Master Physique fondamentale et applications
Nonlinear optics

Informations

Composante : Faculté des Sciences

Responsables

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Langue(s) d'enseignement

Anglais

Contenu

1 Introduction
1.1 Explaining the name
1.2 The origin of the nonlinearity in P(E)
1.3 The polarization density and the susceptibility tensors
1.4 List and classification of NLO effects
1.5 The symmetries of higher order susceptibilities
1.6 Simplified photon picture

2 Linear but anisotropic optics
2.1 Propagation in an anisotropic medium
2.2 The "types" of phase matching;

3 The nonlinear wave equation
3.1 The exact version
3.2 The approximated version for three wave interaction
3.3 Energy conservation and Manley-Rowe rel.

4 Practical aspects of three wave interaction
4.1 SHG
4.2 Phase matched OPA with non-depleted pump
4.3 Influence of the crystal anisotropy: effective nonlinearity

5 Third order nonlinear optical response
5.1 Optical Kerr effect
5.2 Nonlinear optical parameters, ...

Compétences à acquérir

At the end of this module, the student will be able to:

- Understand the formalism of the classical description of nonlinear optics
- Develop an understanding of the classical NLO wave equation for superpositions of monochromatic waves
- Find directions of phase matching in a nonlinear optical crystal
- Understand how the crystal symmetries influence the Chi tensor and the effective nonlinearity
- Establish the system of differential equations describing a chi2 effect.
- Be able to derive the set of differential equations for a given situation and solve it using approximations or numerical tools
- Understand the physics of frequently encountered nonlinear optical phenomena
- Know some basic applications of NLO

Modalités d'organisation

This course is a classical lecture. Excercises are given during the lecture.

Bibliographie, lectures recommandées

P. N. Butcher and D. Cotter "The Elements of Nonlinear Optics", Cambridge University Press (1991, or better1998)

Robert W. Boyd, "Nonlinear Optics" 3rd edition (Academic Press)

Pré-requis obligatoires

A solid mathematical background is needed: complex numbers, complex vector analysis, differential equations, Fourier transforms.

Prérequis recommandés

Scientific programming skills are helpful to evaluate the phase mismatch, solve the sets of differential equations, …

VOLUME HORAIRE

- Volume total: 20 heures
- Cours magistraux: 20 heures

Codes Apogée

- SPFBU30J [ELP]

Pour plus d'informations

Aller sur le site de l'offre de formation...

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