Re: "A single atom can undergo only one transition at a time"

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I can't answer everything, but I'll take a stab at some of your
questions.

> "N.B: A single atom can undergo only one transition at a time."
>
> Three ignorant questions are:
> (i) Where can I find more about this rule?

My guess is that the author was trying to get across the idea that
different atoms undergo different transitions. That is, there isn't
just one atom sitting there doing all the spectroscopy. The same atom
isn't simultaneously doing everything. In other words, you cannot
simultaneously excite the same ground state hydrogen atom from 1s to
both 2p and 4p (I will use this notation for one−electron states, for
simplicity). The electron can only stop in one state. The two
absorption lines corresponding to 1s−>2p and 1s−>4p are probably due to
different atoms absorbing the light. In principle, the same atom could
absorb many photons over time − after the 1s−>2p transition, the atom
could re−emit the photon, relax back to the ground state, then absorb a
1s−>4p photon. However, it could not absorb a 1s−>4p photon while in
the 2p state. I think this is what the author was trying to get
across. Clear as mud?

That said, I understand that multi−photon processes are indeed
possible. For example, I believe two 600nm photons can excite a 300nm
transition. I think that the laser jocks told me that something like
this has an absorption that increases as laser power squared. That is,
like a termolecular reaction, you have a molecule that needs to
simultaneously find TWO partners to interact with, with the encumbrance
on rate that this implies. In other words, it doesn't happen very
often, if you aren't shining a high power laser at it.

> (ii)This is interesting and we can consider that at a "single instant"
> only "one photon" will be absorbed or emitted. My question is that if
> we have a SINGLE multielectron atom say Na atom and assume that
> sodium atom can absorb light of wavelengths of 300, 400 and 500 nm
> corresponding to all allowed transitions. If we were to shine light on

> that "SINGLE ATOM" which contains all these three wavelengths
> simultaneously, would we observe a SINGLE absorption (due to 300 or 400
> or 500 nm) line or three lines at that very instant? If we were to
> observe three lines which wavelength would have caused transition
> first, since we are assuming that one transition is possible at a time