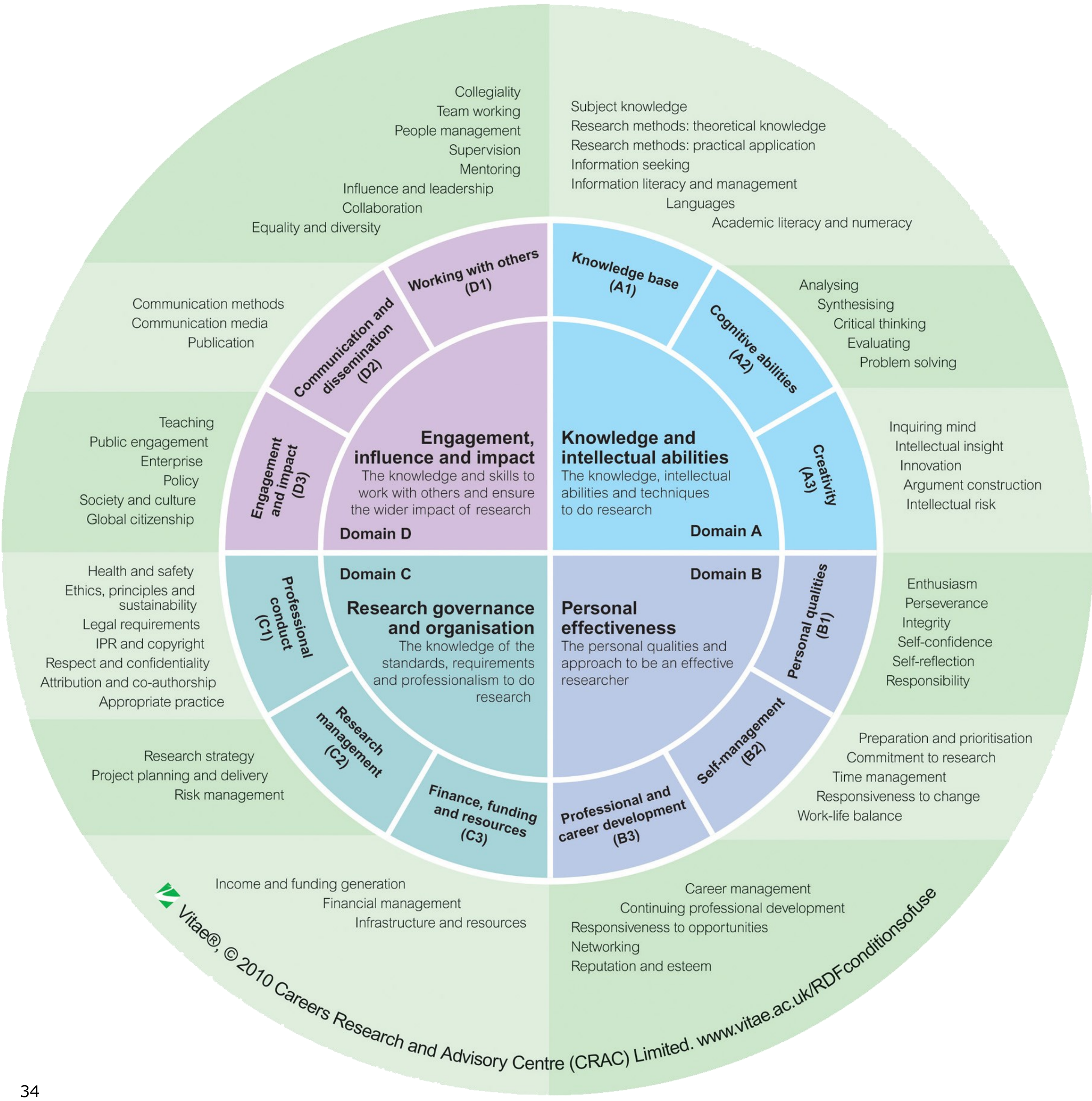
Researcher Development Framework

The Researcher Development Framework

The Researcher Development Framework describes the knowledge, behaviours and attributes of successful researchers and encourages you to aspire to excellence through achieving higher levels of development. It is invaluable for planning, promoting and supporting your personal, professional and career development. Further information can be found online at: www.vitae.ac.uk/rdf

You can use the RDF to identify strengths and prioritise your professional development, considering the skills and experiences that will enhance your career prospects. It will also support you to articulate your knowledge, behaviors and attributes to employers.

As you start your doctorate, consider looking at the 'Getting Started' lens of the RDF, which will help you consider the right questions to identify the training you should consider for the best possible start. The lens can be found at https://www.supa.ac.uk/courses.



Plagiarism

Plagiarism

Whilst undertaking SUPA courses with assessment, you will be required to abide by your university's rules on plagiarism. Those found to have committed plagiarism will be subject to the disciplinary procedures of their home university (not that of the lecturer, if different). More information can be found at your institutions website.