



Optics: Lets look through Lasers

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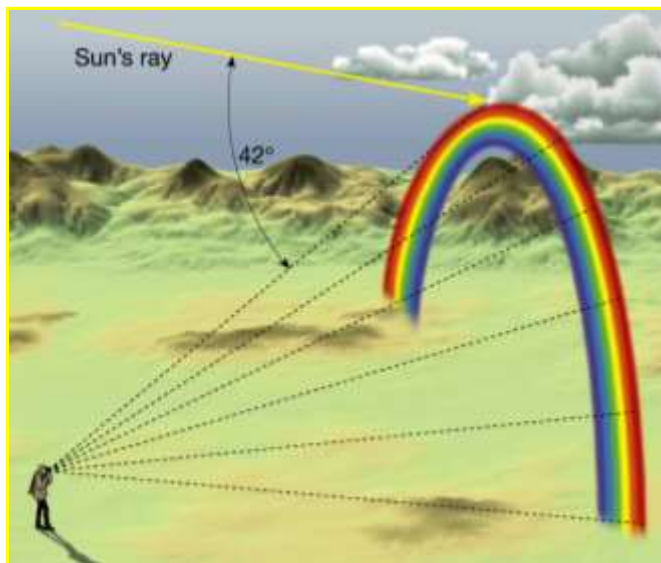
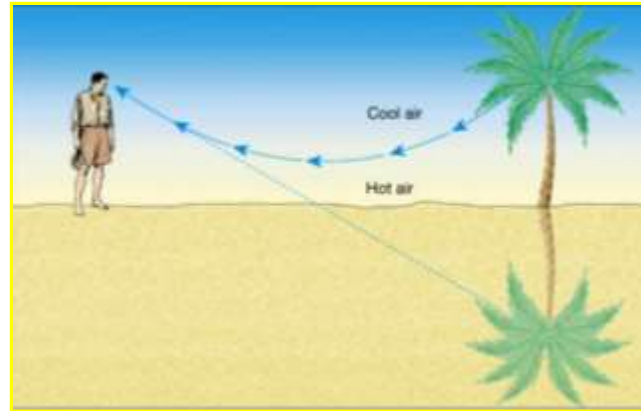
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Known Light Phenomena - Nature





Linearity gives BEAUTY
while
Nonlinearity gives EXCITEMENT

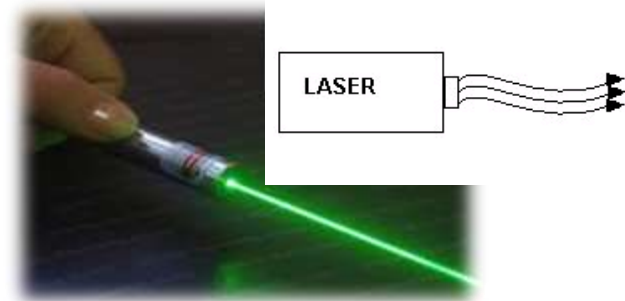




Lasers : New Vision of Optics



1. Many wavelengths
2. Multidirectional
3. Incoherent



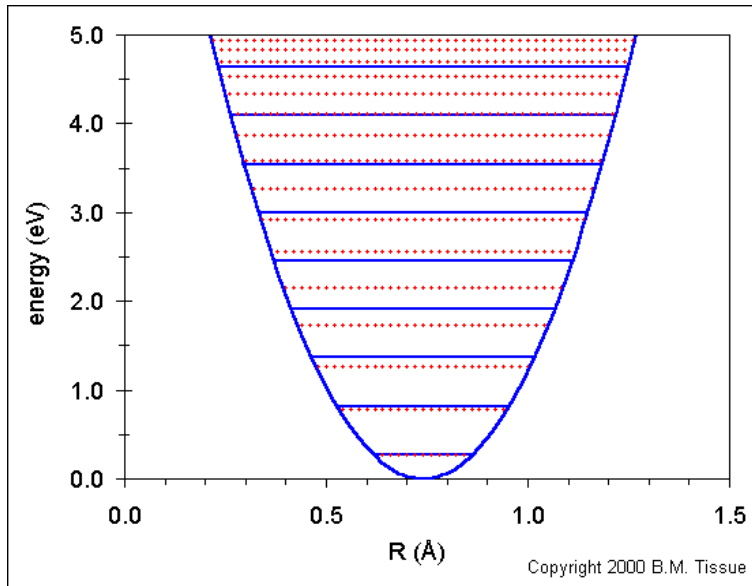
1. Monochromatic
2. Directional
3. Coherent





