University of Gdańsk

Subject card

Subject name and code	Categorical Quantum Mechanics, PG_00158052		
Field of study	Quantum Information Technology		
Date of commencement of studies	October 2024	Academic year of realisation of subject	2024/2025
Education level	Master's studies	Subject group	
Mode of study	full-time studies	Mode of delivery	at the university
Year of study	1	Language of instruction	English
Semester of study	2	ECTS credits	6.0
Learning profile	academic	Assessment form	
Conducting unit			
Name and surname of lecturer (lecturers)	Subject supervisor	dr John Selby	
	Teachers	dr John Selby Matthias Salzger Sina Soltani	

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_K02] is aware of the decisive role of experiment in the verification of physical theories; is aware of the existence of the scientific method in acquiring knowledge	The student is aware about advantages provided by the diagrammatic formalism in modeling nature and experiment.	[SK4] 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
[QITL3_U05] has the ability to synthesize methods and ideas from various areas of physics and other branches of science; is able to notice that distant phenomena are sometimes described by similar models	The student can relate the description of various quantum phenomena based on standard quantum formalism with the diagrammatic one.	[SU4] test/exam - oral or written
[QITL3_W04] knows advanced methods of theoretical and mathematical physics necessary in creating models of quantum mechanics	The student has sufficient knowledge to solve problems and understand phenomena from the perspective of 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
lecture part: exam	51.0%	50.0%
tutorial part: test	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	Adresy na platformie eNauczanie:

Example issues/ example questions/ tasks being completed

Work placement

Not applicable

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