

Course title:

Quantum Information, Complexity and Black Holes

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

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

Name and Contact details of unit organizer(s):

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Course Description [max 150 words]: This course is aimed at providing advanced tools from Quantum Information theory for the description of complex quantum phenomena and information scrambling in local quantum systems, with an emphasis on black holes. We will give a mathematical description of the spreading of information and how causality emerges in local quantum systems. The interplay between entanglement, complexity and information paradox in black holes will be discussed together with a survey of open research problems.

Syllabus:

1. Advanced methods in quantum information
2. Thermalization of closed quantum systems
3. Information scrambling
4. Out-of-time-order correlation functions
5. Entanglement Complexity
6. Black Holes as scramblers
7. Information retrieval from Hawking radiation

Assessment: In-class problem solving and discussion

Suggested reading and online resources:

1. Lectures notes
2. Proposed literature references