

Subject card

Subject name and code	Categorical Quantum Mechanics, PG_00158052						
Field of study	Quantum Information Technology						
Date of commencement of studies	October 2025		Academic year of realisation of subject		2026/2027		
Education level	Master's studies		Subject group				
Mode of study	full-time studies		Mode of delivery		at the university		
Year of study	2		Language of instruction		English		
Semester of study	4		ECTS credits		6.0		
Learning profile	academic		Assessment form		exam		
Conducting unit							
Name and surname of lecturer (lecturers)	Subject supervisor		dr hab. John Selby				
	Teachers		Sina Soltani dr hab. John Selby Matthias Salzger				
Lesson types	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	30.0	30.0	0.0	0.0	0.0	60
	E-learning hours included: 0.0						
Learning activity and number of study hours	Learning activity	Participation in didactic classes included in study plan		Participation in consultation hours		Self-study	SUM
	Number of study hours	60		0.0		30.0	90
Subject objectives	This course aims to introduce you to an exciting new approach to understanding and using quantum theory, based entirely on a pictorial representation of quantum processes. On the one hand, these diagrams prove an intuitive way to understand quantum phenomena and protocols, and, on the other hand, they provide powerful mathematical techniques for proving new results. This diagrammatic approach to quantum theory finds important applications both within the foundations of physics as well as increasingly within the quantum industry.						
Learning outcomes	Course outcome		Subject outcome		Method of verification		
	[QITL3_W02] has in-depth knowledge in the field of advanced mathematics and mathematical and computer methods, necessary to solve physical problems of medium complexity, and advanced knowledge in the area of quantum information and its technological aspects		The student has advanced knowledge of the mathematical foundations of categorical quantum mechanics and of formal methods for describing quantum processes using monoidal categories and string diagrams, enabling the analysis of problems in quantum information.		[SW4] test/exam - oral or written		
	[QITL3_W06] has knowledge of current directions in the development of physics, in particular in the field of quantum information theory		The student knows and understands the basic concepts and terminology used in diagrammatic quantum theory.		[SW4] test/exam - oral or written		
Subject contents	1. The basics of diagrams 2. Pure quantum theory in diagrams 3. ZX calculus as a complete diagrammatic tool 4. Mixed quantum theory in diagrams 5. Interacting quantum and classical theory in diagrams						

Prerequisites and co-requisites			
Assessment methods and criteria	Subject passing criteria	Passing threshold	Percentage of the final grade
	tutorial part: test	51.0%	50.0%
	lecture part: exam	51.0%	50.0%
Recommended reading	Basic literature	1. Coecke, B., & Kissinger, A. (2017). Picturing Quantum Processes: A First Course in Quantum Theory and Diagrammatic Reasoning. Cambridge: Cambridge University Press. doi: 10.1017/9781316219317 2. Coecke, B., & Gogioso, S. (2023). Quantum in Pictures: A New Way to Understand the Quantum World. Cambridge Quantum. ISBN-10:1739214714	
	Supplementary literature	None.	
	eResources addresses		
Example issues/ example questions/ tasks being completed			
Work placement	Not applicable		

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