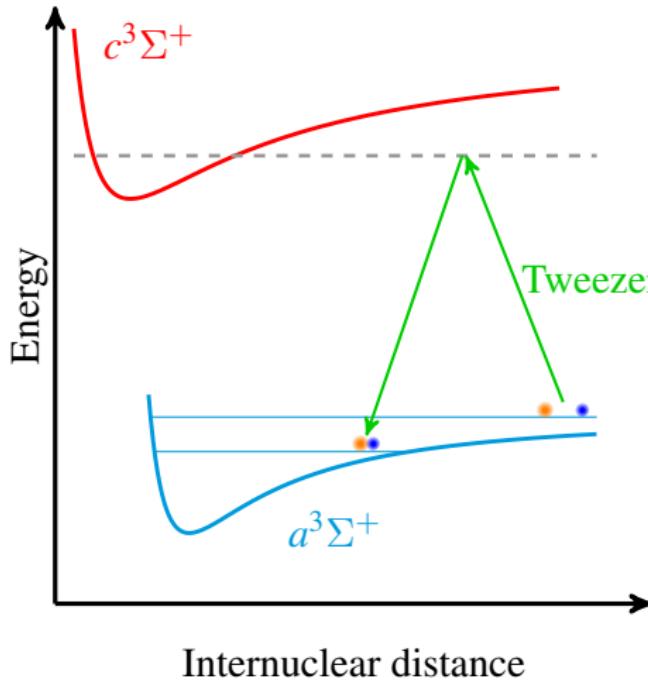


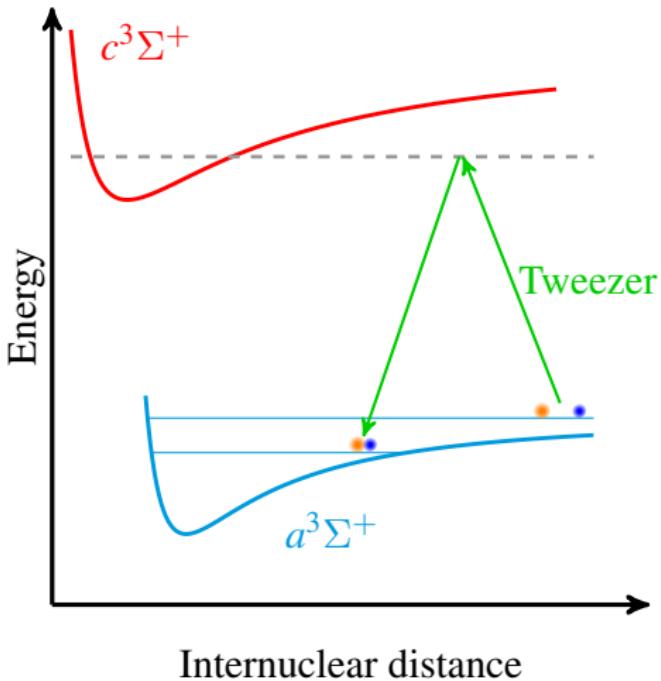
NaCs lab update

Yichao Yu

Ni Group

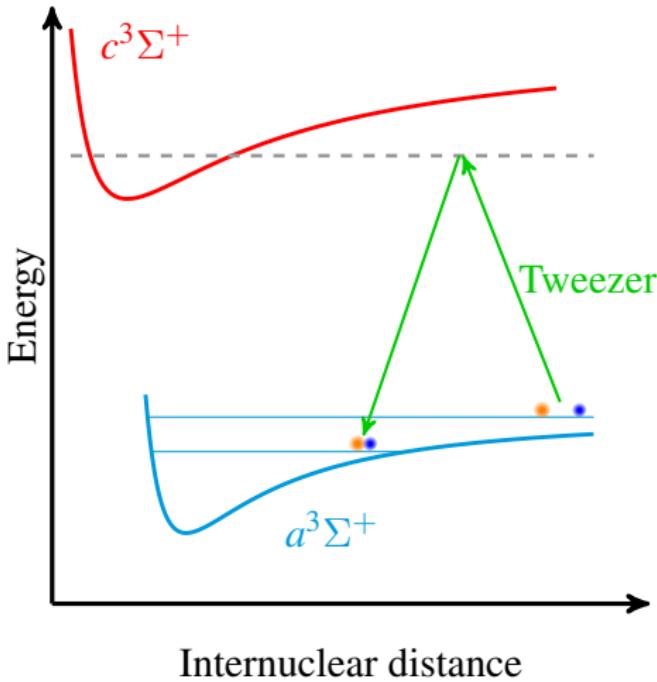
Feb. 21, 2020





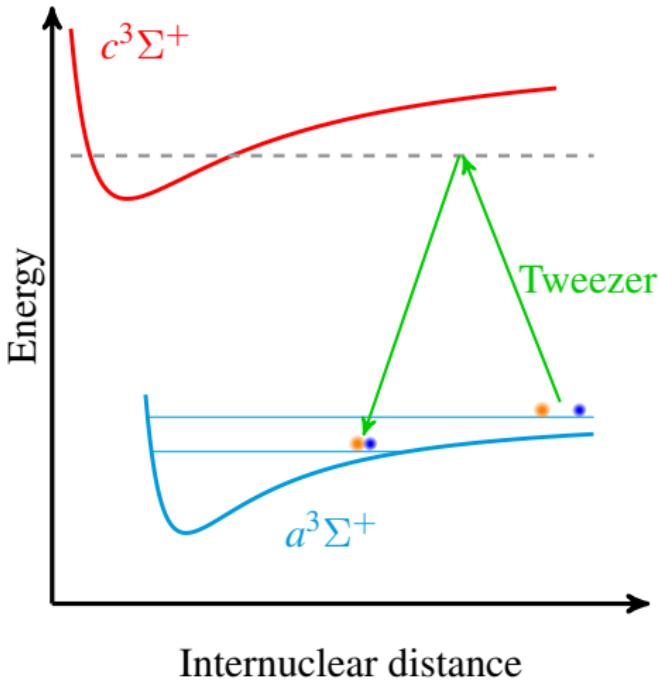
No Rabi oscillation





Still
No Rabi oscillation



