PHYS714

Quantum Information and Technology

S2 Day 2017

Dept of Physics and Astronomy

Contents

General Information

Unit convenor and teaching staff
Unit Convenor
Dominic Berry
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Thursdays 1-2pm; other times by appointment.

Lecturer
Thomas Volz
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Lecturer
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Lab Demonstrator
Xavier Vidal Asensio
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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:

Formulate and solve problems in Quantum Information and Technology using a variety of physics skills.
Understand the science of current day quantum science and technology platforms.
Perform experiments in cutting edge quantum technology practical laboratories.

Assessment Tasks

Name	Weighting	Hurdle	Due
Final examination	35%	No	University Examination Period
Assignments	20%	No	Week 3 and 13
Explorer Investigation	25%	No	Week 6
Final Project	20%	No	Week 11

Final examination

Due: **University Examination Period**
Weighting: **35%**

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

On successful completion you will be able to:

- Formulate and solve problems in Quantum Information and Technology using a variety of physics skills.
- Understand the science of current day quantum science and technology platforms.

Assignments

Due: **Week 3 and 13**
Weighting: **20%**

Two take home assignments with up to 4 problems to be worked on individually.

On successful completion you will be able to:

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Explorer Investigation

Due: **Week 6**
Weighting: **25%**

Each student will undertake a minimum of 3 days of lab practical exploring various aspects of experimental quantum technologies. Students will gain experience in the preparation, manipulation and detection of quantum signals or equivalent in various types of quantum technologies, e.g. quantum optics, diamond quantum systems, cavity QED etc. Students will write a short report based on their required lab tasks and the report is assessed for clarity, depth and comprehension of the lab techniques involved in their practical.

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Final Project

Due: **Week 11**
Weighting: **20%**

A three week final project, focusing on developing problem solving and the concepts covered in the course. The assessment comprises of a written report (<10pages). The project can range over the various topics covered in the course, and can involve theory or experiment or both.

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Delivery and Resources

Lectures in standard lecture room. Labs will be either via the Diamond Lab or Quantum Optics Labs.

Unit Schedule

The unit will start with a two-week introduction to the theory of quantum information. There will

then be 4.5 weeks on the theoretical background of the experimental platforms for quantum information. There will also be a two week experimental project during this time, which will be due in week 6. This will be followed by 6.5 weeks of more advanced topics in quantum information, including quantum algorithms and error correcting codes.

Lectures: Monday 10am-12pm W5C 301, Wednesday 3-5pm EMC G230

Labs: Tuesday 10am-1pm for 2 weeks

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_2016.html

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

Complaint Management Procedure for Students and Members of the Public http://www.mq.edu.au/policy/docs/complaint_management/procedure.html

Disruption to Studies Policy (in effect until Dec 4th, 2017): http://www.mq.edu.au/policy/docs/disruption_studies/policy.html

Special Consideration Policy (in effect from Dec 4th, 2017): https://staff.mq.edu.au/work/strategy-planning-and-governance/university-policies-and-procedures/policies/special-consideration

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/

Results

Results shown in *iLearn*, 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.

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://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.

Graduate Capabilities

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:

Assessment tasks

- Explorer Investigation
- Final Project

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

- Formulate and solve problems in Quantum Information and Technology using a variety of physics skills.
- Understand the science of current day quantum science and technology platforms.

- Perform experiments in cutting edge quantum technology practical laboratories.

Assessment tasks

- Final examination
- Assignments
- Explorer Investigation
- Final Project

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:

Learning outcomes

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- Understand the science of current day quantum science and technology platforms.
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Assessment tasks

- Final examination
- Assignments
- Explorer Investigation
- Final Project

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:

Assessment tasks

- Final examination
- Assignments
- Explorer Investigation

- Final Project

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 outcome

- Perform experiments in cutting edge quantum technology practical laboratories.

Assessment tasks

- Explorer Investigation
- Final Project