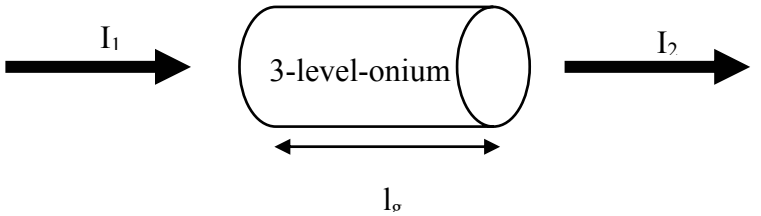
EECS 285B
Homework #3
Due Feb. 11 2005

1) Verdeyen problem 7.10
2) Verdeyen problem 7.13
3) Verdeyen problem 8.18
4) Verdeyen problem 8.29
5) Verdeyen problem 8.31
6) Consider a two-level system. On a lin-log graph, plot the fraction of atoms in the upper state, the fraction of atoms in the lower state, and the "population inversion" (N_2 - N_1) as a function of the irradiated intensity at the frequency $\nu=(\varepsilon_2-\varepsilon_1)/h$. Use the formula from lecture 5, slide 53.
7) In class we discussed gain saturation. We found:



$$\ln\frac{I_2}{I_1}+\frac{I_2-I_1}{I_s}=\gamma_0 l_g$$

On a log-log scale, plot I_2 vs. I_1 for the following typical parameters, i.e. a low intensity gain of 3dB, 15 dB, and 30 dB. On the same plot, indicate I_2 vs. I_1 for the case of an ideal amplifier with gain of 0 dB, 10 dB, 20 dB, and 30 dB. On the same plot, plot the EXTRACTED power defined as I_2 - I_1 for the case of a low intensity gain of 3dB, 15 dB, and 30 dB. (You will have to figure out a way to do this, probably numerically.)
8) Verdeyen 8.30.
9) On a lot-log plot, plot the result of problem 3 for I_2 vs. I_1 for the case of low intensity gain of 3dB, 15 dB, and 30dB. $e^{\gamma_0 l_g}$
10) For the level schemes indicated below, the 2-1 transition is the lasing level pair. A) For efficient lasing, describe for each case conditions on the lifetimes. B) When these conditions are fulfilled, what is the relative efficiency of each scheme? C) Are three level schemes always more efficient than four level schemes?