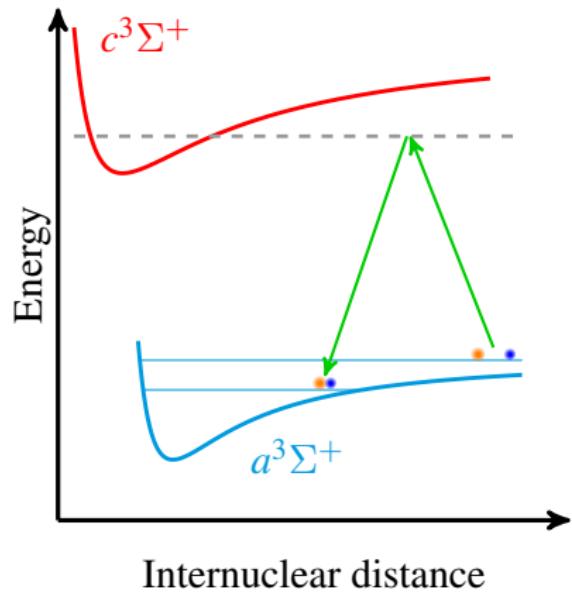


Still
No Rabi oscillation



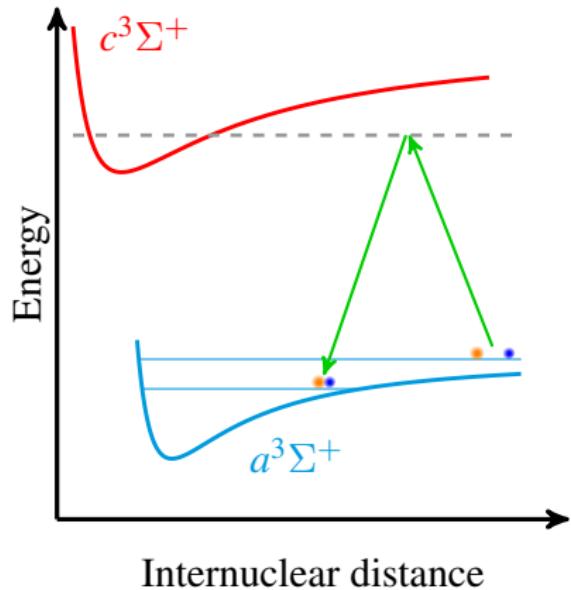
- Understand the issue
- Find a better approach

What can go wrong?



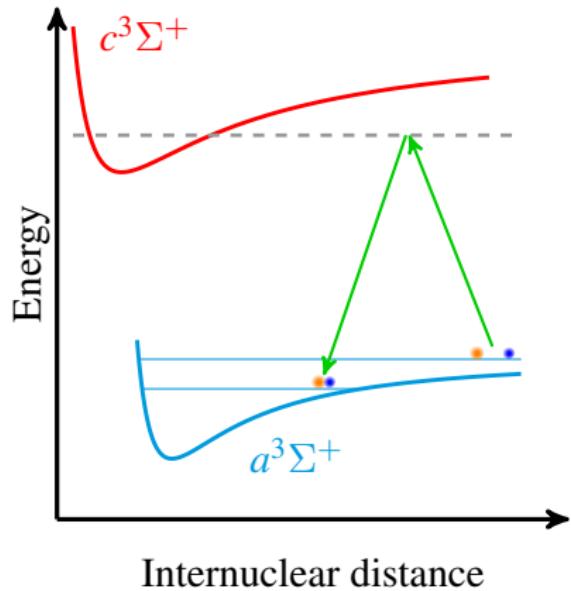
What can go wrong?

Condition	Rabi Oscillation
b	No
r	No
K	No
No	No
...	Still No
...	...



