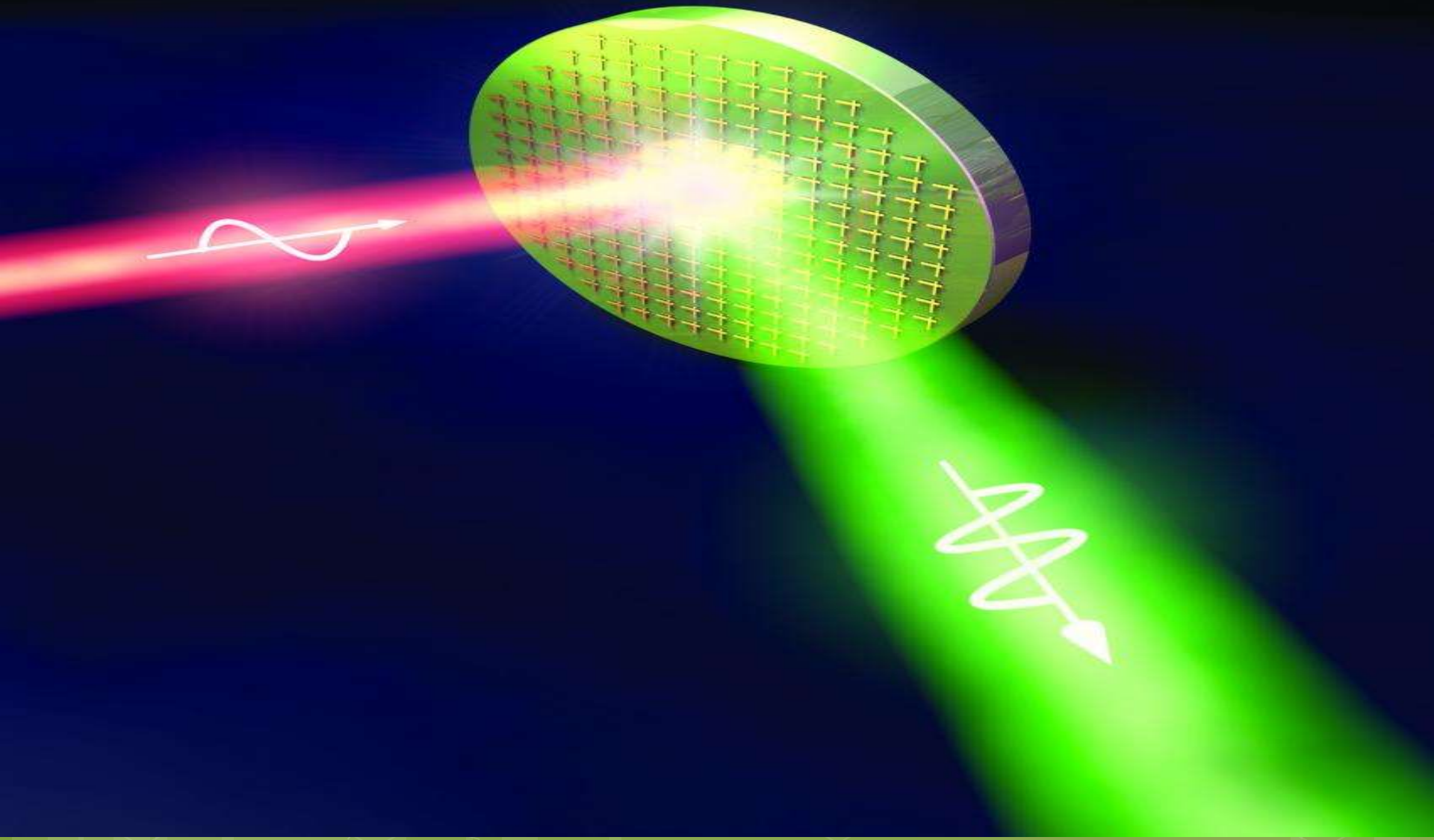
