

Nonlinear Optical Engineering

Stimulated Raman Scattering (3)
(NFO 5th ed: 8.4 ~ 8.5)

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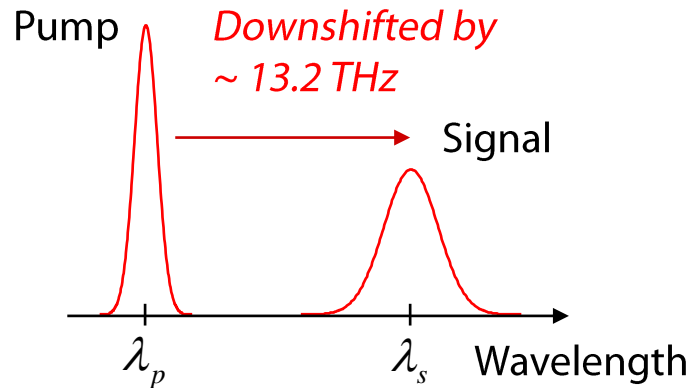
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Soliton Effects (1)

Pump and Signal (Raman Stokes):



Pulse-propagation equations:

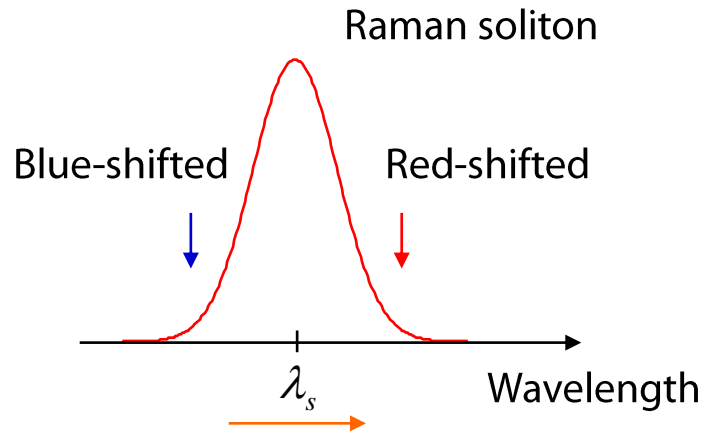
Coupled NLSE:

$$\begin{aligned} \rightarrow \frac{\partial A_p}{\partial z} + \frac{i\beta_{2p}}{2} \frac{\partial^2 A_p}{\partial T^2} &= i\gamma_p \left[|A_p|^2 + (2 - f_R) |A_s|^2 \right] A_p - \frac{g_p}{2} |A_s|^2 A_p \\ \rightarrow \frac{\partial A_s}{\partial z} - d \frac{\partial A_s}{\partial T} + \frac{i\beta_{2s}}{2} \frac{\partial^2 A_s}{\partial T^2} &= i\gamma_s \left[|A_s|^2 + (2 - f_R) |A_p|^2 \right] A_s + \frac{g_s}{2} |A_p|^2 A_s \\ \leftarrow T = t - z / v_{gp}, \quad d = v_{gp}^{-1} - v_{gs}^{-1} \end{aligned}$$

Raman Soliton: Dispersion and SPM balanced

Soliton Effects (2)

Intrapulse Raman scattering:



*Continuous energy transfer
via Raman scattering from blue-shifted
components to red-shifted components*

NLSE:

$$\rightarrow i \frac{\partial u}{\partial \xi} + \frac{1}{2} \frac{\partial^2 u}{\partial \tau^2} + |u|^2 u = \tau_R u \frac{\partial |u|^2}{\partial \tau}$$

*See: Opt. Lett. 26, 358 (2001) &
Optics Express 16, 2381 (2008)*

Spectral shift:

$$\rightarrow \Omega_p = -\frac{8T_R \gamma P_0}{15T_0^2} z = -\frac{8T_R |\beta_2|}{15T_0^4} z \quad \leftarrow N = \gamma P_0 T_0^2 / |\beta_2| = 1$$