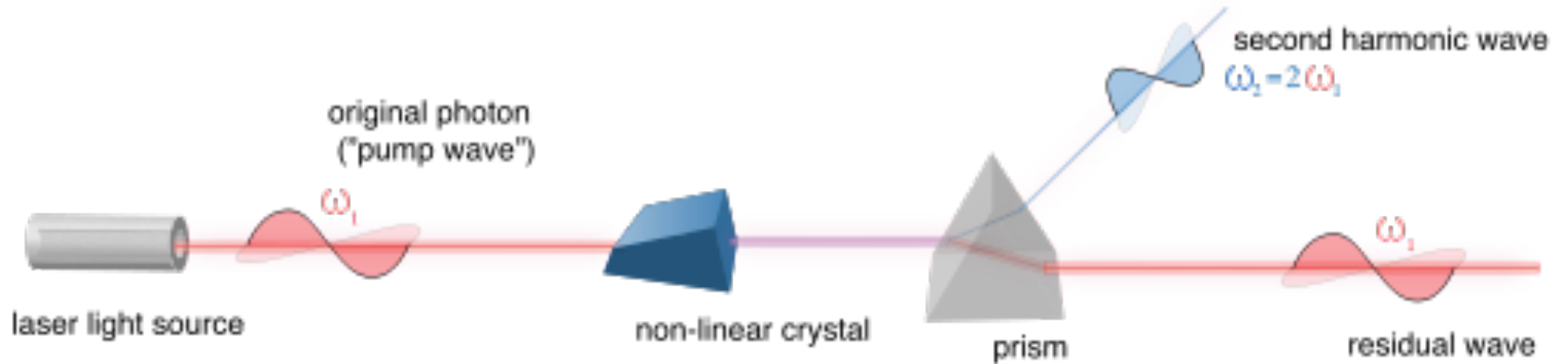


Second harmonic generation in LiNbO_3

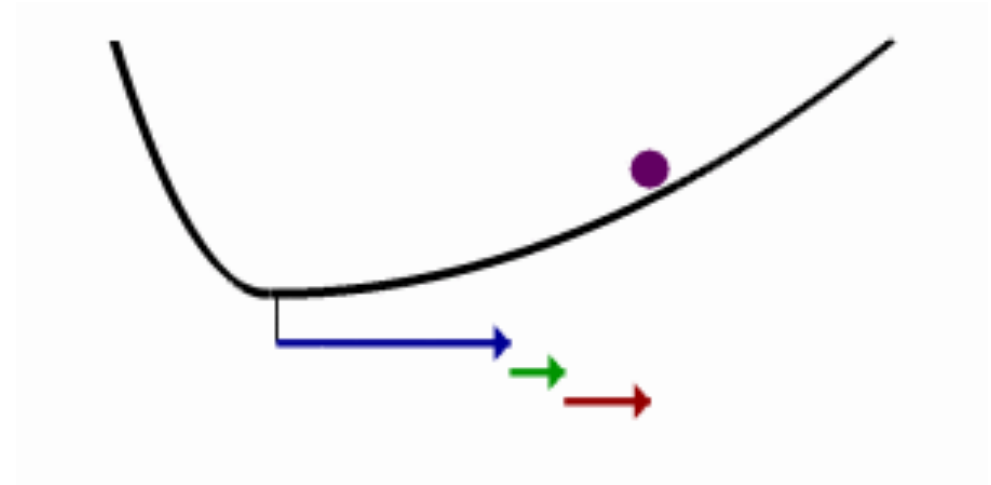
Sofie Berg MATRL286G Spring 2016

Second harmonic generation



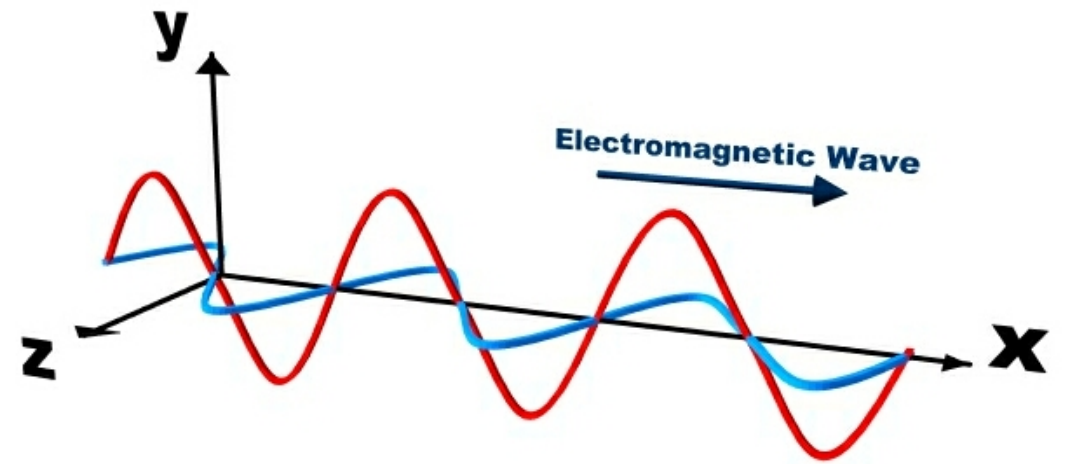
Second harmonic generation

- Frequency doubling = Twice the energy
- Nonlinear process
- No inversion symmetry
