

OPTI-551

Computational Optics: Nonlinear Light-Matter Interactions

Theory, Models, Simulation, ...

Hands-on case-studies sample high-intensity NLO

Course on theory, modeling, and simulation of light-matter interactions in extremely nonlinear regimes. The material is organized into a series of studies, each consisting of a brief theoretical introduction, overview of models and numerical methods, computer-aided modeling practice sessions, and discussion of open problems.

Simulation software provided. Students contribute small-scale programming to implement new or modify existing light-matter interaction modules.

UA Course OPTI 551

Nonlinear Light-Matter Interactions



**University of Arizona
College of Optical Sciences
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Spring Semester 2021**



- **Introduction: Maxwell equations and light-matter interactions**
- **Simulation of ultra-short duration, high-intensity optical pulses**
- **Anatomy of an optical-pulse simulator**
- **Third-order nonlinear interactions**
 - Kerr effect, Raman effect and molecular reorientation
 - Nonlinear self-focusing and beam collapse
 - Self-focusing collapse arrest mechanisms
 - Supercontinuum generation in bulk media and in fibers
- **Second-order NLO in solid-state media**
 - Full-field treatment vs envelope-based models
 - Second-harmonic generation
 - Supercontinuum and higher-harmonic generation
- **Strong-field interactions with atoms and molecules**
 - Quantum systems exposed to EM fields
 - Strong-field approximation
 - High-harmonic generation
- **Final project presentations**