Course unit English denomination	Quantum tools for future scientific research
SS PHYS-04/A	
Teacher in charge	Simone Montangero
Teaching Hours	24
Number of ECTS credits allocated	3
Course period	March - June 2026
Course delivery method	☒ In presence ☐ Remotely ☐ Blended
Language of instruction	English
Mandatory attendance	☒ Yes (50% minimum of presence) ☐ No
Course unit contents	Module I Quantum and classical computing Quantum advantage Elements of superconducting, photonic and Rydberg quantum hardware Module II Elementary tensor operations Tensor network ansatz Tensor network operators Tensor network algorithms; ground state search, time evolution Module III Presentation of selected topics in flipped classroom mode
Learning goals	Learning the concepts of quantum computation and simulations, quantum advantage and the main hardware supports developed to achieve them. Acquiring knowledge of the current available methodologies and concepts developed in quantum information theory and their potential applications to different research areas, such as condensed matter physics and high energy physics.

	Acquiring knowledge on tensor network methods. Learning to present advanced topics in the field, being able to transmit knowledge and make connections among different fields
Teaching methods	Frontal lessons, case studies, flipped classroom
Course on transversal, interdisciplinary, transdisciplinary skills	☐ Yes ☒ No
Available for PhD students from other courses	☒ Yes ☐ No
Prerequisites (not mandatory)	Quantum Mechanics
Examination methods	
Examination methods (if applicable)	Oral exam – presentation on selected topic
Suggested readings	
Additional information	

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