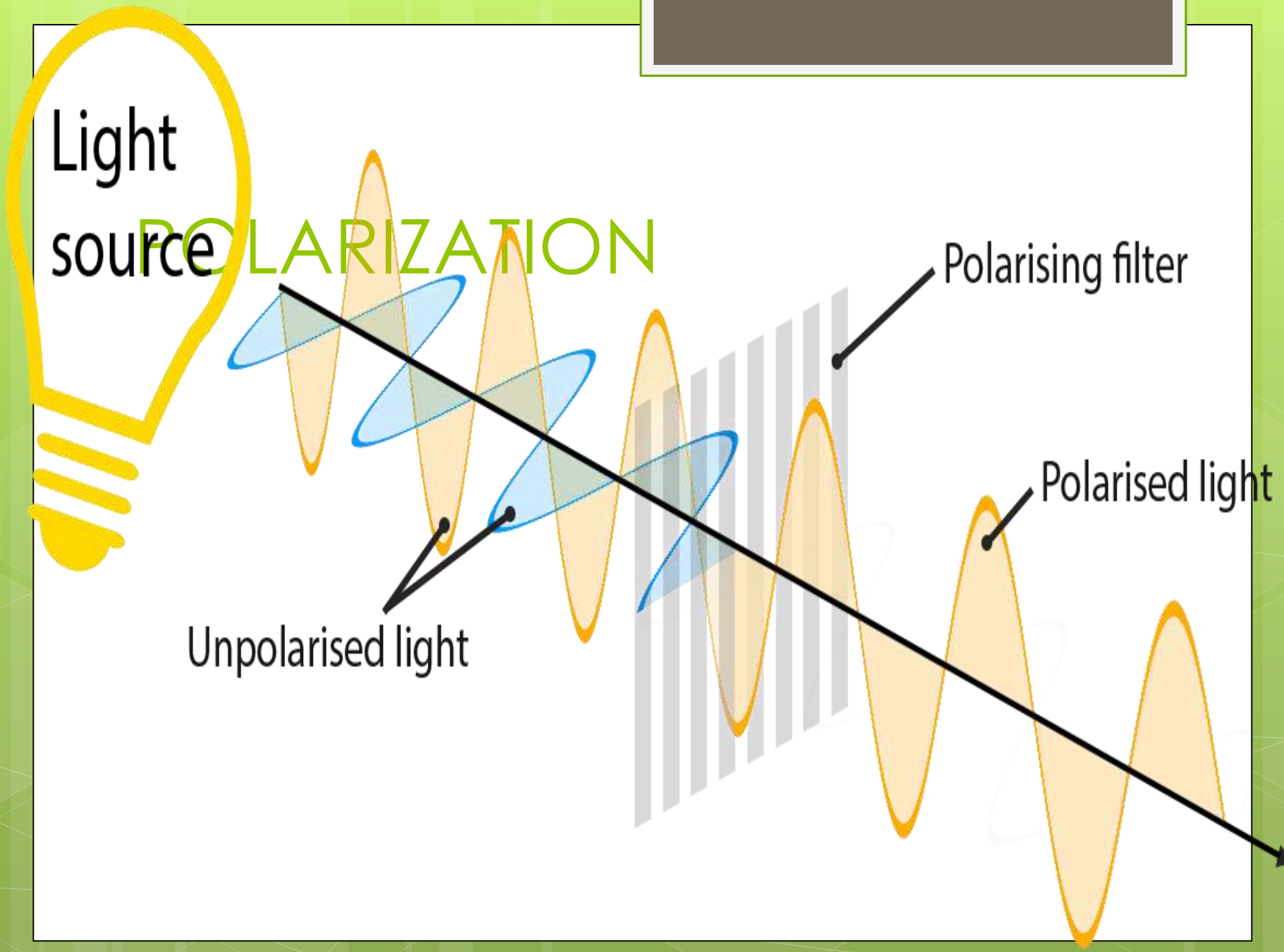
Welcome