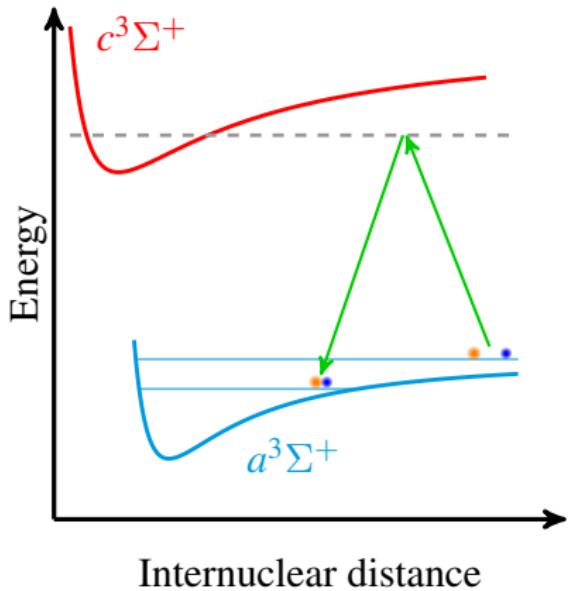
What can go wrong?

$$\frac{\Gamma_{\text{(Line width)}}}{\Omega_{\text{(Rabi frequency)}}}$$



What can go wrong?

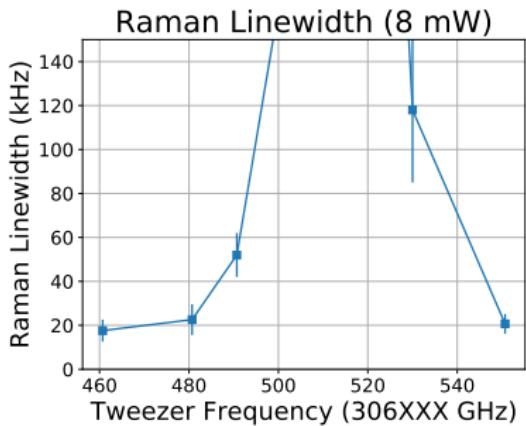
$$\frac{\Gamma_{\text{(Line width)}}}{\Omega_{\text{(Rabi frequency)}}}$$



What can go wrong?

$$\frac{\Gamma_{\text{(Line width)}}}{\Omega_{\text{(Rabi frequency)}}}$$

- Single PA line effect
- Flucutation
- Scattering



What can go wrong?

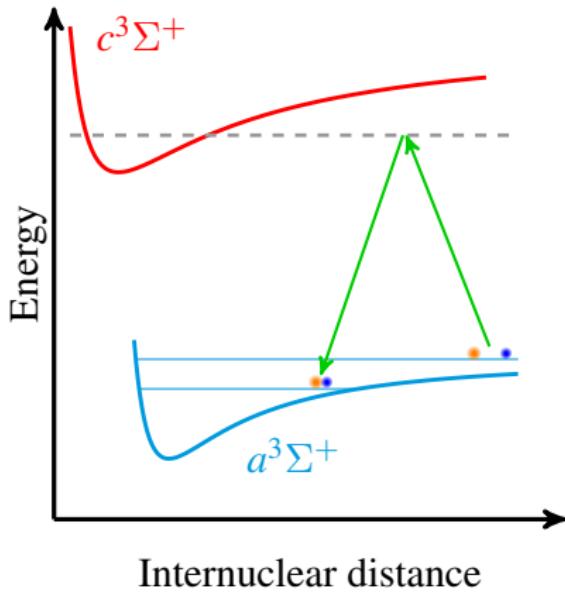
$$\frac{\Gamma_{\text{(Line width)}}}{\Omega_{\text{(Rabi frequency)}}}$$

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What can go wrong?

$$\frac{\Gamma_{\text{Line width}}}{\Omega_{\text{Rabi frequency}}}$$

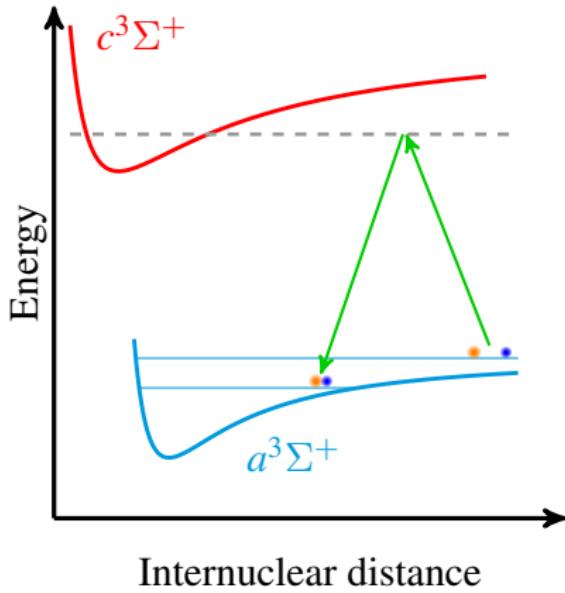
- Single PA line effect
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What can go wrong?

$$\frac{\Gamma_{\text{(Line width)}}}{\Omega_{\text{(Rabi frequency)}}}$$

- Single PA line effect
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- Scattering



How many photons?

