Stimulated Raman scattering

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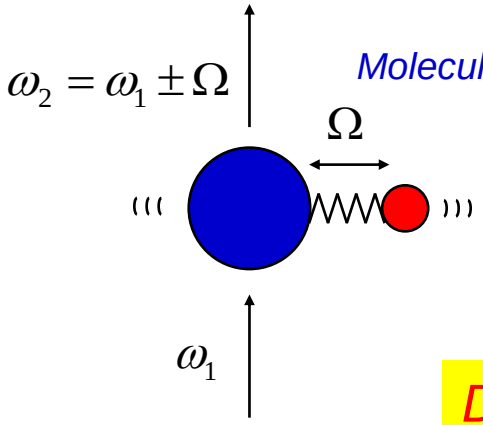
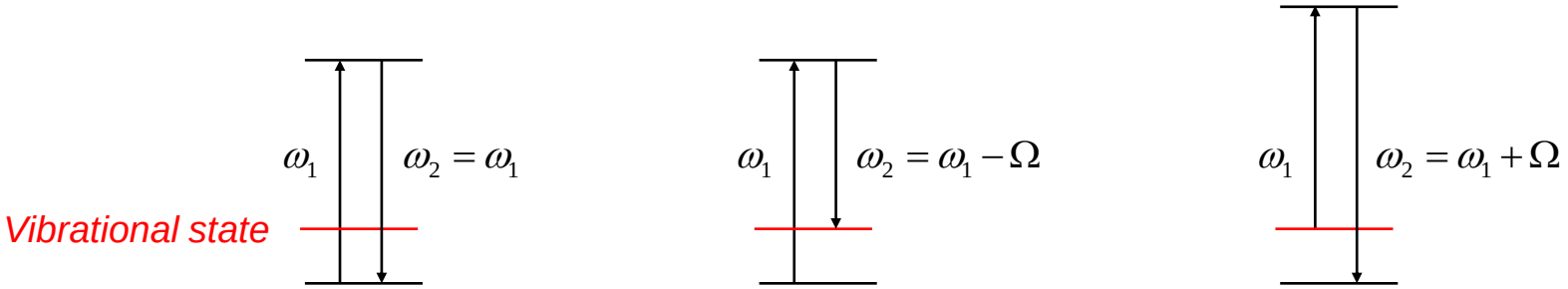
Raman scattering

The Raman effect was discovered in 1928 by C. V. Raman.

Inelastic scattering ← molecular vibrations



Does every kind of molecule vibrate?



