Information Session on Physics Honours at the University of Sydney

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Honours Coordinator for the School of Physics
physics.honours@sydney.edu.au

Monday, 12th September 2022

Today’s zoom will run for ≈ an hour. Please enter questions in the Q&A tab.

1. Welcome / Introduction (HC)
2. General introduction to honours (HC)
3. Introduction to individual lecture courses (HC & lecturers)
4. Introduction to research projects (HC)
5. Administrative and other details (HC)
6. General discussion / Q&A (all)
Welcome to the School of Physics!

This is a resource for those thinking of study beyond bachelor’s level.

The assumption is that you are close to completing a bachelor’s, with a major in physics.

We do *not* assume that you’re already studying here — we regularly take students from an undergraduate background at other institutions.

Physics is not for everyone, but physics is special — that part of the natural sciences where the objects of study are big enough, small enough, or simple enough to yield to a mix of experimental tests, mathematical analysis, fundamental inquiry, and physical intuition.

Physics has open borders with maths and engineering, but also with chemistry, geology, biology, philosophy, IT, environmental science . . . not to mention astronomy, to which physics is joined at the hip (in the US this would be called a department of “Physics and Astronomy”)

in Sydney, the “next step” beyond undergraduate physics is **honours**
General introduction to honours

honours is a fourth year of undergraduate work that is fully devoted to a single subject — physics, in this case

students take an honours year for a variety of reasons:
  - to extend and “round out” their studies in their favourite subject
  - as the (∼ necessary) next step towards higher academic study
  - to “try [physics] on for size” as a discipline
  - as training and/or enrichment for “unrelated” work

the mix in honours varies between fields; in physics, it’s
  - 50% coursework: four advanced-level courses (6CP Units of Study)
  - 50% research: a single, large research project taken over 8–9 months

honours is probably quite unlike the work you have done up to now:
  - you are dedicated to a single area of study
  - the work is academically more demanding
  - you will be apprenticed to a research group all year
  - tasks with qualitatively different time demands must be balanced
  - you will likely have a relatively close cohort
there are various formal application paths:  ₵️ see details later

Sydney Student —> "Course details" —> "Apply for Advanced Studies honours"

deadlines: 15th January (for 2023 S1) or 25th June (for 2023 S2)

the key requirements are:

- a bachelor of science, including “equivalent degrees” and variants:
  the BLAS, the BMedSc, double degrees, parenthetic degrees . . .

- a major in physics:
  a major in nanoscience, or UTS’ Applied Physics also count

- a credit average overall, and in senior physics  ₵️ see details later

- an academic willing to supervise you on a research project;
  they must agree by formal email, cc:physics.honours@sydney.edu.au

the 15-Jan-2023 date is very late relative to the start of semester;
I’d encourage you to apply by the old-style due date, 30-Nov-2022

it’s normal to apply while you’re still finishing 3rd-year coursework . . .
(2) General introduction: coursework

- coursework is worth 50% of your honours mark
- you take 4 courses during the year, all 6CP as usual
- the normal pattern is to take 2 in each semester; other patterns are possible, *but much more difficult*
- 2–4 must be chosen from the dedicated honours courses PHYS412X:
  - each 30–36 lectures in size
  - the mix of assignments, projects, and exams varies
  - the usual 5%-per-day late penalties apply
  - you choose courses by enrolling each semester on Sydney Student
  - exams are mostly in weeks 15 & 16 ("exam weeks 1 & 2") as usual
- up to two other physics 4000- and 5000-level courses can be chosen . . .
- . . . *and*, if you wish, you can choose one of a select group of "external" courses from outside of physics, at 4000- and 5000-level

- **consultation** with your research supervisor is strongly encouraged; I am also available for consultation, and you should take other advice
- a picture tells a thousand words:
PHYSICS HONOURS COURSES: choose 2–4
PHYS4121 Advanced Electrodynamics and Photonics
PHYS4122 Astrophysics and Space Science
PHYS4125 Quantum Field Theory
PHYS4123 General Relativity and Cosmology
PHYS4124 Physics of the Standard Model
PHYS4126 Quantum Nanoscience

PHYSICS 4XXX & 50XX COURSES: choose 0–2
PHYS4015 Neural Dynamics and Computation
PHYS4016 Bayesian Data Inference and Machine Learning
PHYS4036, PHYS4037, PHYS4801, PHYS4802
PHYS50XX Medical Physics master’s courses
PHYS503X Sustainability master’s courses