Two photon scattering

- Stronger intensity than bulk gas
- Less accurate/no prediction
- Evidence from other group

Two photon scattering

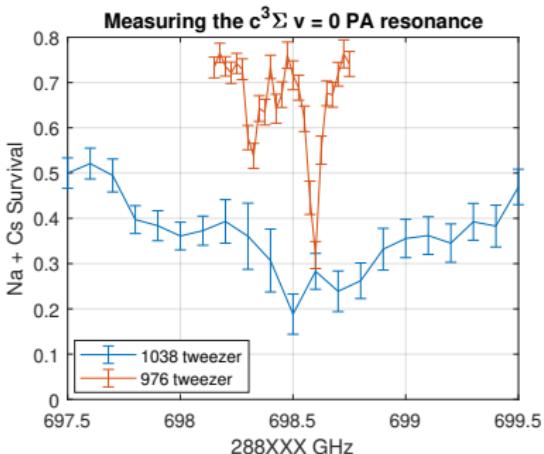
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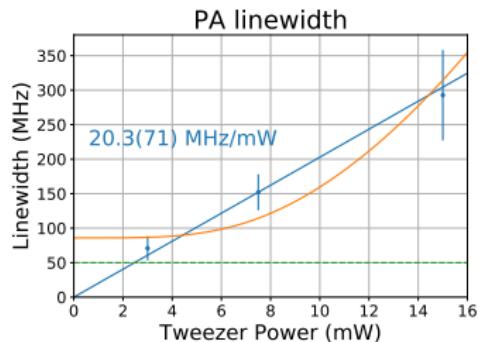
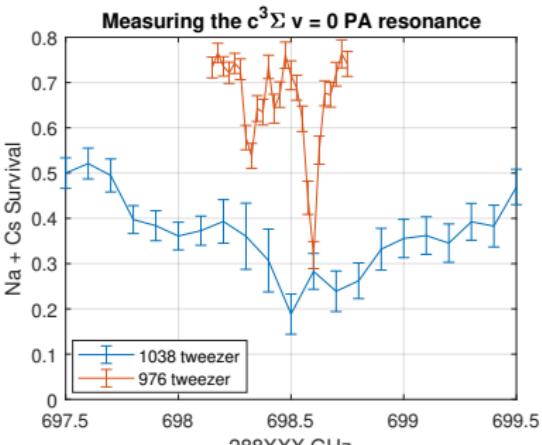
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Two photon scattering

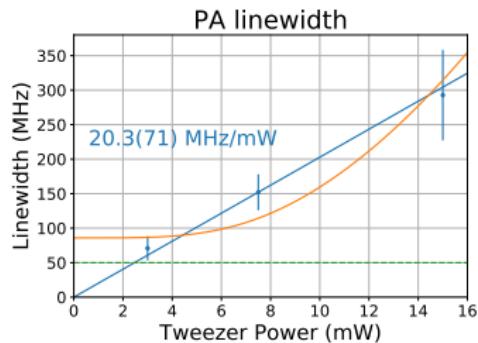
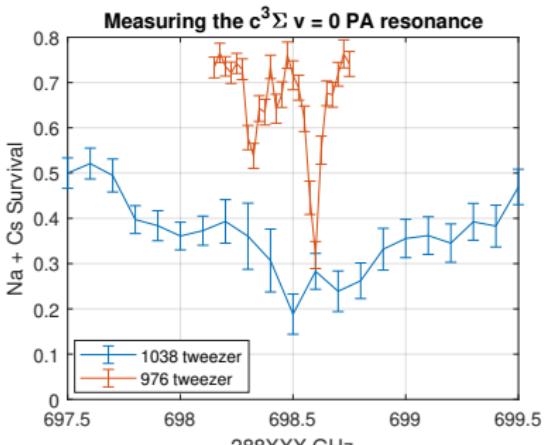
- Stronger intensity than bulk gas
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Two photon scattering

Until ...

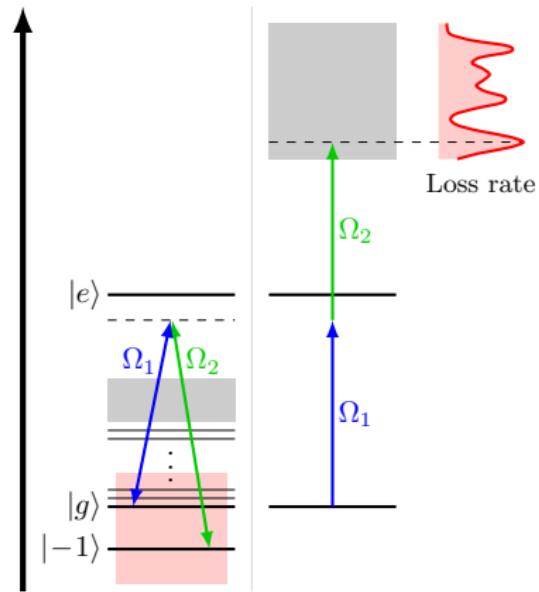
- Two photon up vs down
- One beam vs two beams
- Linear dependency on power for Raman line width



Two photon scattering

Until ...

