



PHYS7909

Quantum Measurement and Control

Session 2, In person-scheduled-weekday, North Ryde 2024

School of Mathematical and Physical Sciences

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General Information

Unit convenor and teaching staff

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Credit points

10

Prerequisites

PHYS714 or PHYS7905

Corequisites

Co-badged status

Unit description

Acquiring information and control are two key aspects of quantum technology that are critical for the successful development and application of quantum devices. Information acquisition requires the use of advanced formalism and techniques for quantum measurements, sensing, and characterisation, which enable researchers to probe the quantum world in unprecedented detail. Furthermore, once information about a quantum system has been obtained, it is often necessary to apply control techniques to manipulate its state and behaviour. The unit introduces students to the formalism of quantum measurements and characterisation techniques, and methods for quantum control. The unit also covers practical application of these techniques using Python quantum modelling libraries.

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: Demonstrate advanced disciplinary knowledge and skills in quantum information.

ULO2: Explain basic concepts of measurement and control of quantum systems and apply them to low-dimensional quantum systems.

ULO3: Use theoretical quantum frameworks to model simple quantum systems.

ULO4: Use numerical packages to model simple quantum systems.

ULO5: Effectively communicate physical arguments in quantum information through explanation in assessment tasks.

General Assessment Information

Requirements to Pass this Unit

To pass this unit you must achieve a total mark equal to or greater than 50%

Hurdle Assessments

There are no hurdle assessments in this unit

Late Assessment Submission Penalty

Unless a Special Consideration request has been submitted and approved, a 5% penalty (of the total possible mark) will be applied each day a written assessment is not submitted, up until the 7th day (including weekends). After the 7th day, a grade of 0 will be awarded even if the assessment is submitted. Submission time for all written assessments is set at 11:55 pm. A 1-hour grace period is provided to students who experience a technical concern.

For any late submission of time-sensitive tasks, such as scheduled tests/exams, performance assessments/presentations, and/or scheduled practical assessments/labs, students need to submit an application for Special Consideration.

Assessments where Late Submissions will be accepted.

- Problem sets – YES, Standard Late Penalty applies
- Project reports – YES, Standard Late Penalty applies
- Examination – NO, unless Special Consideration is granted

Special Consideration

The Special Consideration Policy aims to support students who have been impacted by short-term circumstances or events that are serious, unavoidable and significantly disruptive, and which may affect their performance in assessment. If you experience circumstances or events that affect your ability to complete the written assessments in this unit on time, please inform the convenor and submit a Special Consideration request through ask.mq.edu.au.

Assessment Tasks

Name	Weighting	Hurdle	Due
Problem sets	30%	No	Regularly during semester
Project reports	30%	No	Regularly during semester

Name	Weighting	Hurdle	Due
<u>Oral Final Exam</u>	40%	No	In examination period

Problem sets

Assessment Type ¹: Problem set

Indicative Time on Task ²: 30 hours

Due: **Regularly during semester**

Weighting: **30%**

A sequence of problem sets throughout the session.

On successful completion you will be able to:

- Demonstrate advanced disciplinary knowledge and skills in quantum information.
- Explain basic concepts of measurement and control of quantum systems and apply them to low-dimensional quantum systems.
- Use theoretical quantum frameworks to model simple quantum systems.
- Use numerical packages to model simple quantum systems.
- Effectively communicate physical arguments in quantum information through explanation in assessment tasks.

Project reports

Assessment Type ¹: Report

Indicative Time on Task ²: 32 hours

Due: **Regularly during semester**

Weighting: **30%**

Reports for numerical and computational projects

On successful completion you will be able to:

- Demonstrate advanced disciplinary knowledge and skills in quantum information.
- Explain basic concepts of measurement and control of quantum systems and apply them to low-dimensional quantum systems.
- Use theoretical quantum frameworks to model simple quantum systems.
- Use numerical packages to model simple quantum systems.

- Effectively communicate physical arguments in quantum information through explanation in assessment tasks.

Oral Final Exam

Assessment Type ¹: Viva/oral examination

Indicative Time on Task ²: 20 hours

Due: **In examination period**

Weighting: **40%**

Oral examination in the University Examination period.

On successful completion you will be able to:

- Demonstrate advanced disciplinary knowledge and skills in quantum information.
- Explain basic concepts of measurement and control of quantum systems and apply them to low-dimensional quantum systems.
- Use theoretical quantum frameworks to model simple quantum systems.
- Effectively communicate physical arguments in quantum information through explanation in assessment tasks.

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

Classes

Lectures and SGTA beginning Week 1: There are 3 lecture hours and 1 SGTA a week.

Lectures will be held online via Zoom and will be co-taught with Sydney Quantum Academy PhD Students. SGTA will also be online and make use of Miro as a collaborative whiteboard.

Lecture material

Lecture notes are available, and readily available textbooks will be recommended.

Communication

We will communicate with you via your university email or through announcements on iLearn. Queries to convenors can either be placed on the iLearn discussion board or sent to your lecturers from your university email address.

COVID Information

For the latest information on the University's response to COVID-19, please refer to the Coronavirus infection page on the Macquarie website: <https://www.mq.edu.au/about/coronavirus-faqs>. Remember to check this page regularly in case the information and requirements change during semester. If there are any changes to this unit in relation to COVID, these will be communicated via iLearn.

Unit Schedule

A weekly topic schedule will be available on iLearn.

Policies and Procedures

Macquarie University policies and procedures are accessible from [Policy Central \(https://policies.mq.edu.au\)](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](#)
- [Assessment Procedure](#)
- [Complaints Resolution Procedure for Students and Members of the Public](#)
- [Special Consideration Policy](#)

Students seeking more policy resources can visit [Student Policies \(https://students.mq.edu.au/support/study/policies\)](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 \(https://policies.mq.edu.au\)](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 connect.mq.edu.au or if you are a Global MBA student contact globalmba.support@mq.edu.au

Academic Integrity

At Macquarie, we believe [academic integrity](#) – honesty, respect, trust, responsibility, fairness and courage – is at the core of learning, teaching and research. We recognise that meeting the expectations required to complete your assessments can be challenging. So, we offer you a range of resources and services to help you reach your potential, including free [online writing and maths support](#), [academic skills development](#) and [wellbeing consultations](#).

Student Support

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

The Writing Centre

[The Writing Centre](#) provides resources to develop your English language proficiency, academic writing, and communication skills.

- [Workshops](#)
- [Chat with a WriteWISE peer writing leader](#)
- [Access StudyWISE](#)
- [Upload an assignment to Studiosity](#)
- [Complete the 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

Macquarie University offers a range of [Student Support Services](#) including:

- [IT Support](#)
- [Accessibility and disability support](#) with study
- Mental health [support](#)
- [Safety support](#) to respond to bullying, harassment, sexual harassment and sexual assault
- [Social support including information about finances, tenancy and legal issues](#)
- [Student Advocacy](#) provides independent advice on MQ policies, procedures, and

processes

Student Enquiries

Got a question? Ask us via the [Service Connect Portal](#), or contact [Service Connect](#).

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.

Changes from Previous Offering

We value student feedback to be able to continually improve the way we offer our units. As such we encourage students to provide constructive feedback via student surveys, to the teaching staff directly, or via the FSE Student Experience & Feedback link in the iLearn page.

Student feedback from the previous offering of this unit was very positive overall, with students pleased with the clarity around assessment requirements and the level of support from teaching staff. As such, no change to the delivery of the unit is planned, however we will continue to strive to improve the level of support and the level of student engagement.

Unit information based on version 2024.04 of the [Handbook](#)