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Winter College on Optics and Photonics
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"Nonlinear Guided Wave Optics (NLGWO)"

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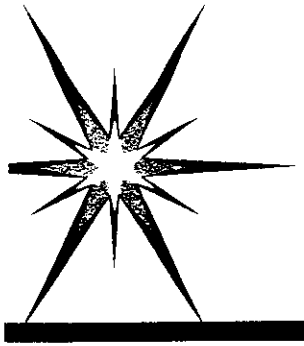
France

Please note: These are preliminary notes intended for internal distribution only.



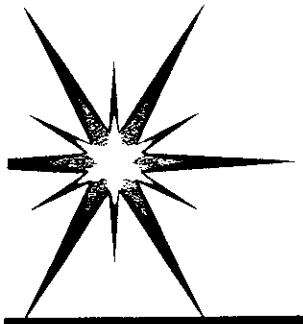
Nonlinear Guided Wave Optics (NLGWO)
ICTP Winter College

D.B. Ostrowsky

Laboratoire de la Physique de la Matière Condensée

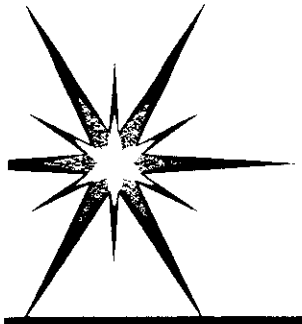
CNRS UMR 6622

Université de Nice-Sophia Antipolis



PLAN (2)

- Parametric generation
- Nonlinear Fiber Optics; Kerr, Brillouin, and Raman effects
  - Self-Phase-Modulation
  - Solitons
  - Switches
- Dynamic nonlinear fiber optics: Stimulated Brillouin Scattering (SBS)
- Conclusion



