# Einstein Coefficients

that nerd who never posts

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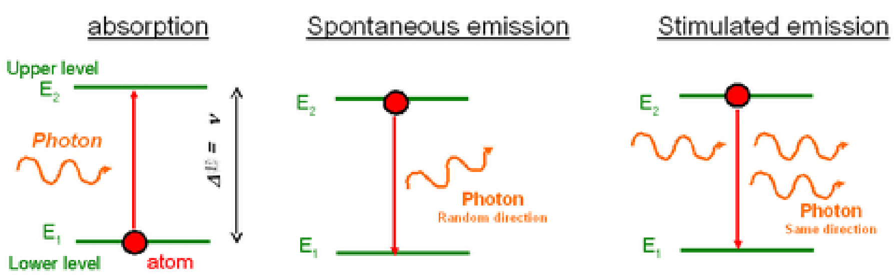
## 1 The fuck are you talking about

This thingie is really interesting,. It revolves around the fact that when hit by a photon, it is possible to make a particle in a high energy state emit another photon, even when in a lower energy state it would have absorbed the photon and rose to a higher energy state as we would expect.




To explain, We're going to assume you know time dependent perturbation theory, because I am lazy- I mean, understanding it is an exercise left for the reader assuming they go read Griffiths Intro to QM. We also assume that a is the lower energy state and b is the higher energy state. From this, we learn $\vec{E} = E_0 cos(\omega t)\vec{k}$ for light (which is electromagnetic waves.) The perturbation in this is thus

$$H'_{ba} = -\rho E_0 cos\omega t$$

assuming that

$$\rho = < \psi_b | z | \psi_b >$$

now, skipping a lot of derivation as i just did and always do and will continue to do because i am an awful teacher and I am 14 and understand nothing, we get two equations for probability. One for a being absorbed and another for when state b goes down to a, which yields spontaneous emission.

$$P_{a-to-b} = (\frac{|\rho| E_0}{\hbar})^2 \frac{sin^2[(\omega_0 - \omega)t/2]}{(\omega_0 - \omega)^2}$$

$$P_{b-to-a} = (\frac{|\rho|E_0}{\hbar})^2 \frac{sin^2[(\omega_0 - \omega)t/2]}{(\omega_0 - \omega)^2}$$

note that these are actually equal! So yeah. That's my proof of spontaneous emission without actually proving anything at all and just telling you to read Griffiths. Good job, me