18.369, Spring 2012

Mathematical Methods in Nanophotonics

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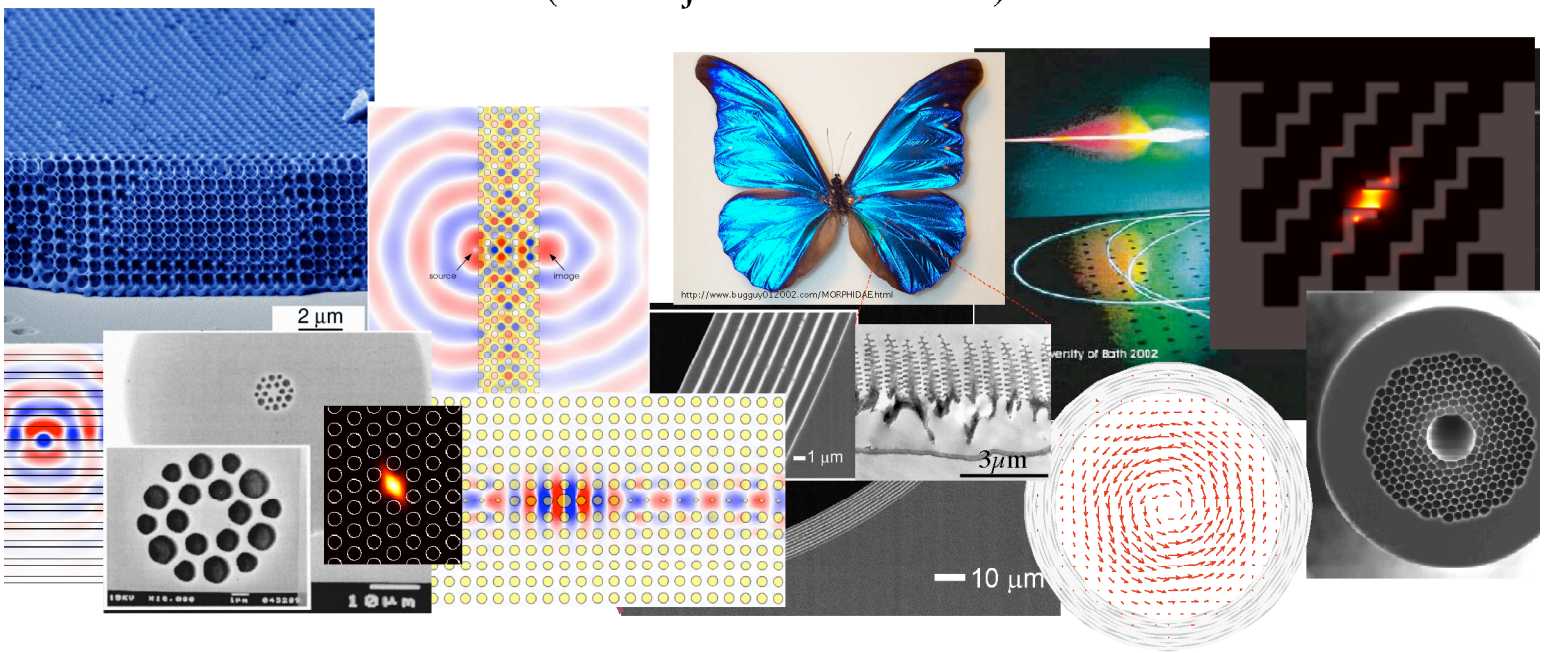

Tired of doing electromagnetism like it's 1865?

Find out what solid-state physics has brought to 8.02 in the last 25 years, in this new course surveying the physics and mathematics of nanophotonics — electromagnetic waves in **media structured on the scale of the wavelength**.

In this regime, which is the basis for everything from iridescent butterfly wings to distributed-feedback lasers and integrated optical devices to the next generation of optical fibers, the 140-year-old analytical techniques you learned in 8.02 aren't very useful. Instead, we will cover computational methods combined with high-level algebraic techniques borrowed from solid-state quantum mechanics: linear algebra and eigensystems, group theory, Bloch's theorem and conservation laws, perturbation methods, and coupled-mode theory, to understand surprising optical phenomena such as those pictured above.

For beginning graduate students and advanced undergraduates.
Prerequisites: 18.305 or permission of instructor
(basically: experience with partial differential equations & linear algebra, e.g. 8.05, 8.07, 8.321, 6.013, 3.21, 2.062, …)