PHYS 568 - Nonlinear Optics
Spring 2007, M-W 5:30-6:45

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


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: midterm exams: 35% each, final presentation: 35%, homework: 30%

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

Grader: Chia-Yeh Li(cyli@unm.edu)

• 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)**


**FIG. 1.** A direct reproduction of the first plate in which there was an indication of second harmonic. The wavelength scale is in units of 100 Å. The arrow at 3472 Å indicates the small but dense image produced by the second harmonic. The image of the primary beam at 6943 Å is very large due to halation.