Kerr Effect

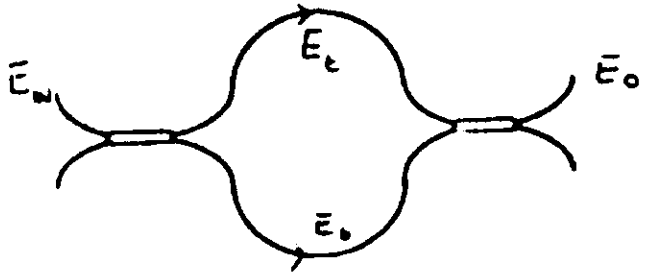
$$n = n_0 + n_2 I$$

$$\Phi = k n_2 I L$$

L = 15 km **t = 5 ps** **E = 0.33 pJ**

Nonlinear Mach-Zehnder

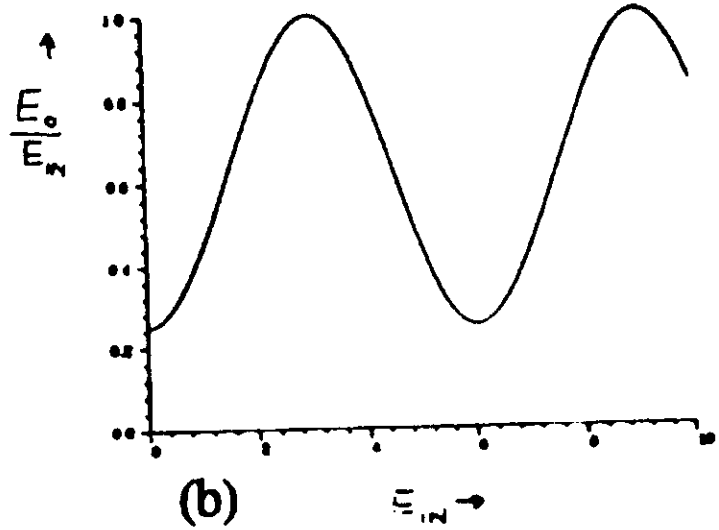
Mach-Zehnder



$$|E_o|^2 = \frac{|E_{in}|^2}{2}(1 - \cos(n_2 k_0 L(|E_t|^2 - |E_b|^2)))$$

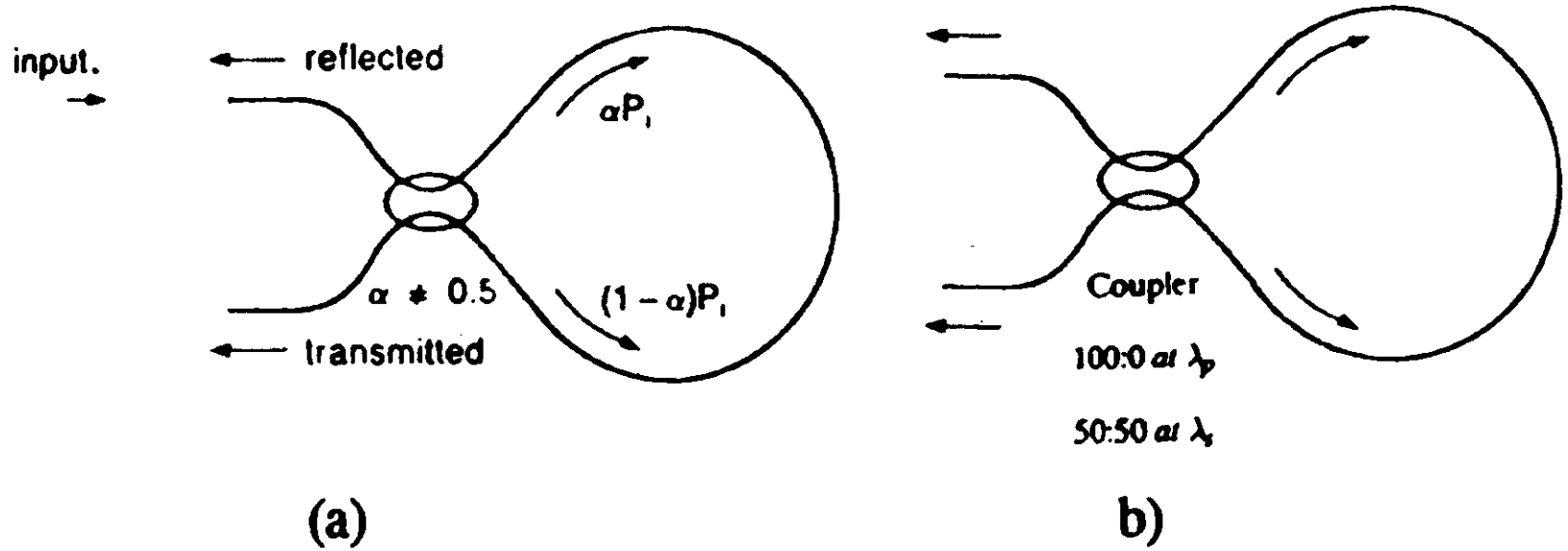
(a)

Sinusoidal nonlinear response.

