PHYS714

Quantum Information and Technology

S2 Day 2014

Physics and Astronomy

Contents

General Information

Unit convenor and teaching staff
Lecturer
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Unit Convenor
Jason Twamley
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Laboratory Lecturer
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Credit points
4

Prerequisites
Admission to MRes

Corequisites

Co-badged status

Unit description
This unit introduces students to the growing field of quantum information science and technology. A general formalism is introduced involving the concept of Hilbert space, states represented by density matrices, open systems evolution via operator sum decompositions, and generalised measurement theory. Much of the unit covers the physics and quantum information aspects of leading physical implementations for a quantum engineered device, including: atomic, (neutral and trapped ion), photonic, superconducting and semiconductor devices. There is a laboratory component based on photonic systems with experiments on quantum correlations in single photons, tests of quantum nonlocality, and generation of entangled photons.

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:

Learn to formulate and solve problems in Quantum Information and Technology using a variety of physics skills

General knowledge of the physics, control and description of the science of current day quantum science and technology platforms

Experimental experience with cutting edge quantum technology practical laboratories

Assessment Tasks

Name	Weighting	Due
Final Examination	25%	29/11/14
Assignments	25%	1411/14
Laboratory	25%	14/11/14
Final Project	25%	14/11/14

Final Examination

Due: **29/11/14**
Weighting: **25%**

Final Examination [problem based], covering the concepts in the course

On successful completion you will be able to:

- Learn to formulate and solve problems in Quantum Information and Technology using a variety of physics skills
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Assignments

Due: **1411/14**
Weighting: **25%**

Three Take Home Assignments

On successful completion you will be able to:

- Learn to formulate and solve problems in Quantum Information and Technology using a variety of physics skills
- General knowledge of the physics, control and description of the science of current day quantum science and technology platforms

Laboratory

Due: **14/11/14**
Weighting: **25%**

4-6 weeks of Laboratories focused on state of the art quantum technologies

On successful completion you will be able to:

- General knowledge of the physics, control and description of the science of current day quantum science and technology platforms
- Experimental experience with cutting edge quantum technology practical laboratories

Final Project

Due: **14/11/14**
Weighting: **25%**

A three week final project (theory), focusing on developing problem solving and the concepts covered in the course. The assessment comprises of a written report (<10pages).

On successful completion you will be able to:

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Delivery and Resources

Lectures in standard lecture room.

Laboratory Practicals uses propietary lab setup

Unit Schedule

LEctures: Tues 11-1pm EMC G230, Thurs 11-12 EMC G230,

Tutes: Tues 2-3pm only alternative weeks

Labs: (4 weeks at most): Friday 10-1pm

Learning and Teaching Activities

Lectures

Lectures

Personal Reading

Reading for Assignments etc.

Experimental Lab Work

Lab practicals

Policies and Procedures

Macquarie University policies and procedures are accessible from Policy Central. Students should be aware of the following policies in particular with regard to Learning and Teaching:

Academic Honesty Policy http://mq.edu.au/policy/docs/academic_honesty/policy.html

Assessment Policy http://mq.edu.au/policy/docs/assessment/policy.html

Grading Policy http://mq.edu.au/policy/docs/grading/policy.html

Grade Appeal Policy http://mq.edu.au/policy/docs/gradeappeal/policy.html

Grievance Management Policy http://mq.edu.au/policy/docs/grievance_management/policy.html

Disruption to Studies Policy http://www.mq.edu.au/policy/docs/disruption_studies/policy.html *The Disruption to Studies Policy is effective from March 3 2014 and replaces the Special Consideration Policy.*

In addition, a number of other policies can be found in the Learning and Teaching Category of Policy Central.

Student Code of Conduct

Macquarie University students have a responsibility to be familiar with the Student Code of Conduct: https://students.mq.edu.au/support/student_conduct/

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 improve your marks and take control of your study.

- Workshops
- StudyWise
- Academic Integrity Module for Students
- Ask a Learning Adviser

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

IT Help

For help with University computer systems and technology, visit http://informatics.mq.edu.au/help/.

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

Graduate Capabilities

PG - Discipline Knowledge and Skills

Our postgraduates will be able to demonstrate a significantly enhanced depth and breadth of knowledge, scholarly understanding, and specific subject content knowledge in their chosen fields.

This graduate capability is supported by:

Learning outcomes

- Learn to formulate and solve problems in Quantum Information and Technology using a variety of physics skills
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Assessment tasks

- Final Examination
- Assignments
- Laboratory
- Final Project

Learning and teaching activities

- Lectures
- Reading for Assignments etc.
- Lab practicals

PG - Critical, Analytical and Integrative Thinking

Our postgraduates will be capable of utilising and reflecting on prior knowledge and experience, of applying higher level critical thinking skills, and of integrating and synthesising learning and knowledge from a range of sources and environments. A characteristic of this form of thinking is the generation of new, professionally oriented knowledge through personal or group-based critique of practice and theory.

This graduate capability is supported by:

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Assessment tasks

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- Assignments
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Learning and teaching activities

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- Reading for Assignments etc.
- Lab practicals

PG - Research and Problem Solving Capability

Our postgraduates will be capable of systematic enquiry; able to use research skills to create new knowledge that can be applied to real world issues, or contribute to a field of study or practice to enhance society. They will be capable of creative questioning, problem finding and problem solving.

This graduate capability is supported by:

Learning outcomes

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Assessment tasks

- Final Examination
- Assignments
- Laboratory
- Final Project

Learning and teaching activities

- Reading for Assignments etc.
- Lab practicals

PG - Effective Communication

Our postgraduates will be able to communicate effectively and convey their views to different social, cultural, and professional audiences. They will be able to use a variety of technologically supported media to communicate with empathy using a range of written, spoken or visual formats.

This graduate capability is supported by:

Learning outcomes

- General knowledge of the physics, control and description of the science of current day quantum science and technology platforms
- Experimental experience with cutting edge quantum technology practical laboratories

Assessment tasks

- Laboratory
- Final Project

Learning and teaching activities

- Lab practicals

PG - Engaged and Responsible, Active and Ethical Citizens

Our postgraduates will be ethically aware and capable of confident transformative action in relation to their professional responsibilities and the wider community. They will have a sense of connectedness with others and country and have a sense of mutual obligation. They will be able to appreciate the impact of their professional roles for social justice and inclusion related to national and global issues

This graduate capability is supported by:

Learning outcomes

- General knowledge of the physics, control and description of the science of current day quantum science and technology platforms
- Experimental experience with cutting edge quantum technology practical laboratories

Assessment task

- Final Project

Learning and teaching activity

- Lectures
- Lab practicals

PG - Capable of Professional and Personal Judgment and Initiative

Our postgraduates will demonstrate a high standard of discernment and common sense in their professional and personal judgment. They will have the ability to make informed choices and decisions that reflect both the nature of their professional work and their personal perspectives.

This graduate capability is supported by:

Learning outcomes

- Learn to formulate and solve problems in Quantum Information and Technology using a variety of physics skills
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Assessment tasks

- Final Examination
- Final Project

Learning and teaching activities

- Lectures
- Reading for Assignments etc.
- Lab practicals