Task 5: Chapter 10

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Assume a Nd:YAG laser operated in the pulsed regime with 200 mJ pulses at 100Hz. The pulses can be assumed to be Gaussian in time with a FWHM pulse length τ=6.5 ns. The laser has an M^2~1.

1. Assume a pulse is sent through a homogenous saturable amplifier with a small signal gain $G_0=\exp(2\alpha_0 L)$. Plot the input and output intensities $I_{in}(t)$ and $I_{out}(t)$ versus t for gains G_0=3, 10 and 100 and for various sizes of the beam size ω_0 so that Uin/Usat=0.01, 0.1 and 1.0.

2. A KTP crystal is pumped using the given laser. How hard does the laser need to be focused to obtain a spatial soliton? Assume that the refractive index and the Kerr nonlinearity of KTP are n_0= 1.747869 and $n_2=1.2*10^{-15}$ cm^2/W for the given wavelength (1064 nm). Is the formation of a first order spatial soliton somehow related to the length of the KTP crystal? For the given pulse properties, KTP has a damage threshold of ~10 J/cm^2, would the crystal be able to withstand the intensity needed to form a spatial soliton?

3. Is it possible to get self-phase modulation employing the second order nonlinearity of a material? If so, how and what could be the application? Discuss!