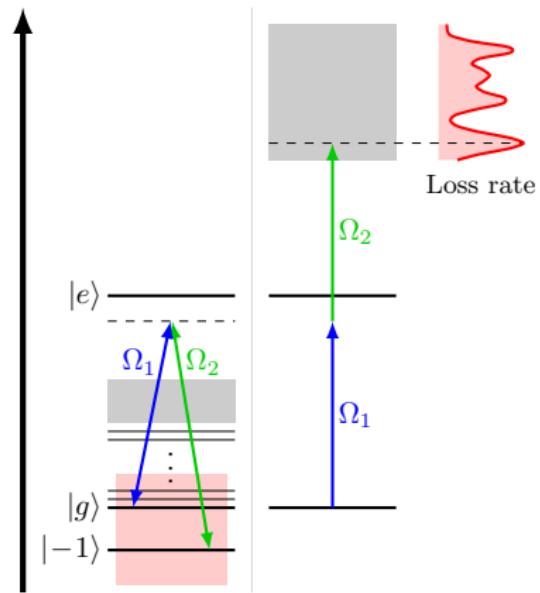
- Two photon up vs down
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Two photon scattering

Until ...

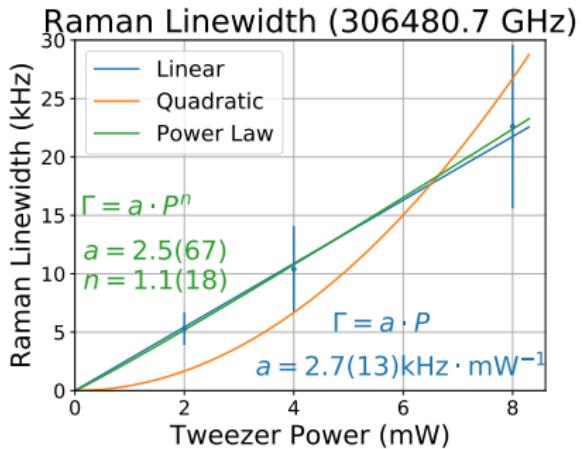
- Two photon up vs down
- One beam vs two beams
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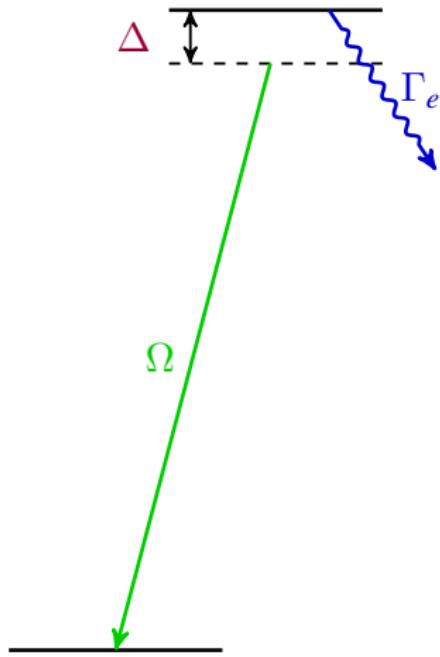
Two photon scattering

Until ...

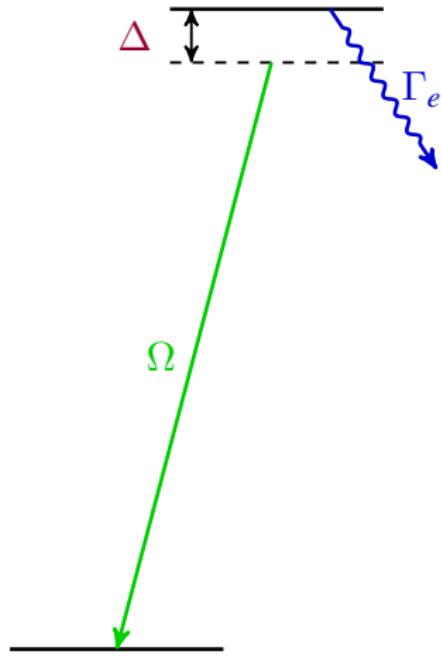
- Two photon up vs down
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- Linear dependency on power for Raman line width



One photon scattering (i.e. the easy kind)

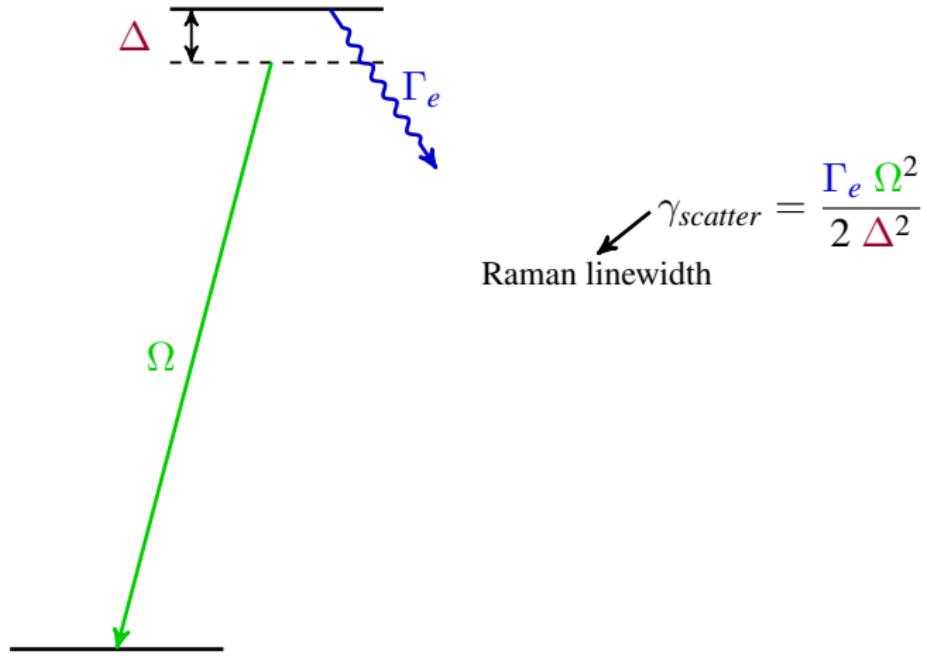


One photon scattering (i.e. the easy kind)