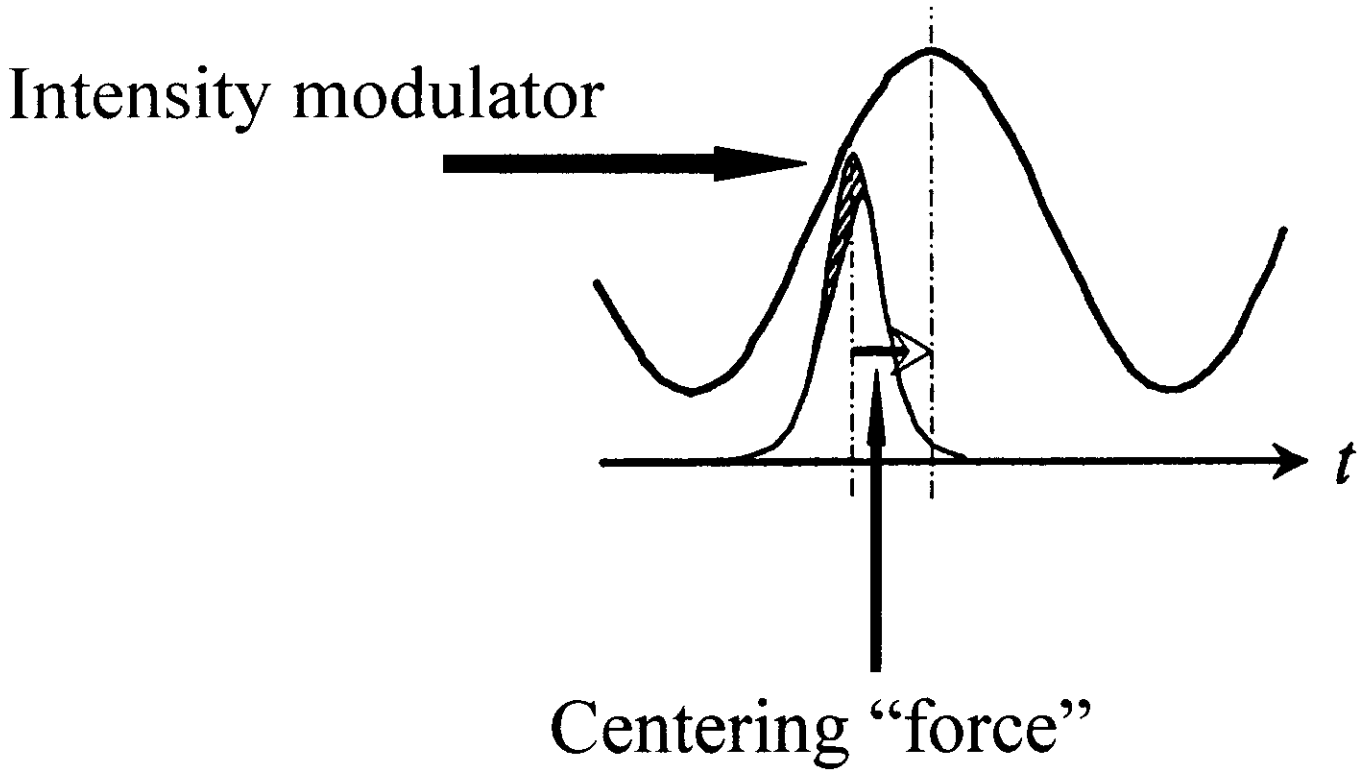


(b)

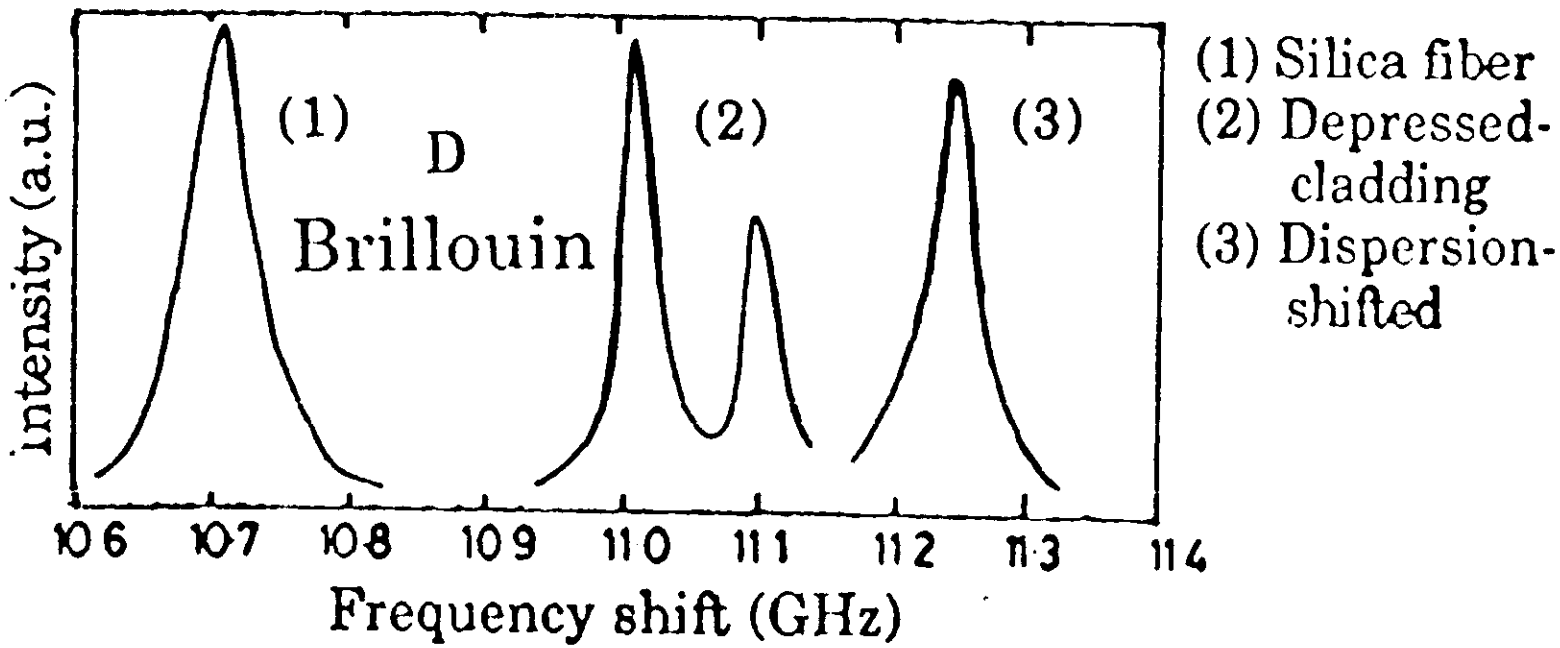
Nonlinear Optical Loop Mirror (NOLM)



