Quantum Optics

- 1. Review of quantum description of bosonic field and quantum states of light. Density operator, phase space representations (Q, P and Wigner functions)
- 2. Quantum coherence and Correlation functions for the field. Measurement, Photoncounting, Hong-Ou-Mandel effect; bunching and anti-bunching, homodyne (and other -dyne detections)
- 3. Single-mode and few mode quantum non-linear optics processes (degenerate parametric down conversion/ amplifier, squeezing non-degenerate optical parametric down conversion, two mode squeezing and entanglement.
- 4. Heralded generation of photons. Conditional Single-photon gates. Single-photons protocols in quantum technologies.
- 5. Multimode quantum non-linear parametric processes. Multimode and entanglement decomposition.
- 6. Continuous Variable Entangled state and measurement-based quantum operation.
- 7.Heralded generation of non-Gaussian states via multiple photon counting. (Schoedinger cat state, cubic phase state).
- 8. Introduction, and basics of Quantum Optomechanics (Mecanical susceptibility, correlation functions and spectra, Wiener-Khinchin theorem, Fluctuation dissipation theorem, thermal noise)
- 9. Cavity optomechanics (Hamiltonian description, quantum Langevin equations, dynamical backation)
- 10. Quantum noise spectrum
- 11. Circuit quantum acousto-dynamics (qubit-mechanical system, applications to fundamental tests)