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Linewidth & SHG efficiency:

Q: **How does linewidth of the pump laser affect the SHG efficiency?**

A:

When using the CW multimode pump to do the second harmonic generation (SHG), the relation between laser linewidth and the PPLN acceptance bandwidth will influence the conversion efficiency a lot. In the case of type 0 and type I SHG, there is a "multimode enhancement" effect [1] that the conversion efficiency can be at most twice larger than the single frequency pump due to the contribution of SFG between the different modes.

The enhancement factor M equals to the simple equation below, where N is the number of mode, if the laser linewidth is quite small compares to the PPLN bandwidth.

$$M = 2 - \frac{1}{N}$$

In the case of N→∞, the real enhancement factor will be influenced by the relation between laser linewidth/shape and the PPLN bandwidth. The figure 1 below shows the result of the enhancement factor under different normalized bandwidth V (laser linewidth divided by PPLN bandwidth) in Gaussian and Lorentzian lineshape, respectively. Figure 2 is the reference of PPLN bandwidth under different input wavelength.

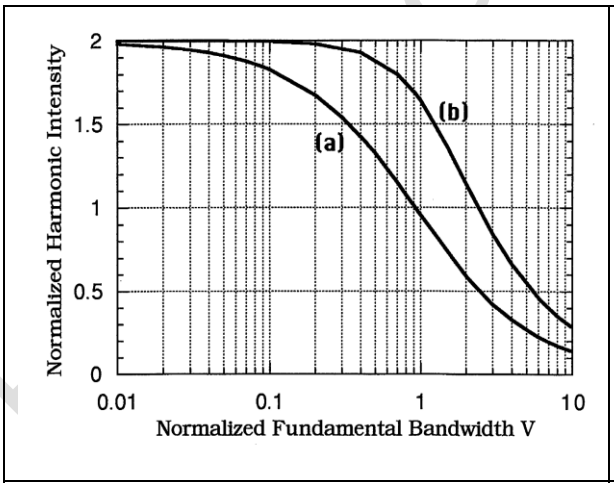

Fig. 1 Relation of normalized fundamental bandwidth V and the enhancement factor (Normalized harmonic intensity) under the (a). Lorentzian and (b). Gaussian lineshape. The figure is reference from [1].

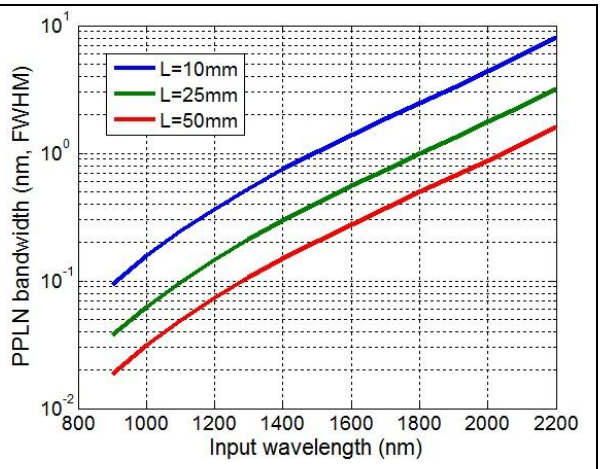

Fig. 2 PPLN bandwidth under different input wavelength at L=10, 25, 50mm. The calculation is based on the Sellmeier equation from [2].

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Reference:

[1] Wang Long Zhou *et al.*, "Theoretical Analysis of Multimode Pumped Second Harmonic Generation", Jpn. J .Appl. Phys. vol. 34 (1995)

[2] O. Gayer, Z. Sacks, E. Galun, and A. Arie, "Temperature and wavelength dependent refractive index equations for MgO-doped congruent and stoichiometric LiNbO3", Appl. Phys. B 91, 343 (2008)