- Anharmonic oscillator

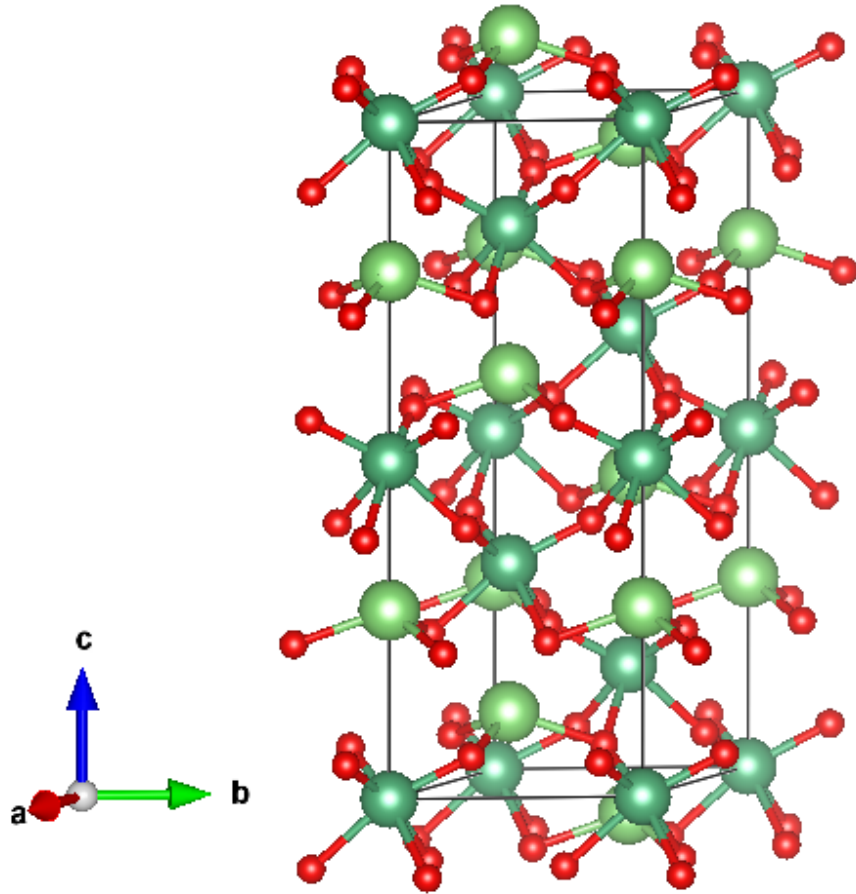


Second harmonic generation

- Photons are an electric field
- $P = P_0 + \epsilon_0 \chi^{(1)} E + \epsilon_0 \chi^{(2)} E^2 + \epsilon_0 \chi^{(3)} E^3 + \dots$
- $I_2 = \gamma I_1^2$
- Oscillating polarization field
- Importance of phase matching
- Dispersion



