Module	***Theory of Quantum Information***
Code	71500
Instruction language	English
ECTS credits	6
Attendance time	5 hours per week
Duration	1 semester
Cycle	Each winter semester
Coordinator	Prof. Martin Plenio
Instructors	Prof. Tommaso Calarco, Prof. Martin Plenio
Allocation to study programmes	Physics M.Sc., elective module, 1st or 2nd semester Wirtschaftsphysik M.Sc., elective module, 1st - 3nd semester
Formal prerequisites	None
Recommended prerequisites	Foundations of Quantum Mechanics
Learning objectives	Students who successfully passed this module • are familiar with the theoretical concepts of Quantum Information • know the application of Quantum Information to other areas of physics, such as quantum mechanical many-particle systems, statistical physics and computer sciences.
Syllabus	• What is Quantum Information Processing? • Quantum complexity and quantum parallelism • Decoherence and errors in a quantum computer • Quantum bits, quantum gates, quantum circuits • Quantum circuits for entanglement production, teleportation, error correction • Quantum dynamics and measurement processes • Ensembles of quantum states and density operators • EPR paradox and Bell inequalities • Quantum cryptography • Quantum algorithms • Physical realizations of quantum processors
Literature	• M.A. Nielsen and I. Chuang, “Quantum Computing and Quantum Information”, Cambridge University Press • Preskill, Quantum Computation Lecture Notes
Teaching and learning methods	Lecture (3 hours per week) Exercise (2 hours per week)
Workload	45 hours lecture (attendance time) 30 hours exercise (attendance time) 105 hours self-study and exam preparation Total: 180 hours
Assessment	Written or oral examination. A prerequisite for the participation in the

	examination is an ungraded course achievement. Form and scope of the examination and of the course achievement are determined and notified by the instructor at the beginning of the course.
Examination	12118 Theory of Quantum Information (prerequisite) 11665 Theory of Quantum Information
Grading procedure	The module grade is the examination grade.
Basis for	Research in the fields of Quantum Information and Technologies