

Basic details

UID	<input type="text"/>	Cohorts covered	Earliest cohort <input type="text" value="2025-26"/>	Latest cohort <input type="text"/>
Long title	<input type="text" value="Quantum Systems 2: Hybrid Quantum Systems"/>			
New code	<input type="text" value="PHYS70058"/>	New short title	<input type="text"/>	
Brief description of module <i>(approx. 600 chars.)</i>	<input type="text" value="The course has three themes: Quantum Photonics, Optical Quantum Information, Matter Qubits and Oscillators. In addition there are two extended laboratory experiments on laser cooling and on photon correlations."/>			
				211 characters
Available as a standalone module/ short course?	<input type="text" value="N"/>			

Statutory details

Credit value	ECTS <input type="text" value="7.5"/>	CATS <input type="text" value="15"/>	Non-credit <input type="text" value="N"/>	HECOS codes	<input type="text"/>
FHEQ level	<input type="text" value="Level 7"/>				<input type="text"/>
				<input type="text"/>	<input type="text"/>

Allocation of study hours

	Hours	
Lectures	<input type="text" value="21"/>	
Group teaching	<input type="text" value="3"/>	<i>Incl. seminars, tutorials, problem classes.</i>
Lab/ practical	<input type="text" value="31"/>	
Other scheduled	<input type="text"/>	<i>Incl. project supervision, fieldwork, external visits.</i>
Independent study	<input type="text" value="132.5"/>	<i>Incl. wider reading/ practice, follow-up work, completion of assessments, revisions.</i>
Placement	<input type="text"/>	<i>Incl. work-based learning and study that occurs overseas.</i>
Total hours	<input type="text" value="187.5"/>	
ECTS ratio	<input type="text" value="25.00"/>	

Project/placement activity

Is placement activity allowed?

Module delivery

Delivery mode	<input type="text" value="Taught/ Campus"/>	Other	<input type="text"/>
Delivery term	<input type="text" value="Term 2"/>	Other	<input type="text"/>

Ownership

Primary department

Additional teaching departments

Delivery campus

Collaborative delivery

Collaborative delivery?

External institution

External department	N/A
External campus	N/A

## Associated staff

Role	CID	Given name	Surname
Module Leader		Steve	Kolthammer
Topic Leader		Steve	Kolthammer
Topic Leader		Michael	Vanner
Topic Leader		Malcolm	Connolly

## Learning and teaching

### Module description

Learning outcomes	<p>On completing this module, students will be able to:</p> <ul style="list-style-type: none"> <li>- understand atomic quantum memories and compare various storage schemes, including analysis of optical cavities.</li> <li>- describe, calculate with a statistical description, and demonstrate in the laboratory aspects of optical detection with reference to single photon experiments.</li> <li>- assemble and implement a magneto-optical trap for Rb and discuss its application to quantum phenomena.</li> <li>- summarise continuous and discrete variable encodings in optical quantum information.</li> <li>- describe quantum key distribution and calculate Bell's inequality protocols for optical quantum information.</li> <li>- describe superconducting circuits as qubits, quantum dots as qubits, and contrast these with atoms.</li> <li>- explain the physics of macroscopic quantum oscillators.</li> </ul>
Module content	Quantum Systems 2 covers three main themes: quantum photonics, optical quantum computing, and matter qubits. It also includes two laboratory experiments, one on atom trapping and the second on photon correlations.
Learning and Teaching Approach	The three themes will be delivered by lectures. The lab experiments will be delivered as practical work, with support from demonstrators and the topic leader.
Assessment Strategy	A final two hour written examination provides summative assessment (60% of the overall mark). Three problem sheets provide summative assessment and formative assessment through detailed marking and solution sheets (20%). Problem sheets will be spaced through the course to coincide with each main theme, each with its own feedback session. The practical laboratory work will be marked by a combination of continuous assessment (6%) and a written report (14%).
Feedback	Feedback will be provided by marked problem sheets and a one hour feedback session for each sheet. For each lab experiment a post-lab meeting will provide formative assessment. Feedback for the laboratory component will be provided by the demonstrators as the lab progresses.
Reading list	

## Quality assurance

## Office use only

Date of first approval

QA Lead

Date of last revision   
Date of this approval

Department staff   
Date of collection

Module leader

Date exported   
Date imported

Notes/ comments