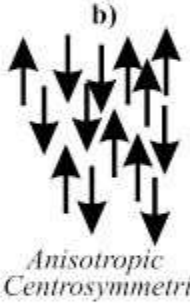
HYPER RAMAN EFFECT

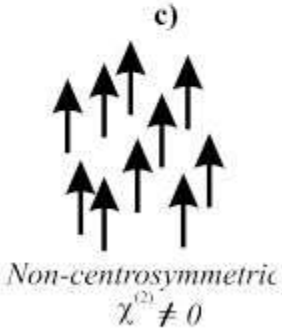


POLARIZATION



Introduction to Nonlinear Optics



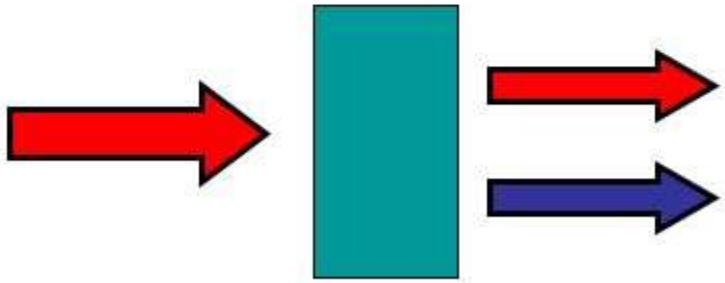


$$P(E) = \chi_L E + \chi^{(2)} E E + \chi^{(3)} EEE + \ldots$$

Linear term

Nonlinear corrections

Example of second-order effect: second harmonic generation (Franken 1961):



Symmetry restriction for second-order processes

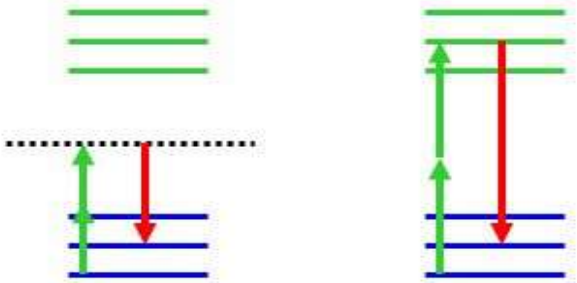
Hyper Raman Effect

- Scattered Radiations at different frequencies
- Three photon process

Hyper Raman and Surface-Enhanced Hyper Raman Spectroscopy

With focused, pulsed laser, you can induce a non-linear interaction:

