Instructor: Hailin Wang  
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Supplementary text: *Elements of Quantum Optics*, Meystre & Sargent

References:

*Optical coherence and quantum optics*, L. Mandel and E. Wolf (Cambridge, 1995)  

Grading:

- Home work: 25%
- Mid-term: 30%
- Final: 40%
- Term paper: 5%
Course topics: In this term, we will focus on the quantum description of light-matter interactions

1) Quantum theory of radiation
   Field quantization
   Number states
   Coherent states
   Squeezed states
   Quantum field distribution and partially coherent radiation

2) Field-field and photon-photon interferometry
   First order coherence, Young’s double slit experiment
   Second order coherence, Hanbury-Brown Twiss experiment
   Photon counting and photon statistics

3) Quantum theory of atom-field interactions
   Interaction Hamiltonian
   Janys-Cummings model
   Weisskopf-Wigner theory of spontaneous emission

4) Quantum theory of damping
   Density operator approach
   Heisenberg-Langevin approach
   Fluctuation-dissipation theorem
   Quantum regression theorem

5) Resonant fluorescence
   Weak field limit
   Strong field limit
   Dressed states
   Photon antibunching

6) Squeezing via nonlinear optical processes
   Degenerate parametric amplification
   Squeezing in a parametric oscillator
   Squeezing in the output of an optical cavity

7) Quantum theory of lasers
   Photon statistics
   Laser linewidth