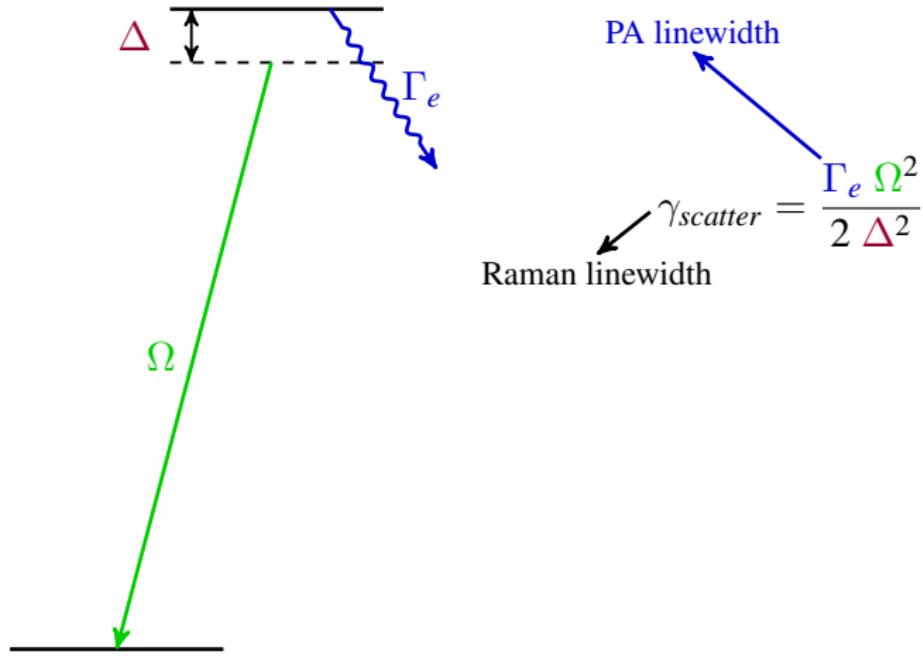


$$\gamma_{scatter} = \frac{\Gamma_e \Omega^2}{2 \Delta^2}$$

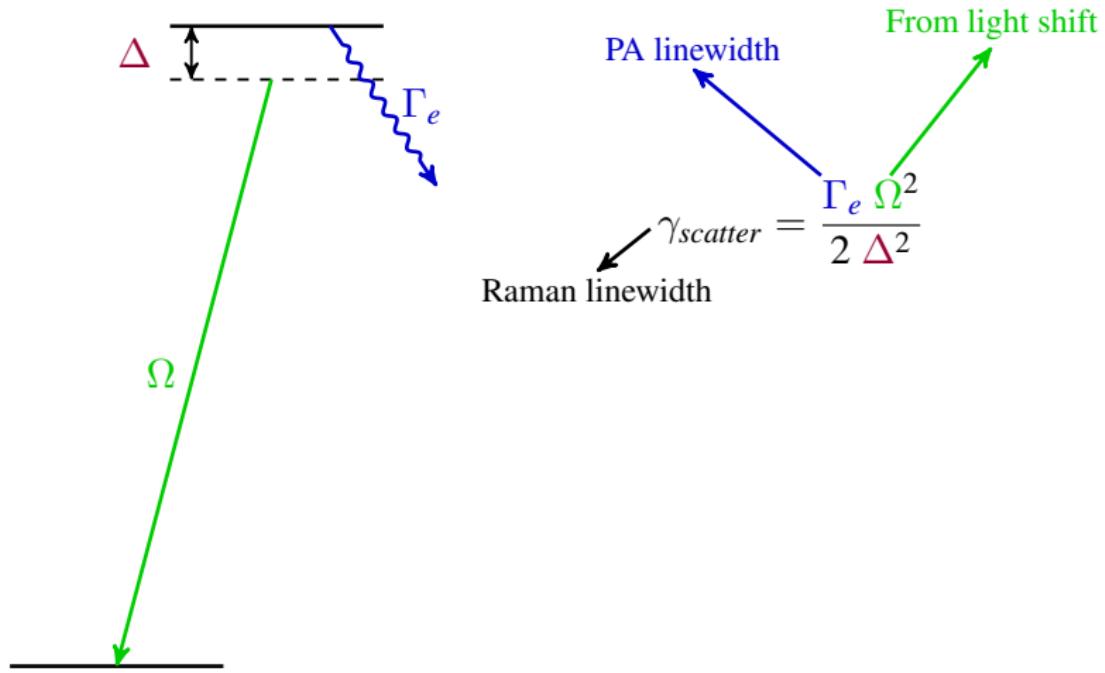
One photon scattering (i.e. the easy kind)