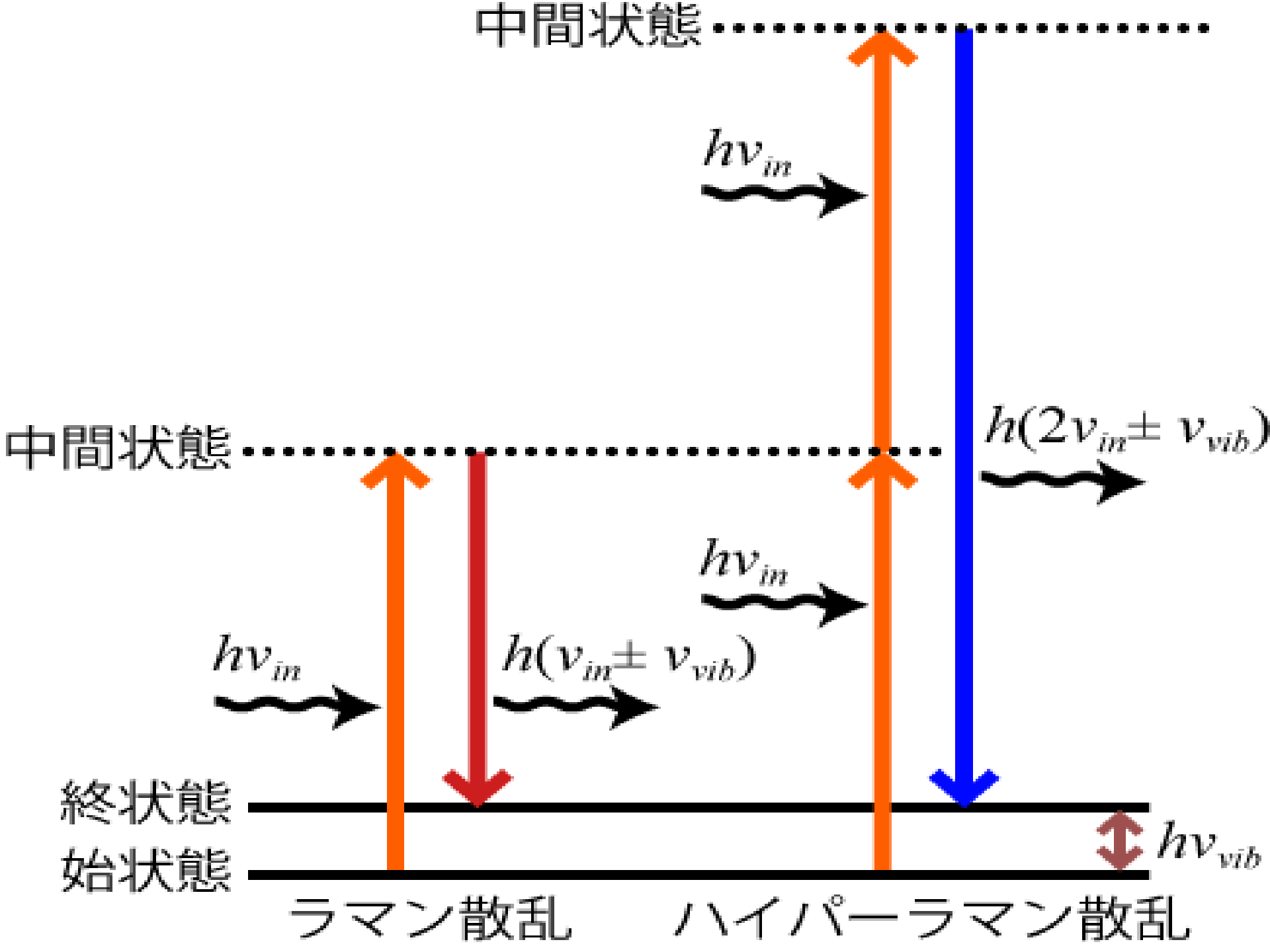
$$\mu_{ind} = \alpha\vec{E} + \frac{1}{2}\beta\vec{E}\cdot\vec{E} + \frac{1}{6}\gamma\vec{E}\cdot\vec{E}\cdot\vec{E} + \ldots$$



Incident: ν_0
Scattered: $2\nu_0$, $2\nu_0 \pm \nu_1$

Selection Rules:

All IR active modes are also hyper-Raman active
Some hyper-Raman active modes are neither IR or Raman active


中間状態
$h\nu_{in}$
中間状態
$h(2\nu_{in} \pm \nu_{vib})$
$h\nu_{in}$
$h\nu_{in}$
$h(\nu_{in} \pm \nu_{vib})$
終状態
始状態
$h\nu_{vib}$
ラマン散乱
ハイパーラマン散乱

Hyper Raman Scattering Selection Rules

- All Infrared – Active bands are Raman active
- All Raman active bands are not Hyper Raman active
- Vibration which are both Infrared and Raman active are Hyper Raman active
- Hyper Raman active vibrations which are IR active are always polarized

