# Modern Optics II: Nonlinear Optics
## Sheet IV

*nonlinear generation of new frequencies* May 2017

**Exercise 1** *Second harmonic generation*

We use a BBO-crystal to perform second harmonic from 1064 nm. The crystal is uniaxial negative and the phase-matching process follows the scheme is *ooe*.

1. The optic axis of the crystal is parallel to the entrance face of the crystal. Calculate the phase-matching angle.
2. At this angle, calculate the effective refractive index $n_e(\theta)$.
3. Suppose that the crystal is 3 mm long, show that the second harmonic signal do not overlap with the incident beam. Any comments ?

We give the typical value of refractive indices for BBO :

| $\lambda\,[\mu m]$ | $n_o$ | $n_e$ |
|---|---|---|
| 0.355 | 1.7055 | 1.5775 |
| 0.532 | 1.6750 | 1.555 |
| 1.064 | 1.6551 | 1.5426 |