Lithium Niobate (LiNbO_3)



- $R3c$
- Very common nonlinear material
- $T_C = 1210^\circ\text{C}$
- $E_G = 4.0\text{ eV}$
- Birefringent

Distortion of LiNbO_3

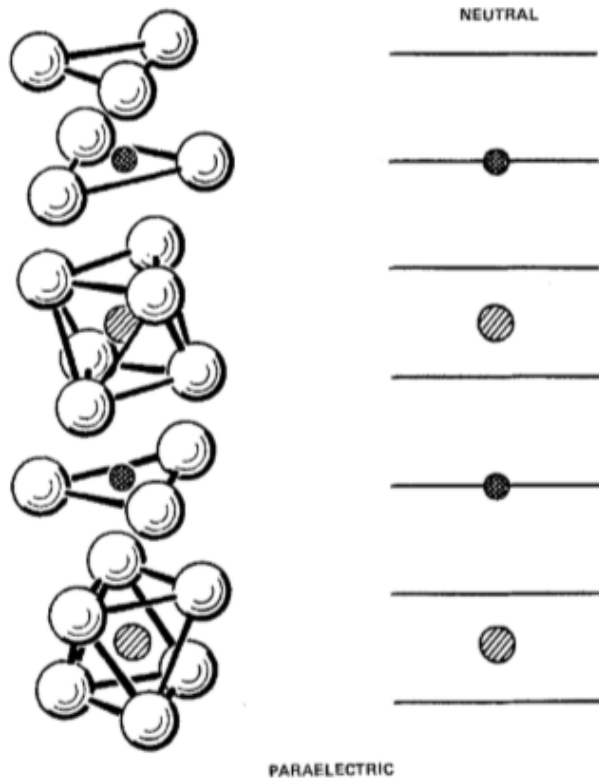


Fig. 1. Positions of the lithium atoms (double cross-hatched circles) and the niobium atoms (single cross-hatched circles) with respect to the oxygen octahedra in the paraelectric phase ($T \geq T_c$) of lithium niobate. The positions of the lithium atoms are actually equally probable to be either above or below the oxygen layers by 0.37 Å. The lithium atoms shown are in the average position – in the oxygen layer. The horizontal lines in the diagram on the right represent the oxygen layers. After [6,7]