Linear Optics

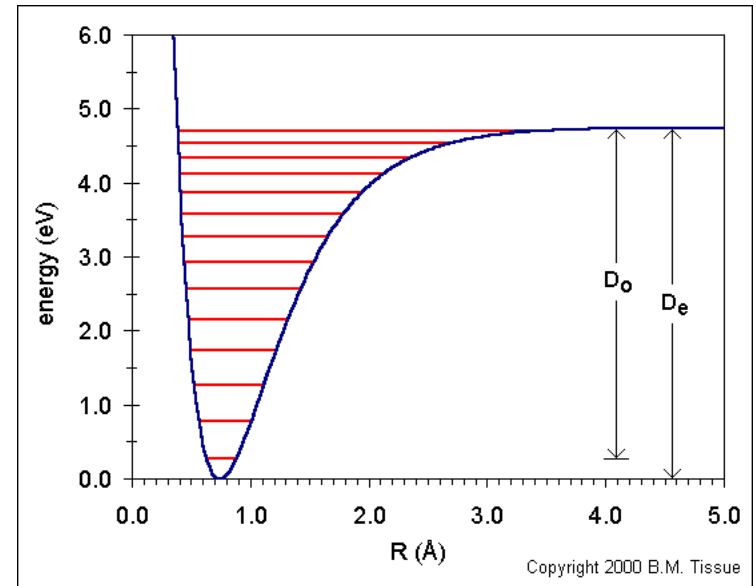
- Interaction of weak electromagnetic field
- Harmonic Oscillator
- Phenomenon – Absorption, Refraction, Polarization



LASERS

Nonlinear Optics

- Interaction of strong electromagnetic field
- Anharmonic Oscillator
- Phenomenon – nonlinear absorption, nonlinear refraction, nonlinear polarization



How does optical nonlinearity appear ?

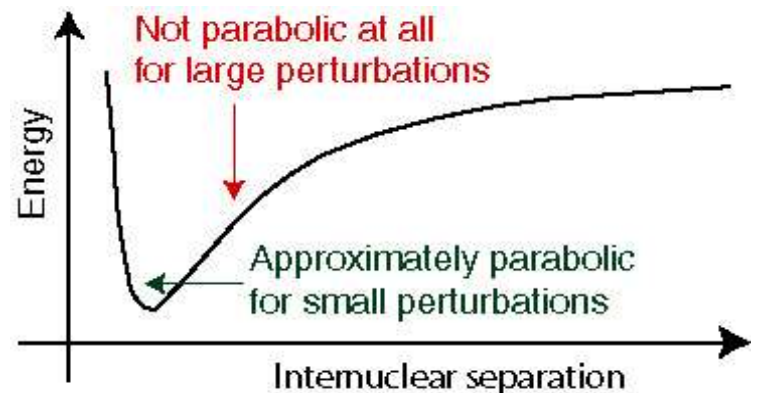
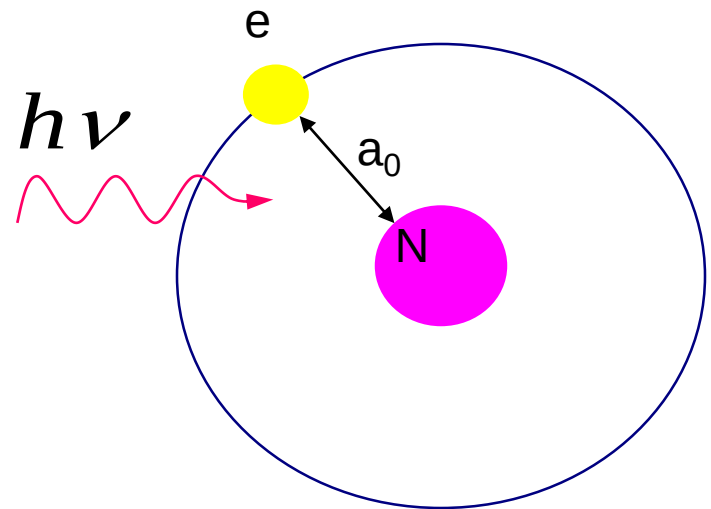


The strength of the electric field of the light wave should be in the range of atomic fields

$$E_{at} = e / a_0^2$$

$$a_0 = \hbar^2 / me^2$$

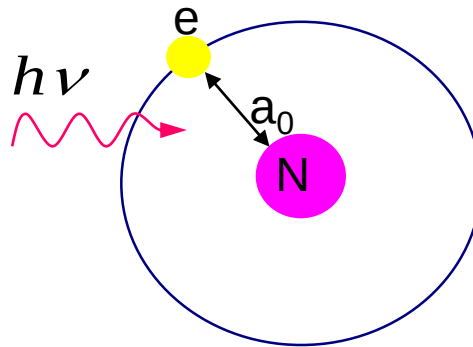
$$E_{at} \approx 2 \times 10^{+7} \text{ esu}$$



Origin of Nonlinear Optics



$$E_{at} \approx 2 \times 10^{+7} \text{ esu}$$



$$P = \epsilon_0 \chi^{(1)} E + \epsilon_0 \chi^{(2)} E E + \epsilon_0 \chi^{(3)} E E E + \dots$$