

Information Session on Physics Honours at the University of Sydney

Associate Professor Bruce Yabsley

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

Monday, 12th September 2022

Today's zoom will run for \approx 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)

(1) Introduction

- 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**

(2) 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 (\approx 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

(2) General introduction: application/enrolment

- there are various formal application paths: * see details later

Sydney Student → "Course details" → "Apply for Advanced Studies honours"

<https://sydney.edu.au/courses/courses/uc/bachelor-of-science-honours.html>

<https://sydney.edu.au/courses/courses/uc/bachelor-of-liberal-arts-and-science-honours.html>

<https://sydney.edu.au/courses/courses/uc/bachelor-of-medical-science-honours.html>

- 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, parenthesis 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

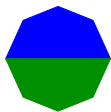
PHYS4122 Astrophysics and Space Science

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

MATH5XXX, STAT5XXX

HPSC4101

SCIE400X

COMP5046, 5310, 5318

COMP5328, 5329, 9120

DATA5441

AERO4701

AMME8520

AMME9302

BMET5931

BMET9981

CHNG5602

ELEC5213

ELEC5511

ELEC5516

ELEC9405

(3) Introduction to lecture courses: physics honours

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 \ni **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]

PHYSICS HONOURS COURSES: choose 2–4

PHYS4121 Advanced Electrodynamics and Photonics

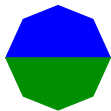
PHYS4122 Astrophysics and Space Science

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

MATH5XXX, STAT5XXX

HPSC4101

SCIE400X

COMP5046, 5310, 5318

COMP5328, 5329, 9120

DATA5441

AERO4701

AMME8520

AMME9302

BMET5931

BMET9981

CHNG5602

ELEC5213

ELEC5511

ELEC5516

ELEC9405

(4) 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

(4) Introduction to research projects: project list

linked from: <https://canvas.sydney.edu.au/courses/T932/>

or: <https://www.sydney.edu.au/content/dam/corporate/documents/faculty-of-science/schools/school-of-physics/physics-honours-projects-2023-2.pdf>

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

(4) Introduction to research projects: project list

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

or: <https://www.sydney.edu.au/content/dam/corporate/documents/faculty-of-science/schools/school-of-physics/physics-honours-projects-2023-2.pdf>

Contents

Grand Challenge Projects.....	2
Astronomical and space science	3
Biological, biomedical and medical physics	10
Complex systems	11
Complex systems; Data science	14
Condensed matter physics; Materials physics.....	15
Nanoscience.....	18
Particle physics	21
Photonics and optical science.....	23
Plasma Physics	27
Quantum physics and quantum information.....	28
Renewable Energy	33

(5) Administrative and other details: application (i)

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:

<https://sydney.edu.au/courses/courses/uc/bachelor-of-science-honours.html>

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

<https://sydney.edu.au/courses/courses/uc/bachelor-of-liberal-arts-and-science-honours.html>

<https://sydney.edu.au/courses/courses/uc/bachelor-of-medical-science-honours.html>

- 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

(5) Administrative and other details: application (ii)

- 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 $\times 6$, 2CP units $\times 2$, ...

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.

(5) Administrative and other details: full/part time

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.

(5) Administrative and other details: enrolment

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 OCP “unit”]

(This looks the same for BSc/BAS and BSc (Hons) students.)

(5) Administrative and other details: enrolment

Seven examples of course enrolments in physics honours:

(2) including a maths course; starting first semester

2023 S1	PHYS4125	Quantum Field Theory
2023 S1	MATH4314	Representation Theory
2023 S1	PHYS4103	Physics Honours Project A
2023 S1	PHYS4104	Physics Honours Project B
2023 S2	PHYS4123	General Relativity and Cosmology
2023 S2	PHYS4126	Quantum Nanoscience
2023 S2	PHYS4105	Physics Honours Project C
2023 S2	PHYS4106	Physics Honours Project D
2023 S2	SCIE4999	Final Honours Mark [special OCP “unit”]

(This looks the same for BSc/BAS and BSc (Hons) students.)

(5) Administrative and other details: enrolment

Seven examples of course enrolments in physics honours:

(3) including another physics course, starting first semester

2023 S1	PHYS4036	Particle and Condensed Matter Physics
2023 S1	PHYS4125	Quantum Field Theory
2023 S1	PHYS4103	Physics Honours Project A
2023 S1	PHYS4104	Physics Honours Project B
2023 S2	PHYS4124	Physics of the Standard Model
2023 S2	PHYS4126	Quantum Nanoscience
2023 S2	PHYS4105	Physics Honours Project C
2023 S2	PHYS4106	Physics Honours Project D
2023 S2	SCIE4999	Final Honours Mark [special OCP “unit”]

(This looks the same for BSc/BAS and BSc (Hons) students.)

(5) Administrative and other details: enrolment

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 OCP “unit”]

(This looks the same for BSc/BAS and BSc (Hons) students.)

(5) Administrative and other details: enrolment

Seven examples of course enrolments in physics honours:

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

2023 S1	PHYS4121	Advanced Electrodynamics and Photonics
2023 S1	BMET5931	Nanomaterials in Medicine
2023 S1	PHYS4103	Physics Honours Project A
2023 S1	PHYS4104	Physics Honours Project B
2023 S2	PHYS4126	Quantum Nanoscience
2023 S1	PHYS5006	Medical Imaging Physics
2023 S2	PHYS4105	Physics Honours Project C
2023 S2	PHYS4106	Physics Honours Project D
2023 S2	SCIE4999	Final Honours Mark [special OCP “unit”]

(This looks the same for BSc/BAS and BSc (Hons) students.)

(5) Administrative and other details: enrolment

Seven examples of course enrolments in physics honours:

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

2023 S2	PHYS4037	Astrophysics and Plasma Physics
2023 S2	PHYS4016	Bayesian Data Inference and Machine Learning
2023 S2	PHYS4103	Physics Honours Project A
2023 S2	PHYS4104	Physics Honours Project B
2024 S1	PHYS4121	Advanced Electrodynamics and Photonics
2024 S1	PHYS4122	Astrophysics and Space Science
2024 S1	PHYS4105	Physics Honours Project C
2024 S1	PHYS4106	Physics Honours Project D
2024 S1	SCIE4999	Final Honours Mark [special OCP “unit”]

(This looks the same for BSc/BAS and BSc (Hons) students.)

(5) Administrative and other details: enrolment

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 OCP “unit”]

(This looks the same for BSc/BAS and BSc (Hons) students.)

(5) Administrative and other details: scholarships

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

See <https://www.sydney.edu.au/scholarships/> for a full list.

(5) Administrative & other details: postgraduate

- 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:

- <https://sydney.edu.au/science/study/undergraduate-courses/honours-in-science.html>
- public-facing Honours Canvas is still under construction; will appear under Student Portal: <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> 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 . . .