Classical Treatment of Hyper Raman Effect

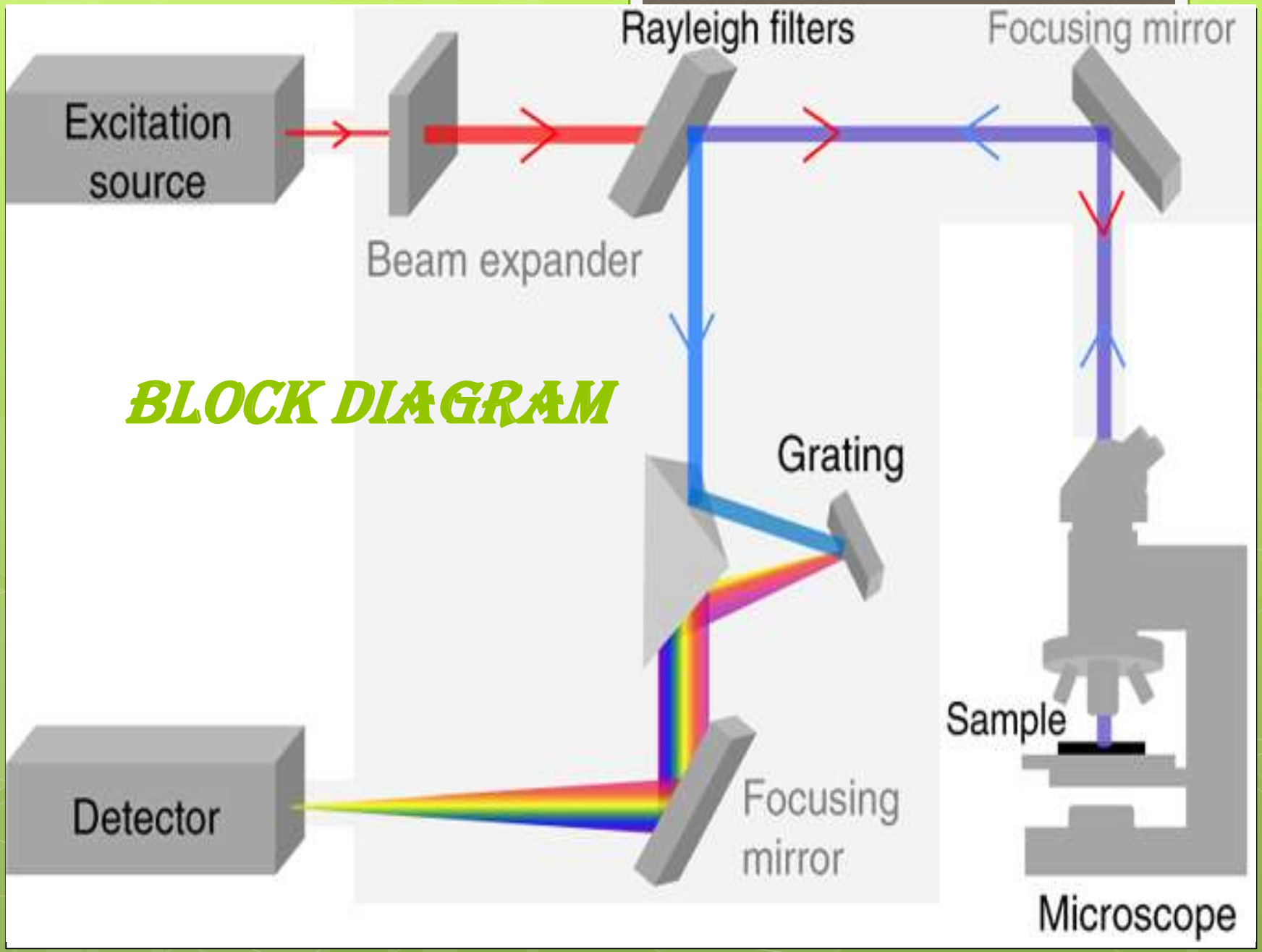
- Findings of Eight Distinct Frequency Components
- Effect of Non-Linear Susceptibility

RAMAN SPECTROMETR

Experimental Techniques for Hyper Raman Effect

- Single Channel and Multi Channel Detection
- Block Diagram of Multichannel Raman Spectrometer

BLOCK DIAGRAM



thank
you