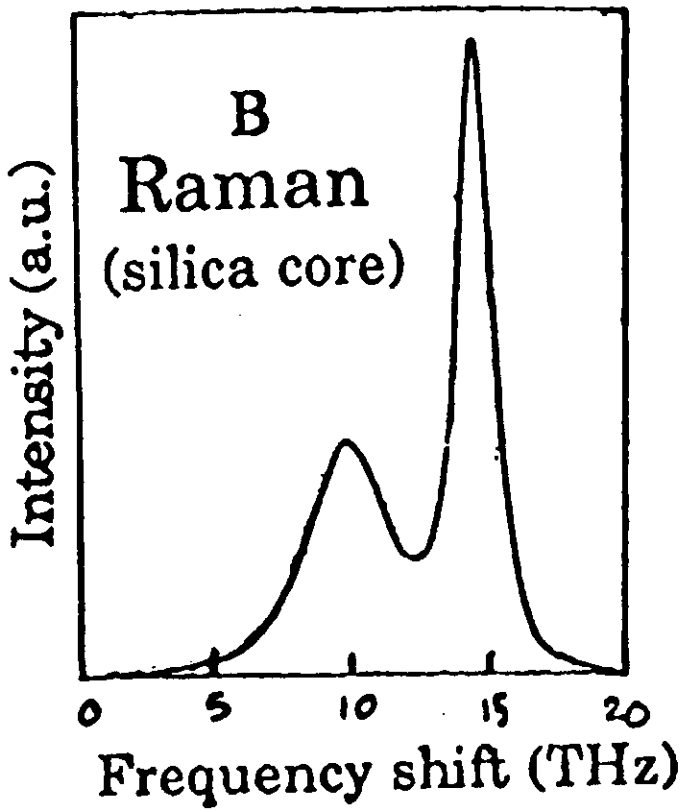
Soliton Jitter Correction



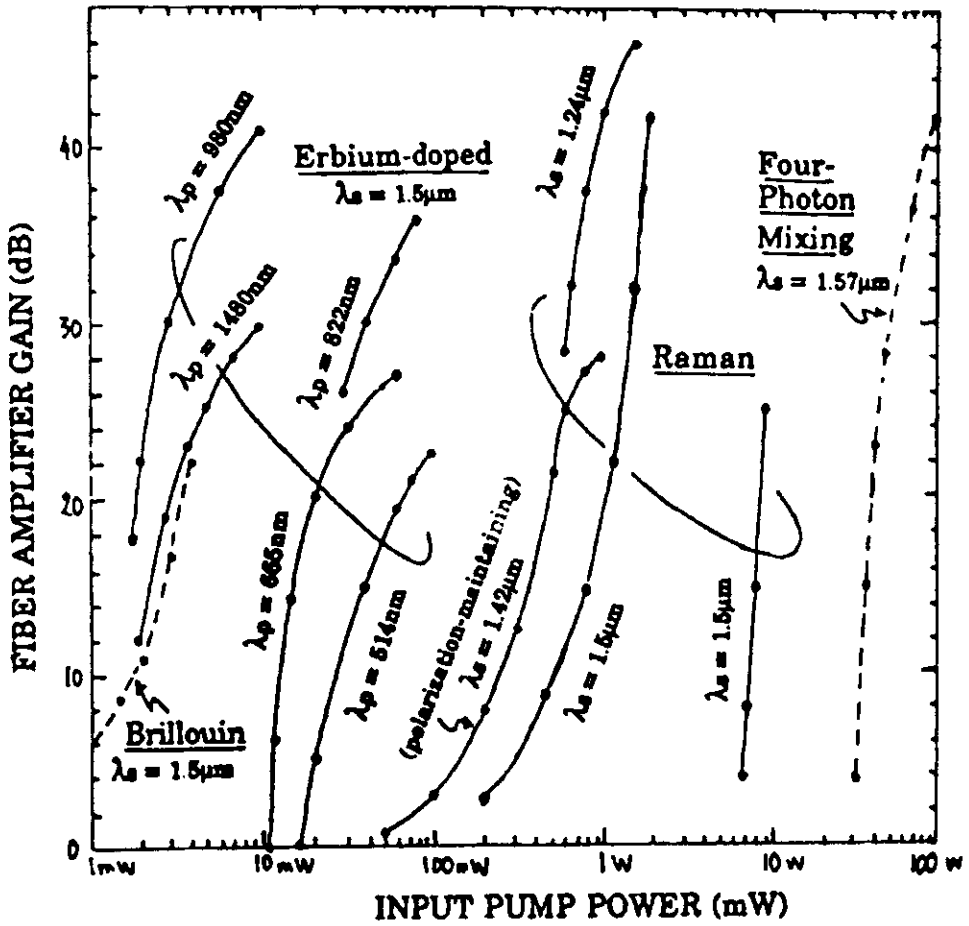
Brillouin Gain



Raman Gain


B
Raman
(silica core)
Intensity (a.u.)
0
5
10
15
20
Frequency shift (THz)

