

# LEARNING ACTIVITY

## OPO using a PPLN crystal

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One intends to build a singly resonant Optical Parametric Oscillator at  $\lambda_p = 1500$  nm, pumped by a Nd:YAG laser at  $\lambda_s = 1064$  nm. The selected nonlinear crystal is a  $L = 5$  mm long periodically poled LiNbO<sub>3</sub> crystal (PPLN) with  $\chi_{ZZZ}^{(2)} = -60$  pm/V. The total power loss of the cavity is set equal to 0.05 (coinciding with the intensity transmission of one of the cavity mirrors)

The ordinary  $n_o$  and extraordinary  $n_e$  refractive indices of the crystal at the interacted wavelengths are :

	$\lambda_p$	$\lambda_s$	$\lambda_i$
$n_o$	2.2340	2.2141	2.1329
$n_e$	2.1554	2.1388	2.0705

**What is the wavelength of the idler beam ? Give an order of magnitude of the QPM period  $\Lambda$  and of the required pump power.**

### Indications

- To evaluate the pump power, derive the threshold condition for a singly resonant OPO. Remember that the parametric gain is usually small (in regards with the losses of the cavity!), justifying the use of Taylor series for cosh function.
- The beam diameter is not provided... although it is required to calculate the pump power ! How can we do ? One way to proceed is to evaluate the smaller beam waist for which diffraction can be neglected along the crystal thickness.