

Frequently asked questions QUANTUM ELECTRONICS
by K Thyagarajan, Physics Department, IIT Delhi, New Delhi.

Module 3: Frequently asked questions:

1. Q: What is the effect of walk off of the extraordinary ray on the efficiency of second harmonic generation?
2. Q: If third order QPM requires much larger periods of domain reversal, why do I not prefer third order QPM for second harmonic generation?
3. Q: When two frequencies ω_1 and ω_2 are incident on a nonlinear medium what determines whether the sum frequency or the difference frequency will get generated?
4. Q: When a pump at frequency ω_p and a signal at frequency ω_s are incident on a nonlinear crystal satisfying the phase matching condition, what determines whether the power will flow from the pump to the signal or from the signal to the pump?
5. Q: What is difference between a phase insensitive amplifier and a phase sensitive amplifier?

Answers of module 3 FAQs:

A1: Due to walk off there is a reduction in the efficiency of the second harmonic generation.

A2: The Fourier coefficient corresponding to the third order QPM condition is smaller than the Fourier coefficient corresponding to the first order QPM. Hence the effective nonlinear coefficient with third order QPM will be smaller than with first order QPM and thus second harmonic generation with first order QPM will be much more efficient than third order QPM.

A3: The phase matching condition will determine whether the sum frequency or difference frequency gets generated.

A4: The relative phases of the pump and signal at the input will determine the direction of power flow. This is the reason why the signal can get either amplified or attenuated depending on the relative phase of the signal with respect to the pump.

A5: In the case of phase insensitive amplifier like amplification by population inversion, an input signal gets amplified irrespective of its phase. On the other hand, in a phase sensitive amplifier like a degenerate parametric amplifier, the signal can get amplified or attenuated depending on its phase relative to the pump.