PHYS3140

Advanced Quantum Mechanics and Quantum Optics

Session 2, Weekday attendance, North Ryde 2021

Archive (Pre-2022) - Department of Physics and Astronomy

Contents

Session 2 Learning and Teaching Update

The decision has been made to conduct study online for the remainder of Session 2 for all units WITHOUT mandatory on-campus learning activities. Exams for Session 2 will also be online where possible to do so.

This is due to the extension of the lockdown orders and to provide certainty around arrangements for the remainder of Session 2. We hope to return to campus beyond Session 2 as soon as it is safe and appropriate to do so.

Some classes/teaching activities cannot be moved online and must be taught on campus. You should already know if you are in one of these classes/teaching activities and your unit convenor will provide you with more information via iLearn. If you want to confirm, see the list of units with mandatory on-campus classes/teaching activities.

Visit the MQ COVID-19 information page for more detail.

General Information

Unit convenor and teaching staff
Alexei Gilchrist
alexei.gilchrist@mq.edu.au

Thomas Volz
thomas.volz@mq.edu.au

Credit points
10

Prerequisites
PHYS303 or PHYS3130 or PHYS2030

Corequisites

Co-badged status

Unit description
Quantum mechanics is perhaps the most fundamental of all theories of modern physics. While its consequences are most readily seen in the microscopic world of elementary particles, atoms and molecules; quantum mechanics provides a set of rules that apply to all physical phenomena: the universe as a whole is governed by its laws. This unit looks at quantum mechanics in greater depth than PHYS3130/PHYS2030 and from a more foundational perspective. After introducing the postulates of quantum theory, we consider the basic mathematical structures including Hilbert Space, the Dirac notation, linear operators, spectral theory and measurements. Tools for the description of multiple systems and statistical combinations of systems are introduced allowing the exploration of entanglement - arguably the most dramatic departure from classical physics. In the second half of the unit Quantum Optics is introduced, which has widespread applications and has played a central role in testing quantum mechanics and exploring its meaning. In this section we cover quantization of the optical field, introduce coherent states and describe the physics behind the quantum interaction of light and atoms.

Important Academic Dates

Information about important academic dates including deadlines for withdrawing from units are available at https://www.mq.edu.au/study/calendar-of-dates

Learning Outcomes

On successful completion of this unit, you will be able to:

ULO1: describe and apply the Hilbert space formalism of quantum mechanics.

ULO2: model the combination and removal of physical systems.

ULO3: use density operators to describe the statistical properties of quantum mechanics.

ULO4: explain how measurements are described and used in quantum mechanics.

Assessment Tasks

Name	Weighting	Hurdle	Due
Assignments	25%	No	Throughout Semester
Final exam	50%	No	Exam period
Midsession exam	25%	No	Week 7

Assignments

Assessment Type [1]: Problem set
Indicative Time on Task [2]: 36 hours
Due: **Throughout Semester**
Weighting: **25%**

Weekly problem-solving assignments

On successful completion you will be able to:

- describe and apply the Hilbert space formalism of quantum mechanics.
- model the combination and removal of physical systems.
- use density operators to describe the statistical properties of quantum mechanics.
- explain how measurements are described and used in quantum mechanics.

Final exam

Assessment Type [1]: Examination
Indicative Time on Task [2]: 20 hours
Due: **Exam period**
Weighting: **50%**

Exam in the University Examination period.

On successful completion you will be able to:

- describe and apply the Hilbert space formalism of quantum mechanics.
- model the combination and removal of physical systems.
- use density operators to describe the statistical properties of quantum mechanics.
- explain how measurements are described and used in quantum mechanics.

Midsession exam

Assessment Type [1]: Quiz/Test
Indicative Time on Task [2]: 15 hours
Due: **Week 7**
Weighting: **25%**

Exam on the content from the first half of the unit.

On successful completion you will be able to:

- describe and apply the Hilbert space formalism of quantum mechanics.
- model the combination and removal of physical systems.
- use density operators to describe the statistical properties of quantum mechanics.
- explain how measurements are described and used in quantum mechanics.

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[1] If you need help with your assignment, please contact:

- the academic teaching staff in your unit for guidance in understanding or completing this type of assessment
- the Writing Centre for academic skills support.

[2] Indicative time-on-task is an estimate of the time required for completion of the assessment task and is subject to individual variation

Delivery and Resources

Lecture notes will be provided, fully solved problems will be provided. Tutorials and lectures will be held online while in lockdown.

Policies and Procedures

Macquarie University policies and procedures are accessible from Policy Central (https://policies.mq.edu.au). Students should be aware of the following policies in particular with regard to

Learning and Teaching:

- Academic Appeals Policy
- Academic Integrity Policy
- Academic Progression Policy
- Assessment Policy
- Fitness to Practice Procedure
- Grade Appeal Policy
- Complaint Management Procedure for Students and Members of the Public
- Special Consideration Policy

Students seeking more policy resources can visit Student Policies (https://students.mq.edu.au/support/study/policies). It is your one-stop-shop for the key policies you need to know about throughout your undergraduate student journey.

To find other policies relating to Teaching and Learning, visit Policy Central (https://policies.mq.edu.au) and use the search tool.

Student Code of Conduct

Macquarie University students have a responsibility to be familiar with the Student Code of Conduct: https://students.mq.edu.au/admin/other-resources/student-conduct

Results

Results published on platform other than eStudent, (eg. iLearn, Coursera etc.) or released directly by your Unit Convenor, are not confirmed as they are subject to final approval by the University. Once approved, final results will be sent to your student email address and will be made available in eStudent. For more information visit ask.mq.edu.au or if you are a Global MBA student contact globalmba.support@mq.edu.au

Student Support

Macquarie University provides a range of support services for students. For details, visit http://students.mq.edu.au/support/

Learning Skills

Learning Skills (mq.edu.au/learningskills) provides academic writing resources and study strategies to help you improve your marks and take control of your study.

- Getting help with your assignment
- Workshops
- StudyWise
- Academic Integrity Module

The Library provides online and face to face support to help you find and use relevant information resources.

- Subject and Research Guides
- Ask a Librarian

Student Services and Support

Students with a disability are encouraged to contact the Disability Service who can provide appropriate help with any issues that arise during their studies.

Student Enquiries

For all student enquiries, visit Student Connect at ask.mq.edu.au

If you are a Global MBA student contact globalmba.support@mq.edu.au

IT Help

For help with University computer systems and technology, visit http://www.mq.edu.au/about_us/offices_and_units/information_technology/help/.

When using the University's IT, you must adhere to the Acceptable Use of IT Resources Policy. The policy applies to all who connect to the MQ network including students.