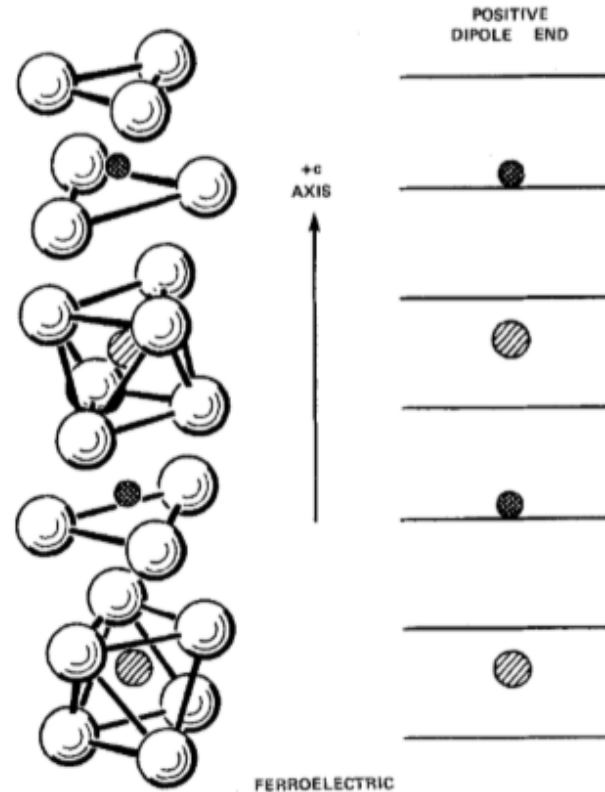
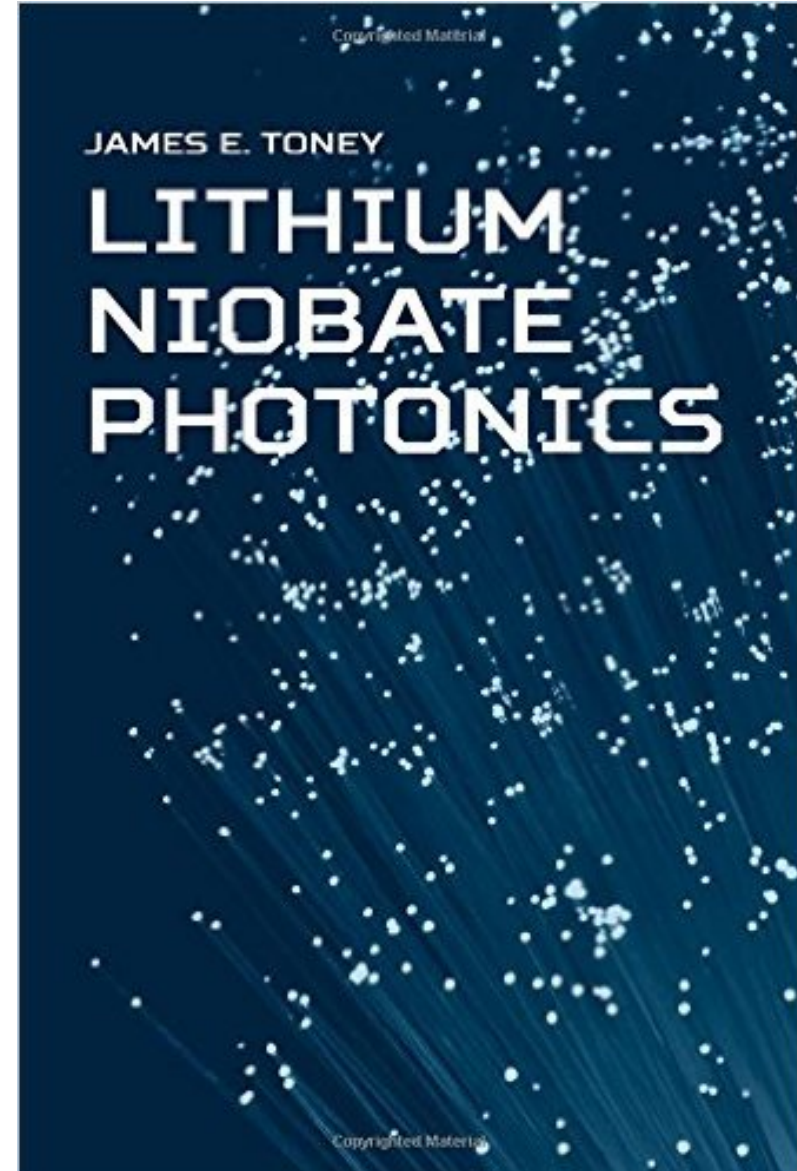
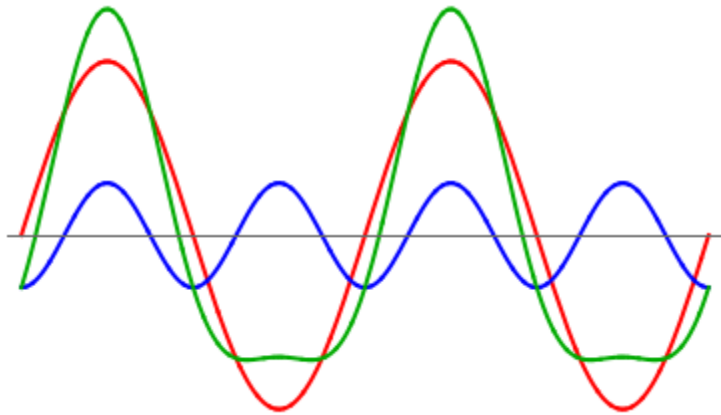


Fig. 2. Positions of the lithium atoms and niobium atoms with respect to the oxygen octahedra in the ferroelectric phase ($T < T_c$) of lithium niobate. After [6,7]

Hybridization?
Role of Lithium?

SHG in LiNbO_3

- Orientation important for phase matching
- Birefringence is an advantage



Questions?



References

- A good explanation of SHG:
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