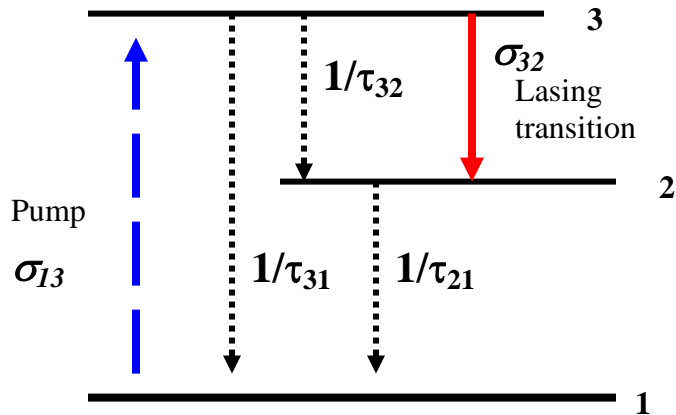


Homework 2

Consider a three-level system shown here. The lasing transition is from the level 3 to level 2. Population of level 3 spontaneously decays to **both** level 2 and level 1 with rates shown. Total density of atoms is N



1. What are the lifetime of level 3, τ_3 and lifetime of level 2, τ_2 ?
2. Write the rate equations and solve them to determine the steady state value of gain.
3. Is there a transparency pump power density?
4. How does the gain depend on τ_2/τ_3 assuming fixed $\tau_{32}/\tau_{31}=\kappa$? Plot it
5. How does the gain depend on τ_{32}/τ_{31} assuming fixed $\tau_2/\tau_3=m$? Plot it
6. Can you always obtain a steady state gain?
7. Can you always obtain gain in a transient (pulsed) regime? To answer this question think about a very short pump pulse (i.e. $\tau_{\text{pulse}} \ll \tau_{\text{mn}}$) of a given energy density $E_{\text{pump}} = S_{\text{pump}} \times \tau_{\text{pulse}}$