OTHER COURSES: choose 0–1
MATH4XXX, STAT4XXX
PHYSICS HONOURS COURSES: choose 2–4
MATH5XXX, STAT5XXX
HPSC4101
SCIE400X
COMP5046, 5310, 5318
COMP5328, 5329, 9120
DATA5441
AERO4701
AMME8520
AMME9302
BMET5931
BMET9981
CHNG5602
ELEC5213
ELEC5511
ELEC9405
ELEC5516
ELEC9405
SEMESTER 1:

- **PHYS4121** Advanced Electrodynamics and Photonics (Zdenka Kuncic +)
- **PHYS4122** Astrophysics and Space Science (Jesse Van De Sande +)
- **PHYS4125** Quantum Field Theory (Archil Kobakhidze)

SEMESTER 2:

- **PHYS4123** General Relativity and Cosmology (Geraint Lewis)
- **PHYS4124** Physics of the Standard Model (Kevin Varvell)
- **PHYS4126** Quantum Nanoscience (John Bartholomew +)

+ : These are multi-lecturer courses; the staff member who will speak to the course today is shown.

Matching courses **PHYS512X** are available at HDR level . . .
(3) Introduction to lecture courses: other physics

- PHYS4036 Particle and Condensed Matter Physics
- PHYS5002 Anatomy and Biol Essentials for Physicists
- PHYS5011 Nuclear Physics and Magnetic Resonance Imaging
- PHYS5012 Radiation Physics and Dosimetry
- PHYS5029 Computation and Image Processing
- PHYS4801 Industrial Ecology
- PHYS5031 Ecological Econ and Sustainable Analysis

- PHYS4037 Astrophysics and Plasma Physics
- PHYS4015 Neural Dynamics and Computation (interdisciplinary)
- PHYS4016 Bayesian Data Inference and Machine Learning
- PHYS5005 Radiotherapy Physics
- PHYS5006 Medical Imaging Physics
- PHYS5018 Health Physics and Radiation Protection
- PHYS5020 Computation and Image Processing
- PHYS4802 Quantitative Disaster Analysis
- PHYS5034 Life Cycle Analysis

senior options / medical physics / sustainability \(\Rightarrow\) PHYS5032 & 5033 either semester
(3) Introduction to lecture courses: external

Reminder: at most one such course can be taken.

Faculty-of-Science-hosted courses:

- **SCIE4001** Science Communication [S1]
- **SCIE4002** Experimental Design and Data Analysis [Intensive March]
- **SCIE4003** Ethics in Science [Intensive March & August]

An HPS unit:

- **HPSC4101** Philosophy of Science [S1]

Units offered at 4000- and 5000-level by Mathematics and Statistics:

  - *e.g.* **MATH4314** Representation Theory [S1]
  - *e.g.* **MATH4077** Lagrangian and Hamiltonian Dynamics [S2]
  - *e.g.* **STAT4022** Linear and Mixed Models [S1]
  - *e.g.* **STAT4027** Advanced Statistical Modelling [S2]
  - *e.g.* **MATH5431** Mathematical Models for Natural Phenomena Alt [S2]
  - *e.g.* **STAT5610** Advanced Inference [S2]
(3) Introduction to lecture courses: external

IT and Engineering units:

- COMP5046 Natural Language Processing [S1]
- COMP5310 Principles of Data Science [S1/S2]
- COMP5318 Machine Learning and Data Mining [S1/S2]
- COMP5328 Advanced Machine Learning [S2]
- COMP5329 Deep Learning [S1]
- COMP9120 Database Management Systems [S1/S2]
- DATA5441 Networks and High-dimensional Inference [S2]
- AERO4701 Space Engineering 3 [S1]
- AMME8520 Advanced Control and Optimisation [S1]
- AMME9302 Materials 1 [S2]
- BMET5931 Nanomaterials in Medicine [S1]
- BMET9981 Applied Biomedical Engineering [S2]
- CHNG5602 Cellular Biophysics [S2]
- ELEC5213 Engineering Optimisation [S1]
- ELEC5511 Optical Communication Systems [S1]
- ELEC5516 Electrical and Optical Sensor Design [S1]
- ELEC9405 Communications Electronics and Photonics [S2]
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PHYS4121 Advanced Electrodynamics and Photonics
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PHYS50XX Medical Physics master’s courses
PHYS503X Sustainability master’s courses
Introduction to research projects

- The research project is likewise worth 50% of your honours mark.

