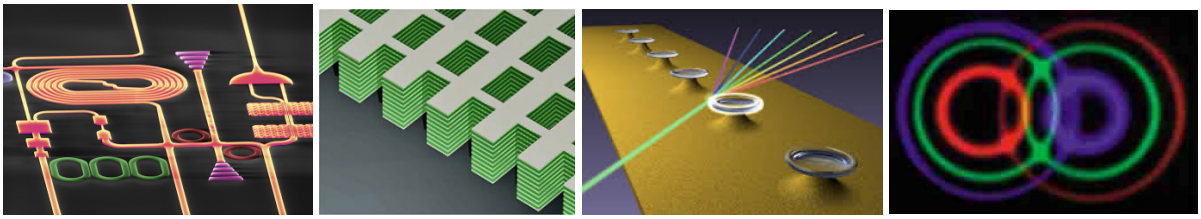
Phys 427B/576A Advanced Topics in Optics and Photonics (Winter 2022)



Instructor	Prof. Mo Li	**Office**	**EEB M246**
Tel	206-616-6966	**Email**	moli96@uw.edu
Time:	1:30-2:50 MF	**Room**	PAB B101

Prerequisites: This class is open to seniors and graduate students in Physics, ECE, and MSE. Prerequisite requires a solid background in electromagnetic theory and quantum mechanics.

Synopsis: Optics and photonics are one of the most fast-developing fields in science and engineering. The impact of photonics technology of the society and everyday life has been tremendous, ranging from telecommunication to the display in smartphones, and more recently to Lidar in autonomous cars. Remarkably, all of these technologies fundamentally have their roots in Maxwell's equations and solid-state physics.

After a quick review of E&M and wave propagation, this course will provide an advanced survey of the latest topics in photonics and optics with moderate depth. The course will emphasize the theoretical backgrounds of the topics and the latest development that are not covered by other courses.

Lecture Topics (20 Lectures)
Quick review of E&M Theory and Wave Propagation (2 Lectures)
Maxwell equations, EM waves in isotropic and anisotropy media, Gaussian beams
Guided wave optics (3 Lectures)
Modes in dielectric slab waveguides, Modes in circular waveguides and fibers, Dispersion effect in optical fibers, Coupled mode theory
Optical resonators (3 Lectures)
Optical cavities, mode stability, losses, quality factor, dispersion, travelling wave resonators
Electro-optic devices (2 Lectures)
Electro-optic effect, Amplitude and phase modulation
Optical Properties of Materials (4 Lectures)
Complex dielectric function, absorption spectrum, excitons, luminescence, quantum confinement effect, phonons and polaritons
Nonlinear Optics (6 Lectures)
Wave propagation in nonlinear media, second-harmonic generation, Parametric amplification, Frequency up-conversion, Frequency comb generation, Multiphoton imaging

Textbook

- A. Yariv and P. Yeh, *Photonics: Optical Electronics in Modern Communications*, 6th edition, Oxford, New York (2007).
- M. Fox, *Optical Properties of Solids*, 2nd Edition, Oxford University Press (2010)
- Boyd, R. W. (2008). *Nonlinear optics*. 3rd Ed. Amsterdam ; Boston, Academic Press.

Grading

There will be 3-4 homework assignments, one take-home final exam and a term paper. The allocation of grade will be: Homework: 50% Final: 30% Term Paper: 20%

Religious Accommodations

Washington state law requires that UW develop a policy for accommodation of student absences or significant hardship due to reasons of faith or conscience, or for organized religious activities. The UW's policy, including more information about how to request an accommodation, is available at Religious Accommodations Policy (https://registrar.washington.edu/staffandfaculty/religious-accommodations-policy/). Accommodations must be requested within the first two weeks of this course using the Religious Accommodations Request form (https://registrar.washington.edu/students/religious-accommodations-request/).