

## Problem set for Advanced Microscopy Lecture on Wednesday 16.01.2013

### 1.) Second Harmonic Generation

Consider the case of frequency doubling in tissue. The amplitude of the frequency doubled field emitted by the tissue is given by:

$$\frac{dA_2}{dz} = \frac{i\omega_2^2 \chi^{(2)}}{k_2 c^2} A_1 e^{i\Delta k z}, \text{ with } \Delta k = k_2 - 2k_1$$

If the pump beam is very strong, the attenuation of the driving field can be neglected and the amplitude  $A_1$  can be set constant.

a.) Solve the equation for the amplitude  $A_2$  of the second harmonic light emitted by integrating the equation, the interaction length should be chosen from  $z = 0$  to  $z = l$ .

b.) Calculate the intensity of the SHG-light by using  $I_2 = \frac{c}{8\pi} n_2 |A_2|^2$ .

(use:  $2\sin(\frac{\Delta k l}{2}) e^{\frac{i\Delta k l}{2}} = i(e^{i\Delta k l} - 1)$ )

c.) Can you draw the behavior of the SHG-signal for different interaction length?

### 2.) Reading and discuss of the manuscript Sunney Xie, 2009, SRS microscopy.