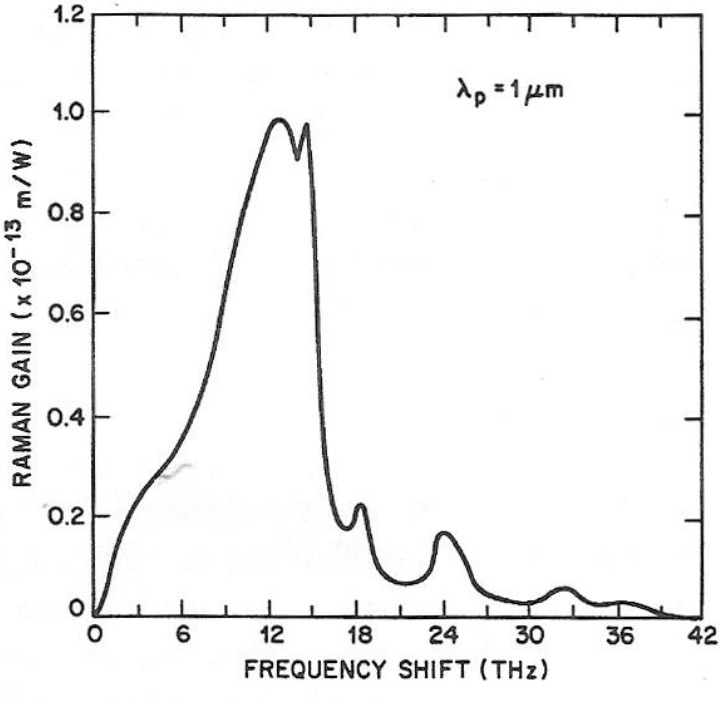
Elastic scattering: Rayleigh scattering

Inelastic scattering: Stokes scattering

Inelastic scattering: Anti-Stokes scattering

Raman gain

Raman-gain spectrum for fused silica at a pump wavelength $\lambda_p = 1\,\mu m$



Source: Nonlinear Fiber Optics, G. P. Agrawal

$$\frac{dI_s}{dz} = g_R I_p I_s - \alpha_s I_s,$$

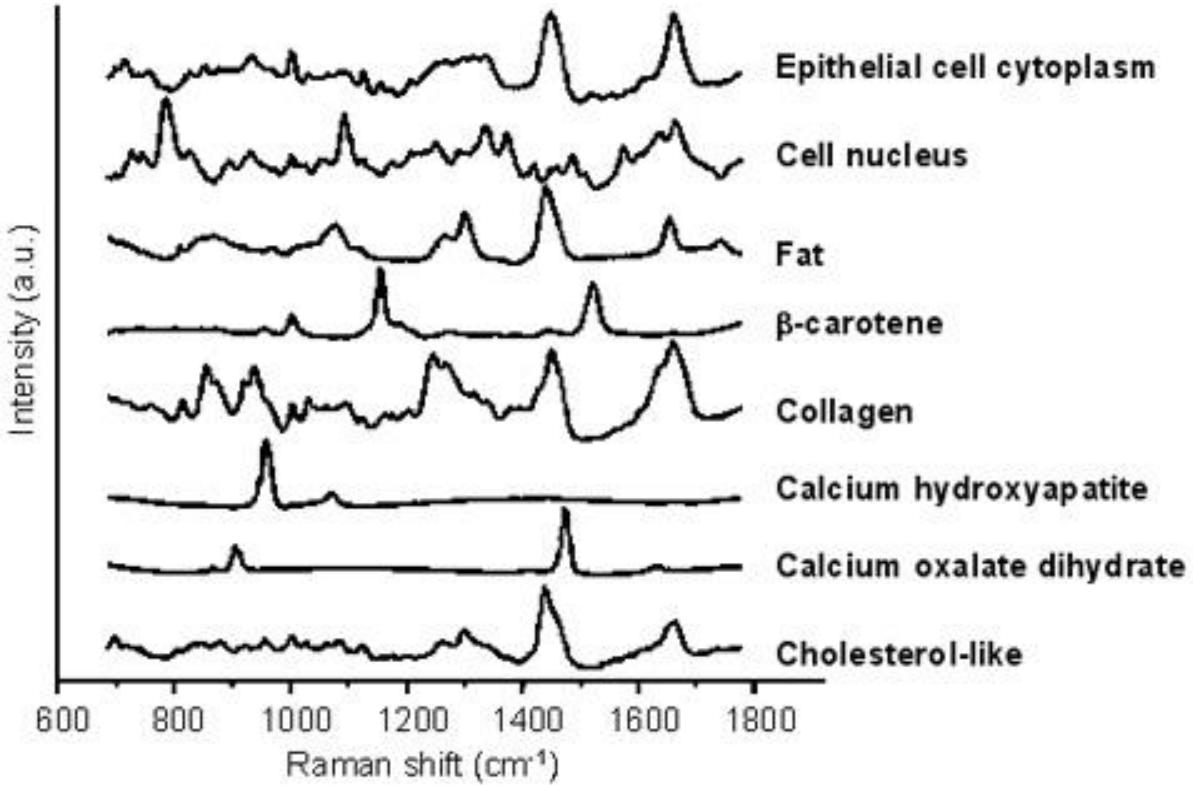
$$\frac{dI_p}{dz} = -\frac{\omega_p}{\omega_s} g_R I_p I_s - \alpha_p I_p.$$

$g_R \sim 10^{-13}$ m/W, $\Omega_R \sim 13.2$ THz

$$\frac{d}{dz}\left(\frac{I_s}{\omega_s} + \frac{I_p}{\omega_p}\right) = 0 \text{ for lossless media}$$

Raman spectroscopy

Raman spectra vary with materials:

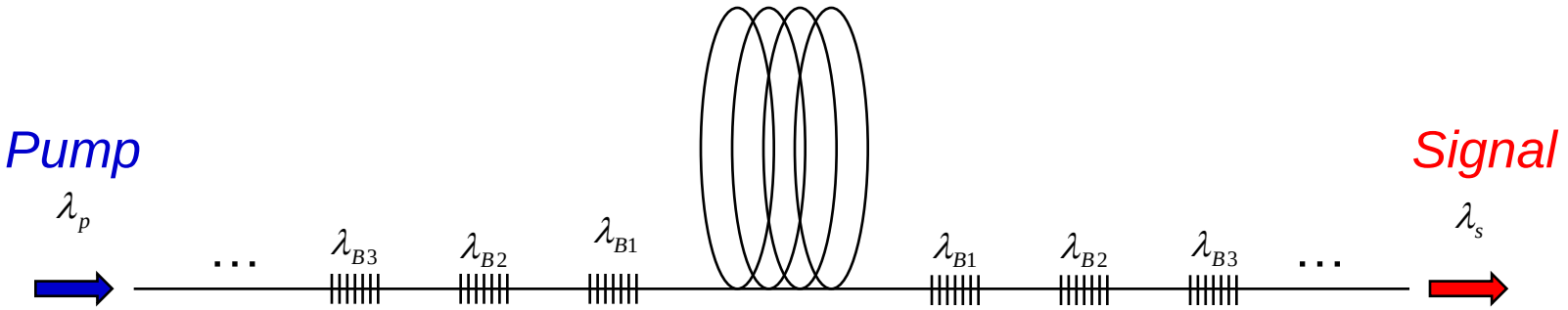


Source: http://web.mit.edu/spectroscopy/research/biomedresearch/Raman_breast.html

Raman conversion

Raman scattering readily converts higher energy photons to lower energy photons (down-shift)

Cascaded Raman fibre lasers



Wide-range wavelength access!

Raman solitons

Optics Express, Vol. 16 Issue 4, pp.2381-2386 (2008)

Double-clad Raman fibre lasers

Optics Letters, Vol. 31 No. 15, pp. 2290-2292 (2006)