Quantum Information

- **Quantum Computing**
    - Logic gates, universality and efficient classical (non)-simulability
    - Examples of quantum algorithms: factorization and search
    - Sub-universality, BosonSampling and some principles of its implementations in quantum optics.

- **Entanglement, decoherence and error correction.**
    - Entanglement, its detection and quantification.
    - CHSH inequality, contextuality.
    - Neumark extension, positive operator valued measurements (POVMs), and the Lindblad equation.
    - The stabilizer formalism and error correction. Bosonic codes.

- **Quantum simulation and physical implementation of quantum computing**
    - General principles of digital quantum simulation: universal gates and the Trotter expansion.
    - The case of bosons: universal gate sets, continuous variables quantum information and encodings.
    - Application: efficient and inefficient simulation of a quantum computer with single photons.
    - Analog quantum simulation.

- **Quantum information and communication**
    - Entropy, mutual information and Holevo bound.
    - Teleportation, quantum repeaters and entanglement swapping.
    - Entanglement based communication.

Bibliographical resources:

- Quantum Computation and Quantum Information, M. Nielsen and I. Chuang, Cambridge University Press.
- Quantum Information, S. Barnett, Oxford University Press.
- Quantum Computing Since Democritus, S. Aaronson, Cambridge University Press.
- Scientific papers.