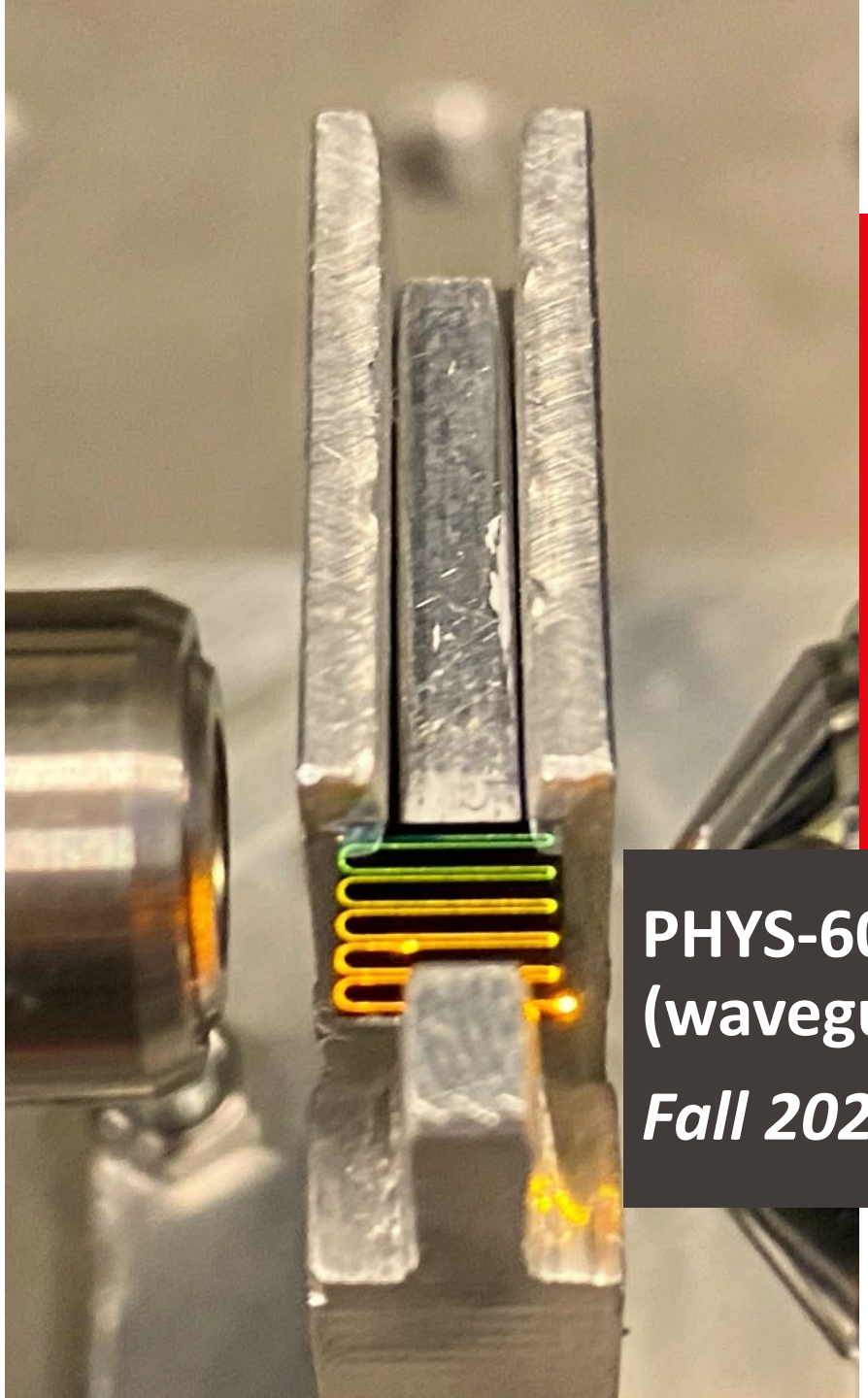

Quizz solutions

PHYS-607 : Nonlinear fibre (waveguide) optics

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Quiz

Silica has n_2 = 2.8 x 10^{-20} m^2/W at 1550 nm

What is the maximum nonlinear phase-shift experienced by a transform-limited Gaussian pulse of peak power 1 mW after

a) Propagation in bulk where the focal point has a surface area of 1 μm^2 and effective propagation around the focal point of 0.5 cm (quite ambitious)

b) In 100 km of optical fibre perfectly loss compensated with an effective area of 50 μm^2.

c) In 100 km of optical fibre with 0.2 dB/km of loss with an effective area of 50 μm^2.

SOLUTIONS:

a) 0.55 10^{-6} rad

b) 0.227 rad

c) 0.49 rad

Quiz

Nonlinear effects which are defined by the intensity dependent refractive index of the waveguide are called:

a) Raman effect

b) Dispersive effect

c) **Kerr effects**

d) Soliton effect

Quiz

A Gaussian pulse with a full width half maximum of T_{FWHM} = 10 ps is launched into an optical fiber with a dispersion parameter of D = 15.7 ps/nm-km a nonlinear coefficient γ = 2 $W^{-1}km^{-1}$.

What should be the peak power of the pulse in order to excite a soliton of order 2 inside the fiber?

a) 1.1 W

b) 400 mW

c) 872 mW

d) 314 mW

SOLUTIONS: you should find 1.1 W

You need to calculate beta 2 from D (you should get 19.5 ps^2/km) and T0 (you should get 6 ps)

Quiz

We consider degenerate FWM and want to use a pump positioned at 1500 nm. We want to mix it with a signal wavelength at 1510 nm

We have a fiber with a nonlinear coefficient γ = 5 $W^{-1}km^{-1}$, β_2 = -20 ps^2/km and negligible β_4. What should be the pump power P_0 such that phase matching be satisfied?

a) 1 .3 W

b) 138.5 W

c) 256 mW

d) 69 W

SOLUTION: you should get 138.5 W

You need to find P_0 to have $\kappa = 0$. You therefore need to express the frequency separation in frequency (you should get 10 nm -> $|\omega_p - \omega_S| = 2\pi(1.33)$ rad/ps). Then $P_0 = \frac{|\beta_2|}{2\gamma}\left(\omega_p - \omega_s\right)^2$

Quiz

Two different lengths (5 mm and 20 mm) of the same waveguide are used for parametric amplification using the same pump (degenerated case). Three different combinations of length/pump power are tested:

- L = 5 mm and P = 350 mW
- L = 20 mm and P = 350 mW
- L = 5 mm and P = 1400 mW

Match these combinations to parametric gain measured as a function of signal detuning:

$$G \propto \gamma P L$$

$$BW \propto \sqrt{\frac{1}{L}}$$