- You are apprenticed to a research group, in particular to your supervisor(s):
  - to participate in the life of the group,
  - to learn (by doing) the methods of their work,
  - to learn (by instruction and osmosis) about the subject area,
  - and to carry out research work of your own.

- Our list of research projects for 2023 is posted on the web:
  - You should discuss projects that interest you directly with the staff member listed as contact.
  - These projects are an indicative sample: treat them as a guide.
  - It may be possible to negotiate a project that is not on the list.

- We recommend project work start three weeks before the start of lectures.

- Assessment is via a formal talk (10%) due by S2 week 9, and a 40pp written report (90%) due by S2 week 12, assessed by your group (who also consider your work), and ≥2 external examiners.

- Enrolment is in PHYS\{4103,4104\} (S1) and PHYS\{4105,4106\} (S2); you get one single mark overall for your project.
Physics Honours Projects: 2023

This document lists a number of potential honours research projects within the School of Physics, together with supervisor contact details and a paragraph describing each of the projects. These are only some of the opportunities available, and you are welcome to explore other possibilities with potential supervisors. If you are free, please also join us for the Honours Information Session at 15:00 on Monday 12th September.

It is important to choose a project and supervisor to suit your interests and skills. You are encouraged to have discussions with several possible supervisors before making a decision. Speaking to honours and postgraduate students will also give you valuable feedback. The Web of Science (accessible from the Library website) will give you information on the research activity of the School's academics. You should also read the School’s Research pages (https://sydney.edu.au/science/schools/school-of-physics.html) for more information on areas of active research.

You must arrange a supervisor and project prior to applying for honours. When you have reached agreement with a supervisor, please ask them to send you a formal email agreeing to take you on as a student, with cc to physics.honours@sydney.edu.au. Note that you should aim to start work on your research project three weeks before the start of lectures. This will enable you to get your project underway before lectures and assignments compete for your time. You should also make certain that your proposed supervisor will not be absent for protracted periods during semester, unless an associate supervisor is also involved. These issues will need to be formally settled when you submit your Research Plan, two weeks after the start of your first semester as an honours student.

Thank you for your interest in physics honours.

Bruce Yabsley, Honours Coordinator (physics.honours@sydney.edu.au), 8th September 2022
Introduction to research projects: project list

linked from: https://canvas.sydney.edu.au/courses/7932/

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USyd has a distinctive “Bachelor of Advanced Studies”, and most science students here are in a combined BSc/BAS degree. This runs for four years, and honours is a specialisation of that fourth year.

- such students apply in Sydney Student: “Course Details” and then “Apply for Advanced Studies honours”
- most students in other degrees, and all students from other universities, should apply for the BSc (Hons) degree:
  

- there are a couple of USyd degrees with their own enrolment paths: you will probably recognise these if they apply to you
  

- once you are accepted into honours, the difference between these cases will be \( \approx \) invisible to you: unit enrolment etc. works the same way in all cases
there can be a delay between a “provisional offer” and the “final offer” … which won’t be issued until your bachelor’s degree is fully graded

your offer may also need to wait on any outstanding fees/fines/…

if there are problems/delays with your application, please contact me

you can enrol in honours after a gap: e.g. if you finished your bachelor’s a semester ago, or two years ago, this is still OK

The University’s eligibility test for honours relies on the **WAM** (Weighted Average Mark), with 6CP units weighted ×6, 2CP units ×2, …

Physics’ requirement on the senior physics mark works the same way.

Note that the WAM and senior physics average **count all course attempts, including fails**: e.g. your senior physics grades at Fictitious University are 68 (PHY301), 44 (PHY302), 71 (PHY303), & 64 (PHY304), and you re-take PHY302 receiving 73 — in this case, the senior physics average is 64.
So far everything has assumed that you enrol in honours full time (meaning full-time-full-time: 24CP per semester for two semesters).

From the degree resolutions:

*Candidates . . . must complete the requirements for the honours component full-time over two consecutive semesters. If the School is satisfied that a student is unable to attempt the honours component on a full time basis and if the Associate Dean so recommends, permission may be granted to undertake honours part-time over four consecutive semesters.*

Historically, this has only been done rarely: once every few years.

There have been more cases recently, to manage COVID disruption, or following illness. It is still not common, and permission is required.

