Quantum Optics, IPT5340

Time: T7T8F7F8 (15:30-17:20, Tuesday, and 16:00-17:20, Friday), at Room 208, Delta Hall

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Syllabus:

Date	Topic	To Know	To Think
week 8 (5/11, 5/14)	Photon-Atom Interactions	☐ Einstein's AB coefficients ☐ Classical model ☐ Semi-Classical	☐ Rabi-frequency ☐ Wavefunction Revival ☐
weeks 9-10 (5/18, 5/21, 5/25)	Full Quantum model	☐ Jaynes-Cummings ☐ Dicke model ☐ Cavity-QED	☐ Vacuum Rabi oscillation ☐ Collective interaction ☐ Circuit-QED ☐
week 11-12 (5,/28, 6/1, 6/4)	Open systems	☐ Weisskopf-Wigner approximation ☐ Born-Markovian approximation ☐ Master equation ☐ Lindblad equation	☐ dissipation-fluctuation theorem ☐ non-Markovian ☐

- **Assignment**

  Deadline: 4:00PM, Friday, June 4th

  – (1) [**Quantum Langevin noises**] :
  Show that the Langevin noise operators have *zero means*, $\langle \hat{F}_a(t)\rangle_R = \langle \hat{F}_a^\dagger(t)\rangle_R = 0$, but non-zero variances,

$$\langle \hat{F}_a^\dagger(t)\hat{F}_a(t')\rangle_R \;=\; \sum_k |g_k|^2 \bar{n}_k \exp[i(\nu_k-\omega)(t-t')] = \Gamma \bar{n}_{th}\delta(t-t'), \tag{1}$$

  which is called the *dissipation-fluctuation theorem.*

- **Take-home Messages:**
  1. Damping via Oscillator Reservoir
  2. Weisskopf-Wigner theory
  3. Markovian White Noise
  4. Dissipation-Fluctuation theorem
  5. Quantum Noises
  6. Thermo Noises

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