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.
- **Quantum simulation and physical quantum information**
  - 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 processors are open systems: decoherence and error correction.**
  - Entanglement, its detection and quantification.
  - Neumark extension, positive operator valued measurements (POVMs), and the Lindblad equation.
  - The stabilizer formalism and error correction. Bosonic codes.
- **Quantum information and communication**
  - Entropy, mutual information and Holevo bound.
  - CHSH inequality, contextuality, teleportation 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.