

**Course title: Quantum Information Theory**

**Duration** [number of hours]: **12 hours**

**PhD Program** [MERC/MPS/SPACE]: **SPACE**

**Name and Contact details of unit organizer(s):**

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**Course Description:** This course provides a rigorous introduction to quantum information theory, emphasizing the mathematical and conceptual foundations of quantum theory. Beginning with the linear-algebraic and operator-theoretic structure of quantum theory, the course develops a precise framework for describing quantum states, measurements, and dynamics. Central topics include quantum channels and their structural properties, the theory of entanglement and its operational consequences, and information-theoretic perspectives on open quantum systems. Building on these foundations, the course explores modern applications of quantum information to problems in thermalization and equilibration, quantum chaos, and the information-theoretic structure of quantum black holes.

**Syllabus:** 1. The mathematical structure of quantum theory 2. Quantum Channels 3. Entanglement 4. Thermalization in quantum systems 5. Quantum Chaos 6. Quantum Black Holes.

**Assessment: Problem set**

**Suggested reading and online resources:**

```
Lecture Notes
@book{watrous2018theory,
  title = {The Theory of Quantum Information},
  author = {Watrous, John},
  year = {2018},
  publisher = {Cambridge University Press},
  address = {Cambridge, United Kingdom},
  isbn = {9781107180567},
  pages = {598},
}
```