
Modern Optics II: Nonlinear Optics

PERTURBATION THEORY

Exercises' sheet No 1

May 2017

Exercise 1

The refractive index for Lithium Niobate is given by the Sellmeier equation :

$$n^2 - 1 = \frac{2.6734\lambda^2}{\lambda^2 - 0.01764} + \frac{1.2290\lambda^2}{\lambda^2 - 0.05914} + \frac{12.614\lambda^2}{\lambda^2 - 474.60} \quad (1)$$

where λ is expressed in micron. Pumping a lithium niobate crystal at $\lambda = 1064$ nm in order to generate second harmonic, calculate the coherence length of this process.

Exercise 2

In the sum-frequency process, prove the momentum conservation cannot be satisfied in a *normally dispersive medium*.

Exercise 3

BBO (β -barium borate) is commonly used for 2nd-order autocorrelator where second harmonic is used. One possible way to use this crystal is in non-collinear configuration (Fig.). Calculate the angle required for phase-matching in this process, i.e. the angle between

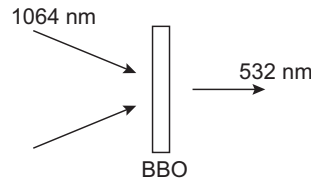


FIGURE 1 – Non-collinear phase-matching for second harmonic generation in β -barium borate crystal.

the two beams entering the crystal. We give the refractive indices $n_{1064} = 1.6551$ and $n_{532} = 1.5555$.