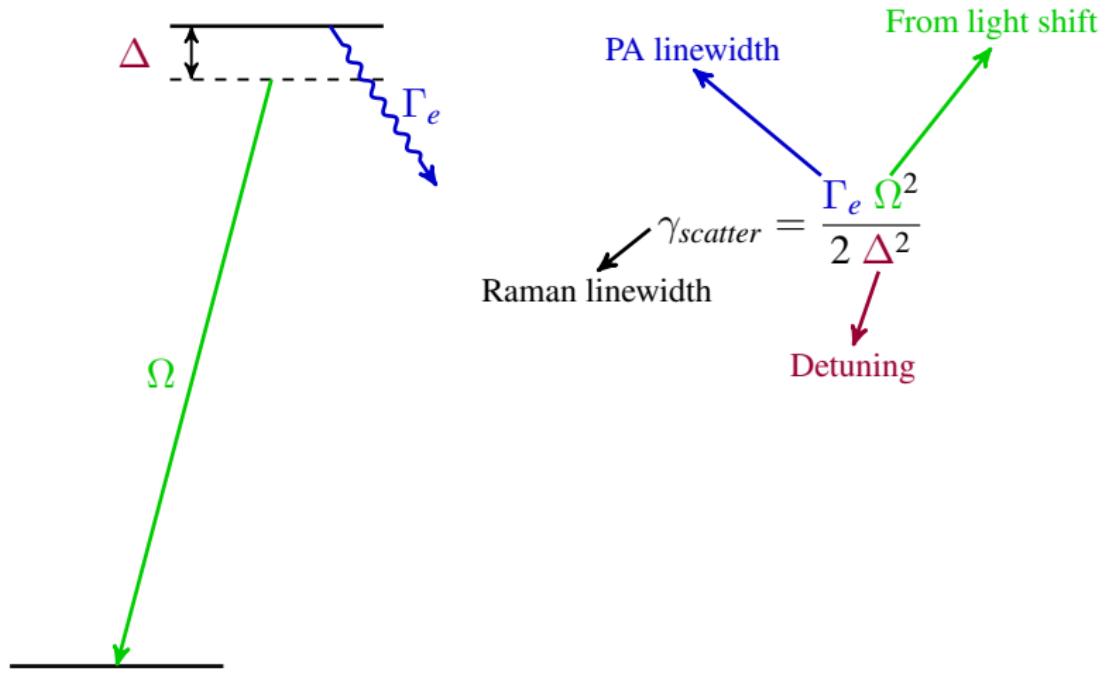
One photon scattering (i.e. the easy kind)



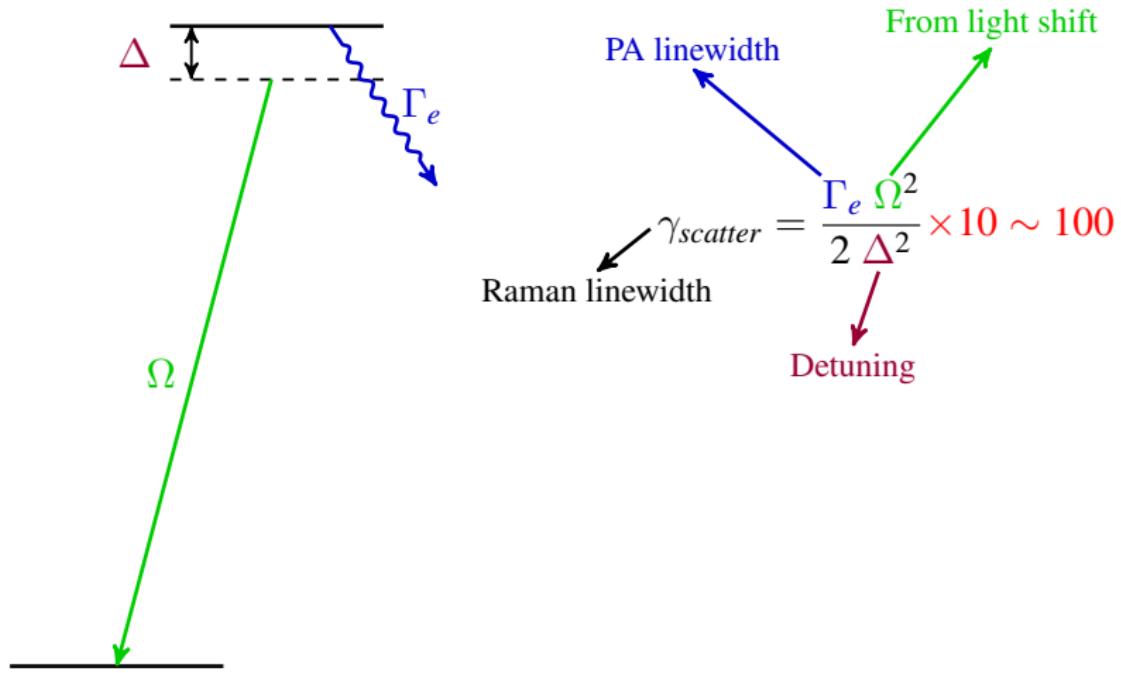
One photon scattering (i.e. the easy kind)



