Second Harmonic intensity

Second harmonic intensity is given by: $I_{2\omega} = \kappa(\chi_{eff}^{(2)})^2 \, l^2 \left[\frac{\sin(\frac{\Delta kl}{2})}{\frac{\Delta kl}{2}}\right]^2 I_\omega^2$

κ = constant, $\chi_{eff}^{(2)}$= second order susceptibility

l = path length of fundamental light through crystal

Wave vector difference $\Delta k,$ I_ω= intensity of fundamental light.

Ways to enhance SHG:-

1. Increasing incident power
2. Choosing material having larger second order susceptibility
3. Material fulfiling the condition of phase matching
4. Choosing longer crystal.

Practical Issues

- Polarization is given by: $\mathrm{P} = \chi_{ij}^{(1)} E + \chi_{ijk}^{(2)} E^2 + \chi_{ijkl}^{(3)} E^{(3)} + \cdots$
- Potential energy: $\mathrm{V(E)} = -\left[\frac{1}{2}\chi_{ij}^{(1)} E^2 + \frac{1}{3}\chi_{ijk}^{(2)} E^3 + \frac{1}{4}\chi_{ijkl}^{(3)} E^{(4)} + \cdots\right]$

$$\mathrm{V(-E)} = -\left[\frac{1}{2}\chi_{ij}^{(1)} E^2 - \frac{1}{3}\chi_{ijk}^{(2)} E^3 + \frac{1}{4}\chi_{ijkl}^{(3)} E^{(4)} - \cdots\right]$$

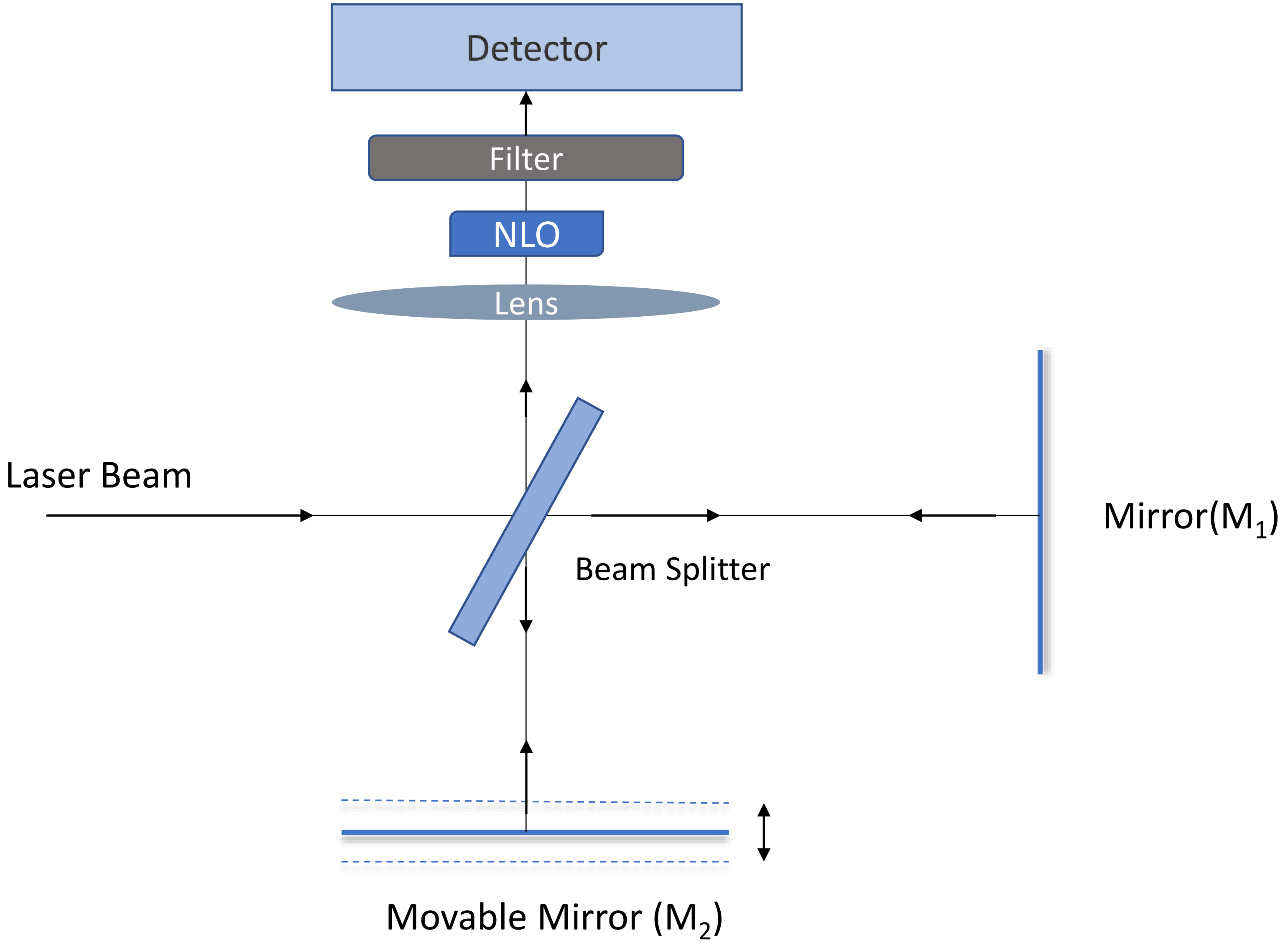
For centrosymmetric molecules: $\mathrm{V(+E)} = \mathrm{V(-E)}$, this is possible only when all even order susceptibility are zero :-

$$\chi_{eff}^{(2)} = \chi_{eff}^{(4)} = \cdots = \chi_{eff}^{(2n)} = 0$$

By electric dipole approximation we can say for centrosymmetric molecule all even order non linear process are not observed in particular ,SHG = 0

Autocorrelation

Pulse width of ultrashort pulses can be measured using autocorrelation technique which is based upon non-linear optical phenomena. In this technique two pulses from same source are allowed to interact as function of time delay between them created using a movable mirror.



Autocorrelator