Fiber Amplifier Comparison



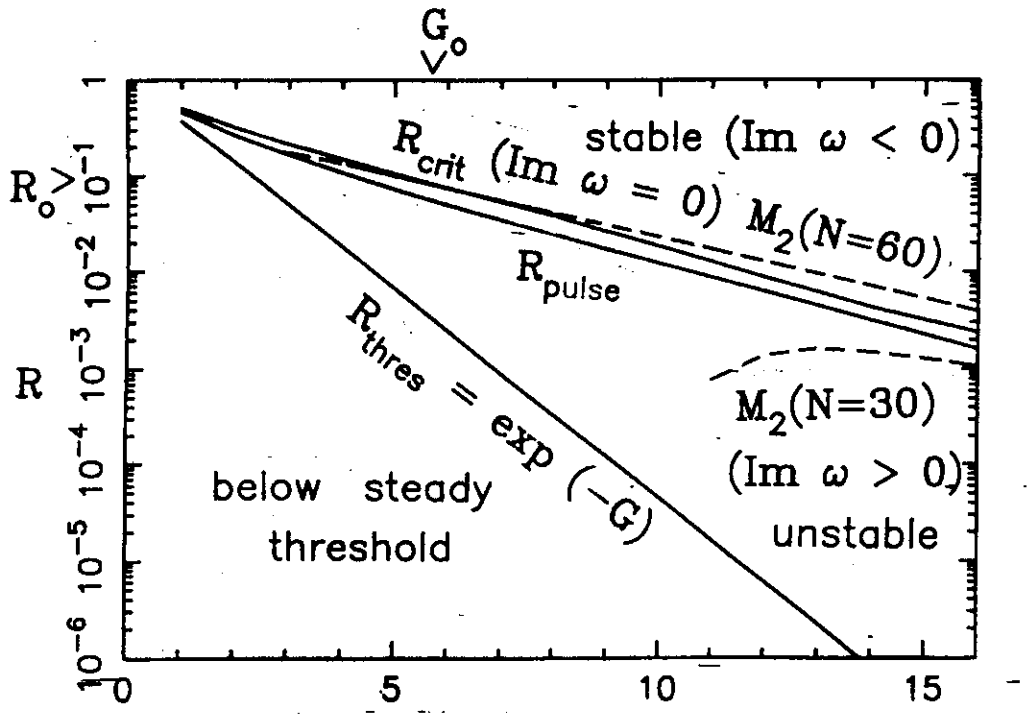
SBS equations

$$\left[\partial_t + \frac{c}{n}\partial_z + \gamma_e\right]E_p = -kE_B E_a$$

$$\left[\partial_t - \frac{c}{n}\partial_z + \gamma_e\right]E_B = kE_p E_a^*$$

$$\left[\partial_t + C_a\partial_z + \gamma_a\right]E_a = kE_p E_B^*$$