Bottom line: **Honours is a lot of work and it needs your full attention. Part-time honours is only by special permission.**
Seven examples of course enrolments in physics honours:

(1) **PHYS412X courses only; starting first semester**

- 2023 S1 PHYS4122 Astrophysics and Space Science
- 2023 S1 PHYS4125 Quantum Field Theory
- 2023 S1 PHYS4103 Physics Honours Project A
- 2023 S1 PHYS4104 Physics Honours Project B
- 2023 S2 PHYS4123 General Relativity and Cosmology
- 2023 S2 PHYS4124 Physics of the Standard Model
- 2023 S2 PHYS4105 Physics Honours Project C
- 2023 S2 PHYS4106 Physics Honours Project D
- 2023 S2 SCIE4999 Final Honours Mark [special 0CP “unit”]

(This looks the same for BSc/BAS and BSc (Hons) students.)
Seven examples of course enrolments in physics honours:

(2) including a maths course; starting first semester

<table>
<thead>
<tr>
<th>Year</th>
<th>Semester</th>
<th>Code</th>
<th>Course Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>2023</td>
<td>S1</td>
<td>PHYS4125</td>
<td>Quantum Field Theory</td>
</tr>
<tr>
<td>2023</td>
<td>S1</td>
<td>MATH4314</td>
<td>Representation Theory</td>
</tr>
<tr>
<td>2023</td>
<td>S1</td>
<td>PHYS4103</td>
<td>Physics Honours Project A</td>
</tr>
<tr>
<td>2023</td>
<td>S1</td>
<td>PHYS4104</td>
<td>Physics Honours Project B</td>
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<tr>
<td>2023</td>
<td>S2</td>
<td>PHYS4123</td>
<td>General Relativity and Cosmology</td>
</tr>
<tr>
<td>2023</td>
<td>S2</td>
<td>PHYS4126</td>
<td>Quantum Nanoscience</td>
</tr>
<tr>
<td>2023</td>
<td>S2</td>
<td>PHYS4105</td>
<td>Physics Honours Project C</td>
</tr>
<tr>
<td>2023</td>
<td>S2</td>
<td>PHYS4106</td>
<td>Physics Honours Project D</td>
</tr>
<tr>
<td>2023</td>
<td>S2</td>
<td>SCIE4999</td>
<td>Final Honours Mark [special 0CP “unit”]</td>
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(This looks the same for BSc/BAS and BSc (Hons) students.)
Seven examples of course enrolments in physics honours:

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<th>Year</th>
<th>Semester</th>
<th>Code</th>
<th>Course</th>
</tr>
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<tbody>
<tr>
<td>2023</td>
<td>S1</td>
<td>PHYS4036</td>
<td>Particle and Condensed Matter Physics</td>
</tr>
<tr>
<td>2023</td>
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<td>Quantum Field Theory</td>
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<tr>
<td>2023</td>
<td>S2</td>
<td>PHYS4124</td>
<td>Physics of the Standard Model</td>
</tr>
<tr>
<td>2023</td>
<td>S2</td>
<td>PHYS4126</td>
<td>Quantum Nanoscience</td>
</tr>
<tr>
<td>2023</td>
<td>S2</td>
<td>PHYS4105</td>
<td>Physics Honours Project C</td>
</tr>
<tr>
<td>2023</td>
<td>S2</td>
<td>PHYS4106</td>
<td>Physics Honours Project D</td>
</tr>
<tr>
<td>2023</td>
<td>S2</td>
<td>SCIE4999</td>
<td>Final Honours Mark [special 0CP “unit”]</td>
</tr>
</tbody>
</table>

(This looks the same for BSc/BAS and BSc (Hons) students.)
Seven examples of course enrolments in physics honours:

(4) including an IT course; starting first semester

- 2023 S1 PHYS4121 Advanced Electrodynamics and Photonics
- 2023 S1 PHYS4125 Quantum Field Theory
- 2023 S1 PHYS4103 Physics Honours Project A
- 2023 S1 PHYS4104 Physics Honours Project B
- 2023 S2 PHYS4123 General Relativity and Cosmology
- 2023 S1 COMP5310 Principles of Data Science
- 2023 S2 PHYS4105 Physics Honours Project C
- 2023 S2 PHYS4106 Physics Honours Project D
- 2023 S2 SCIE4999 Final Honours Mark [special 0CP “unit”]

(This looks the same for BSc/BAS and BSc (Hons) students.)
Seven examples of course enrolments in physics honours:

