



PHYS 555 - Nonlinear Optics

Spring 2005, Tu-Th 5:30-6:45

www.optics.unm.edu/sbahae/courses/

Instructor: **Mansoor Sheik-Bahae**, Room 1109 , Tel: 277-2080, e-mail: msb@unm.edu

Text: Nonlinear Optics 2nd Edition by R.W. Boyd, Academic Press

Reference books: Handbook of Nonlinear Optics , *R.L. Sutherland*, Dekker
Optical Electronics in Modern Communications, 5th ed. by A. Yariv, Oxford
OSA's Handbook of Optics, IV, McGraw Hill
The Principles of Nonlinear Optics, *Y. R. Shen*, Wiley

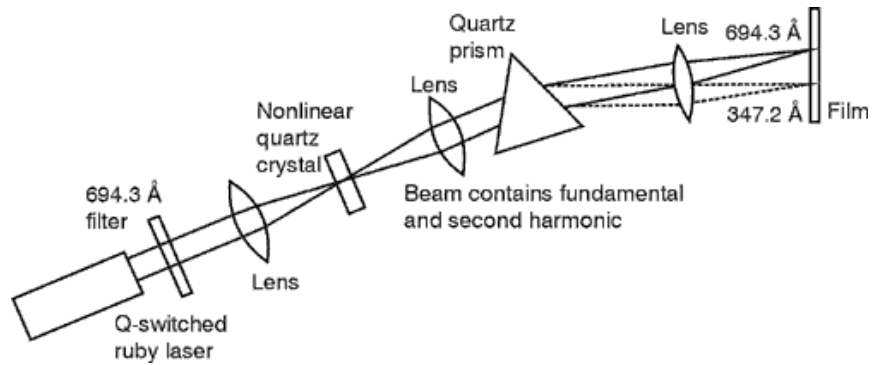
Grading: 2 midterm exams: 25% each, final presentation: 25% , homework: 25%

Office hours: Tuesdays 2:00-3:00 p.m., or by appointments.

Grader: Amarin Ratanavis (amarin@unm.edu), TA Office Hours: Tuesdays 4-5 pm, Rm.1112

- **Introduction** (*historical overview, applications of NLO*)
- **Nonlinear Susceptibilities** ($\chi^{(2)}$ and $\chi^{(3)}$ processes, *nonlinear refraction and absorption*)
- **Classical Anharmonic Oscillator Model**
- **Properties of Nonlinear Susceptibilities** (*symmetries, Kramers-Kronig dispersion relations*)
- **Wave Propagation in NLO Media** (*coupled amplitude equations for $\chi^{(2)}$ processes, phase matching, second harmonic generation, sum and difference frequency generation, optical parametric processes, cascading nonlinearities*)
- **Quantum Mechanical Treatment of Nonlinear Susceptibilities**
- $\chi^{(3)}$ **Processes** (*electronic, vibrational and rotational effects, optical Kerr effect, self-focusing, wave-mixing, bistability, phase-conjugation, beam coupling, solitons*)
- **Photo-Refractive Nonlinearities**
- **Stimulated Light Scattering** (*stimulated Raman, Brillouin, and Rayleigh scattering*)

Peter Franken's pioneering experiment on second-harmonic generation (1961)



The famous figure in Physical Review Letters: [Phys. Rev. Lett. 7, 118 \(1961\)](#)