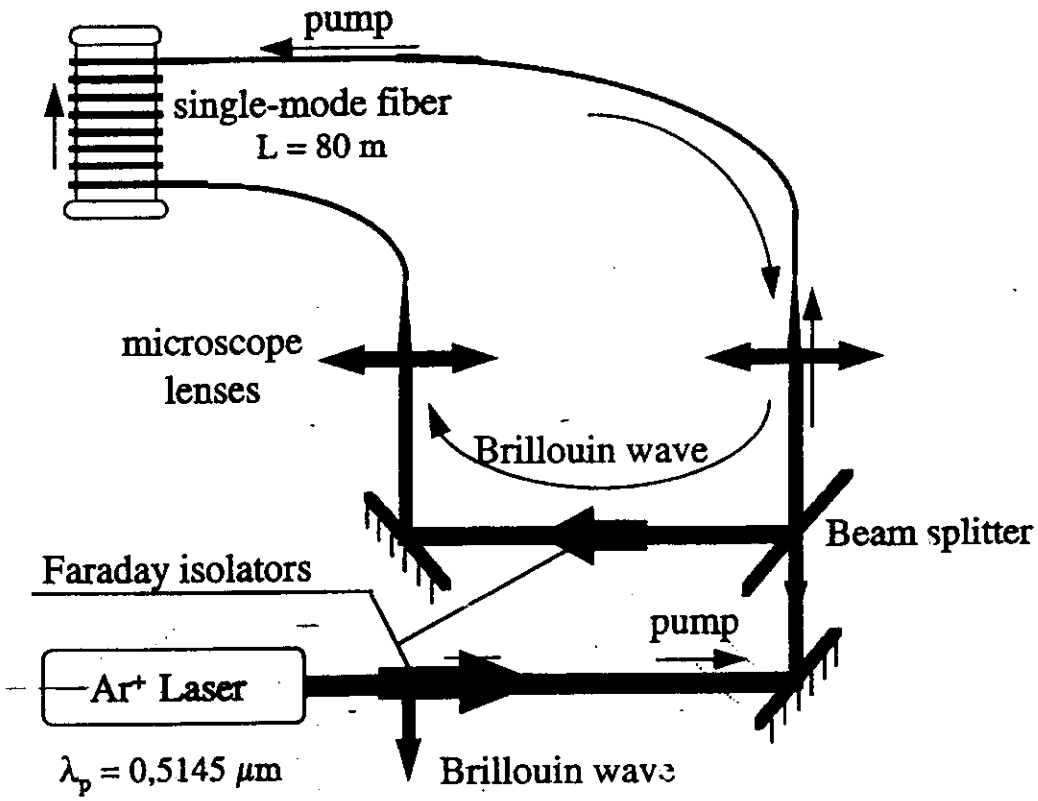
SBS stability



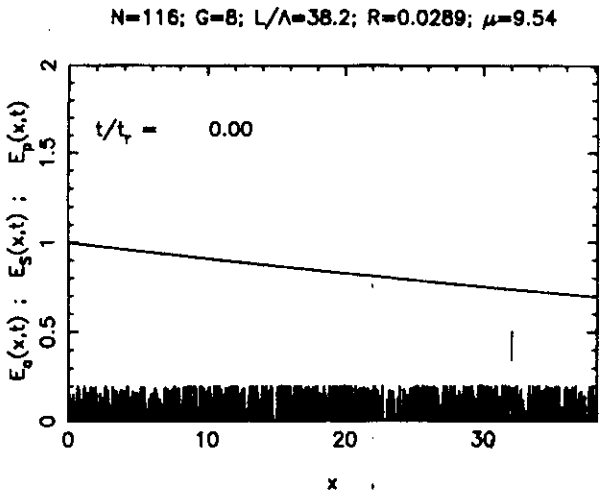
$G = g\ I_p\ L$

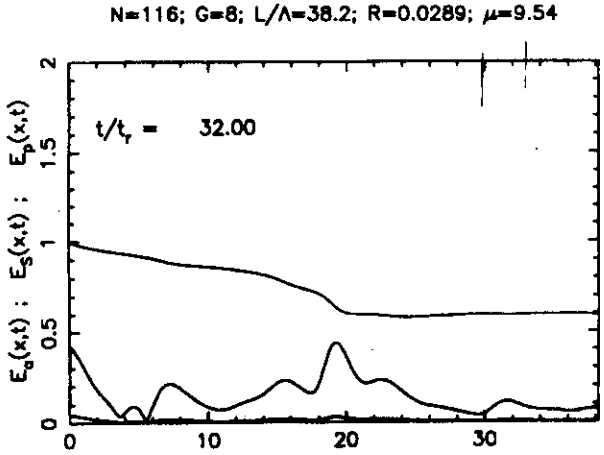
$0 < N < 60$

SBS experiment

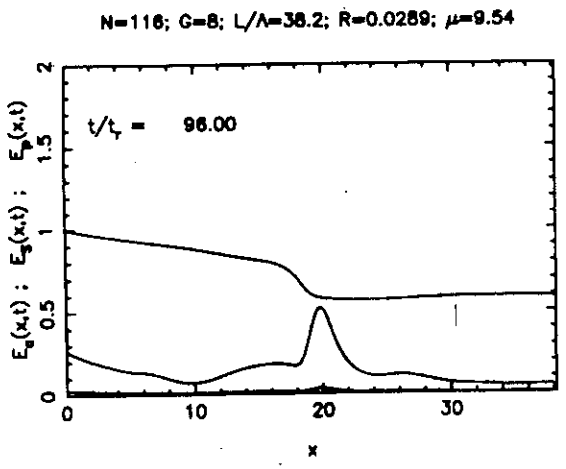


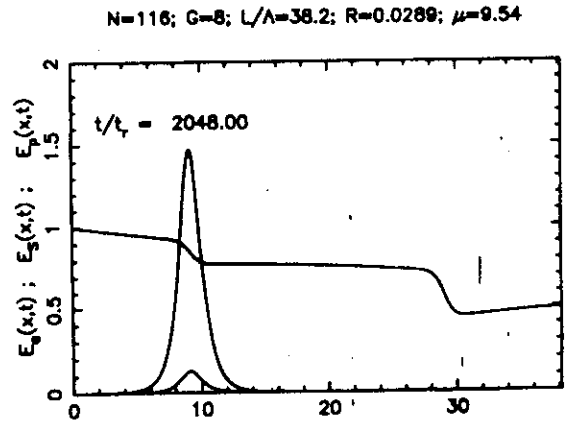
SBS evolution (1)



