

Introduction to Nonlinear Optics

Session #1

Introduction:

- The Non linear Optical Susceptibility Tensor;
- On the Physical Origins of the Nonlinear Optical Coefficients;

Second Order Optical Nonlinearities:

- Second Harmonic Generation, Phase matching, examples of phase matching techniques;
- Basic equations of Parametric Amplification, three-wave mixing, frequency up- and down-conversion, Parametric Oscillation.

Third Order Optical Nonlinearities:

- The Nonlinear Constants, Intensity dependence of the refractive index;
- Self Focusing of Optical Beams, Diffraction-less propagation of Optical beams: Spatial Solitons;

Session #2

Third Order Optical Nonlinearities:

- Third harmonic generation; Third order parametric processes, four wave mixing;
- Molecular Raman Scattering, Stimulated Molecular Raman Scattering;
- Stimulated Brillouin Scattering.

Introduction to Optical Solitons:

- Wavepackets, Group velocity and Dispersion;
- Nonlinear wavepackets and the nonlinear Schrödinger equation;
- Self phase modulation, Spectral broadening, effects on group velocity dispersion, Pulse Compression;
- Modulation instability, Fundamental and higher orders Solitons.

References:

- A. Yariv, "Quantum Electronics", -3rd edition, Wiley & Sons Inc. 1989
- R. W. Boyd, "Nonlinear Optics", second edition, Academic Press, Inc. 2003
- A.C. Newell, J.V. Moloney, "Nonlinear Optics", Addison-Wesley Publishing Company, 1992
- G.P. Agrawal, "Nonlinear Fiber Optics, Academic Press Inc. 1989