(5) incl. other physics & external courses; starting first semester

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<tr>
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<th>Semester</th>
<th>Code</th>
<th>Course Name</th>
</tr>
</thead>
<tbody>
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<td>S1</td>
<td>PHYS4121</td>
<td>Advanced Electrodynamics and Photonics</td>
</tr>
<tr>
<td>2023</td>
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<td>BMET5931</td>
<td>Nanomaterials in Medicine</td>
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<td>PHYS4103</td>
<td>Physics Honours Project A</td>
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<td>2023</td>
<td>S1</td>
<td>PHYS4104</td>
<td>Physics Honours Project B</td>
</tr>
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<td>2023</td>
<td>S2</td>
<td>PHYS4126</td>
<td>Quantum Nanoscience</td>
</tr>
<tr>
<td>2023</td>
<td>S1</td>
<td>PHYS5006</td>
<td>Medical Imaging Physics</td>
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<tr>
<td>2023</td>
<td>S2</td>
<td>PHYS4105</td>
<td>Physics Honours Project C</td>
</tr>
<tr>
<td>2023</td>
<td>S2</td>
<td>PHYS4106</td>
<td>Physics Honours Project D</td>
</tr>
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<td>SCIE4999</td>
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</tr>
</tbody>
</table>

(This looks the same for BSc/BAS and BSc (Hons) students.)
Seven examples of course enrolments in physics honours:

(6) including two other physics courses, starting second semester

<table>
<thead>
<tr>
<th>Year</th>
<th>Semester</th>
<th>Code</th>
<th>Course Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>2023</td>
<td>S2</td>
<td>PHYS4037</td>
<td>Astrophysics and Plasma Physics</td>
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<td>S2</td>
<td>PHYS4016</td>
<td>Bayesian Data Inference and Machine Learning</td>
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<td>2023</td>
<td>S2</td>
<td>PHYS4103</td>
<td>Physics Honours Project A</td>
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</tbody>
</table>

(This looks the same for BSc/BAS and BSc (Hons) students.)
Seven examples of course enrolments in physics honours:

(7) with “frontloading”, starting second semester

- 2023 S2 PHYS4123 General Relativity and Cosmology
- 2023 S2 PHYS4124 Physics of the Standard Model
- 2023 S2 PHYS4126 Quantum Nanoscience
- 2023 S2 PHYS4103 Physics Honours Project A
- 2024 S1 PHYS4125 Quantum Field Theory
- 2024 S1 PHYS4104 Physics Honours Project B
- 2024 S1 PHYS4105 Physics Honours Project C
- 2024 S1 PHYS4106 Physics Honours Project D
- 2024 S1 SCIE4999 Final Honours Mark [special 0CP “unit”]

(This looks the same for BSc/BAS and BSc (Hons) students.)
Various scholarships are available in a typical year, including:

- **University of Sydney Honours Scholarships**
- **School of Physics Honours Scholarships**
- **The Malcolm Turki Memorial Scholarship**  
  (for those suffering financial hardship)
- **Faculty of Science Honours Relocation Scholarships**

and others; note that:

- there can be changes year-to-year
- scholarships can be available to domestic students, international students, or both
- some scholarships have special conditions
- you are automatically eligible for some scholarships, but need to actively apply for others

if you are thinking about postgraduate study, svetlana.postnova@sydney.edu.au handles HDR admissions for the School of Physics, and can answer questions

honours is the traditional path to PhD study in the natural sciences in Australia (the situation overseas varies by country)

the basic path would be to do honours in or close to your preferred (sub-)field, obtain First Class Honours (“H1”; ≥ 80 overall), and ideally as good a result as possible

https://www.sydney.edu.au/scholarships/domestic/postgraduate-research/australian-government-research-training-program.html sets out the conditions for “RTP” scholarships

  • this does require an H1
  • deadlines are end March for RP3 & RP4, end October for RP1 & RP2
  • you may need to apply before you receive your honours results

other scholarships exist
(5) Administrative & other details: contacts & dates

Where to find information and help:

- public-facing Honours Canvas is still under construction; will appear under Student Portal: [https://canvas.sydney.edu.au/courses/7932/](https://canvas.sydney.edu.au/courses/7932/)
- Sydney Student → "Course details" → "Apply for Advanced Studies honours" within BSc/BAS; or [https://sydney.edu.au/courses/courses/uc/bachelor-of-science-honours.html](https://sydney.edu.au/courses/courses/uc/bachelor-of-science-honours.html) etc. as appropriate
- current and previous honours students, your (potential) supervisor(s) …

- physics.studentservices@sydney.edu.au
- physics.honours@sydney.edu.au

Important dates:

- end-Nov/early-Dec-2022 application target (deadline not til Jan 2023)
- Monday 30th January 2023 start project work (“week -2”)
- Monday 20st February 2022 start of lectures (“week 1”)
(6) Question and answer . . .