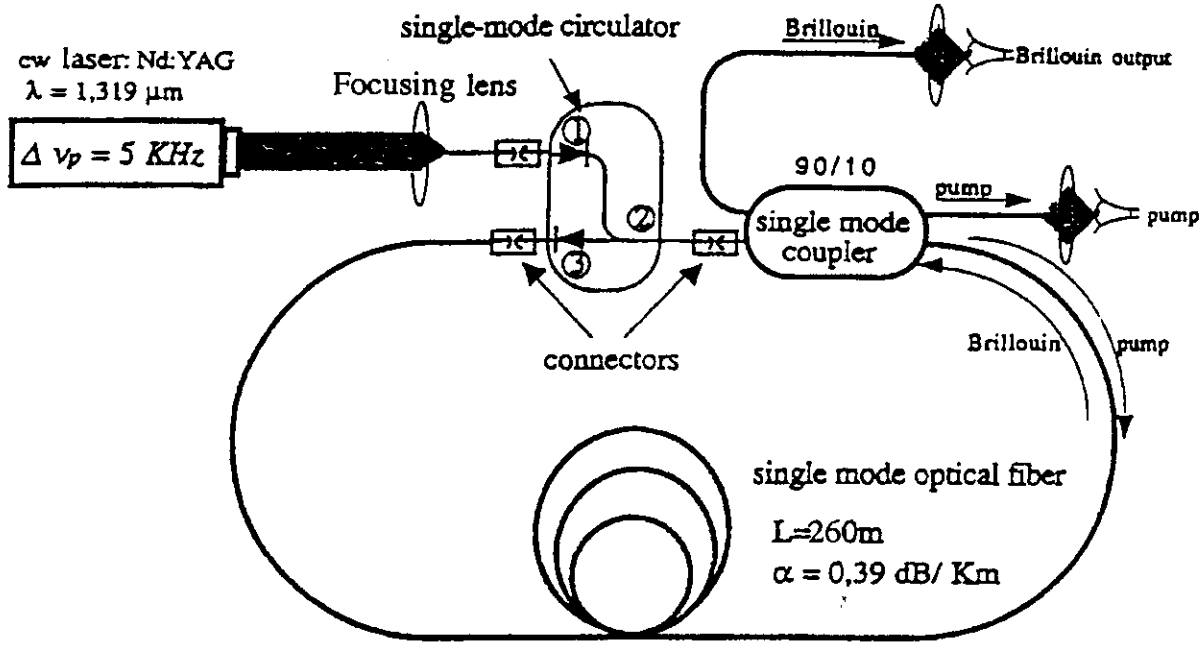


SBS evolution (2)

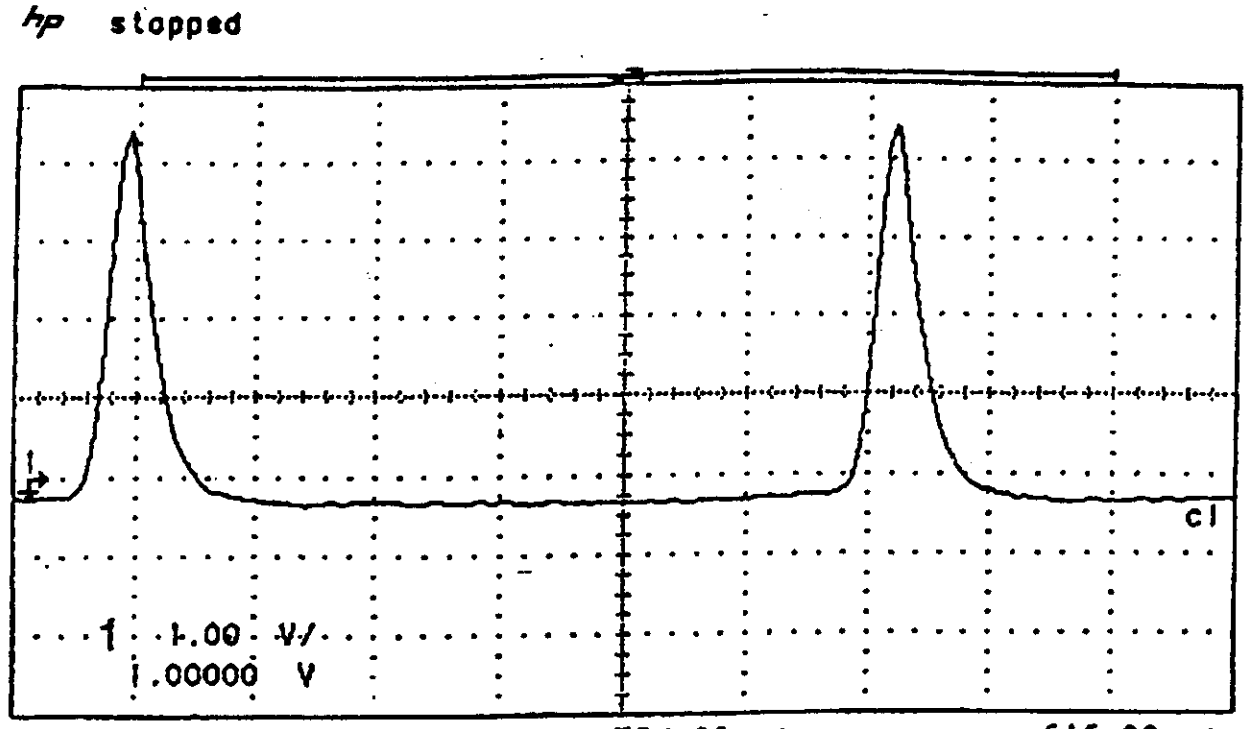




SBS GW experiment



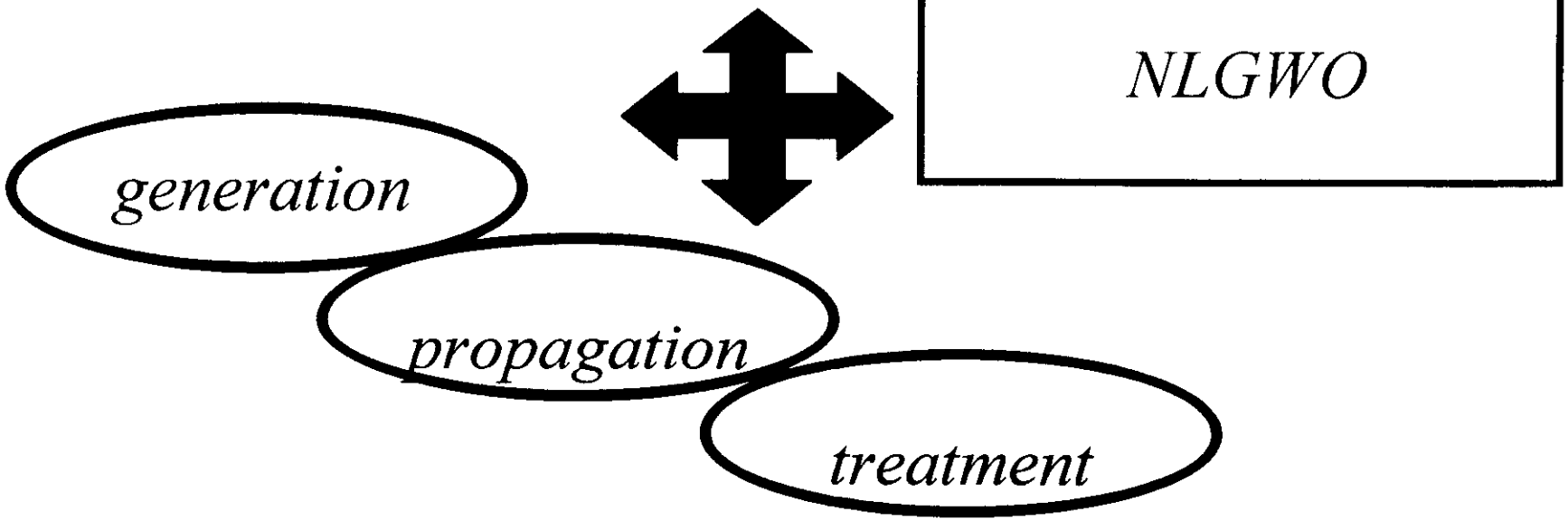
SBS experimental results

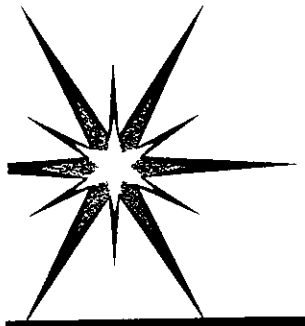


	current	average	std dev
Vp-p	(1) 4.78125 V	4.78125 V	0.00000 V
+width	(1) 73.160 ns	73.160 ns	0.00000 s
period	(1) 1.25904us	1.25904us	0.00000 s

Conclusion

Increasing laser power





Conclusion

Guided WaveNonlinear Optics (GWNLO)

Offers

Extraordinary possibilities for the

Generation
Propagation
Treatment

Of *Optical signals*