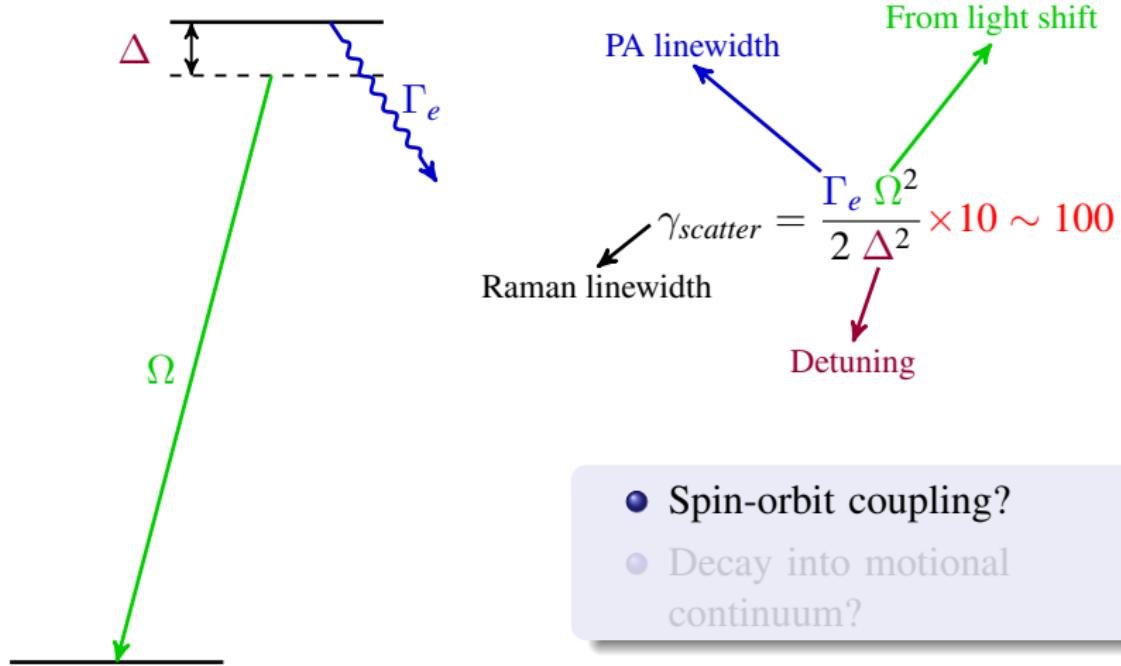
One photon scattering (i.e. the easy kind)



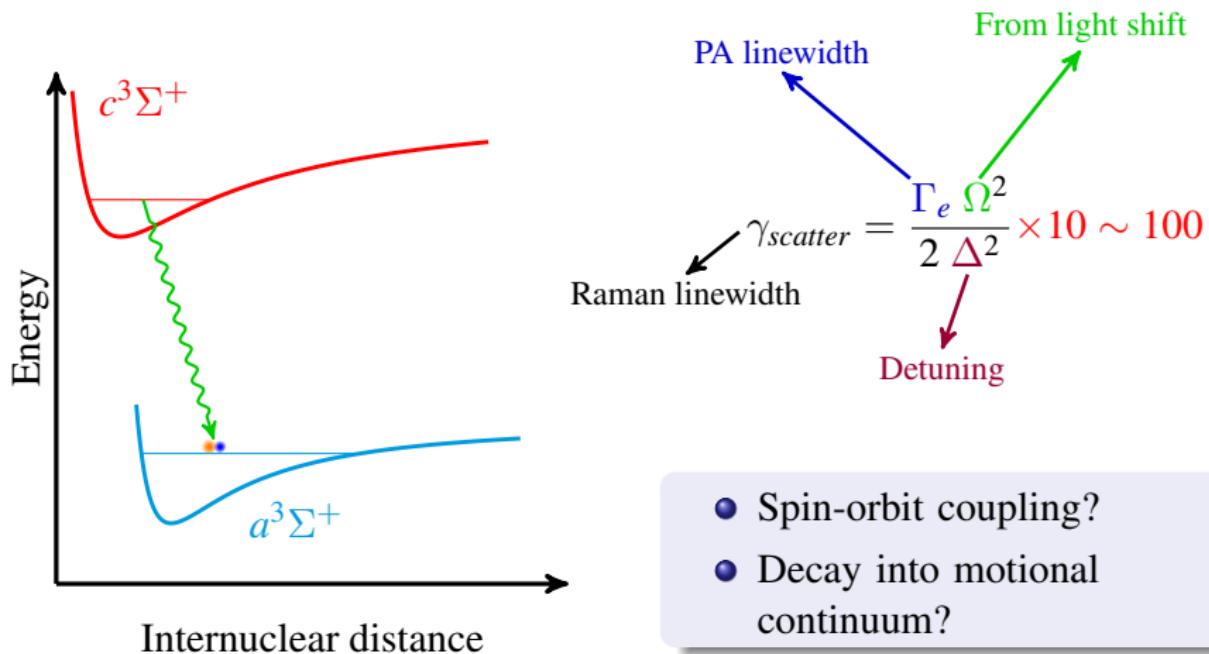
One photon scattering (i.e. the easy kind)



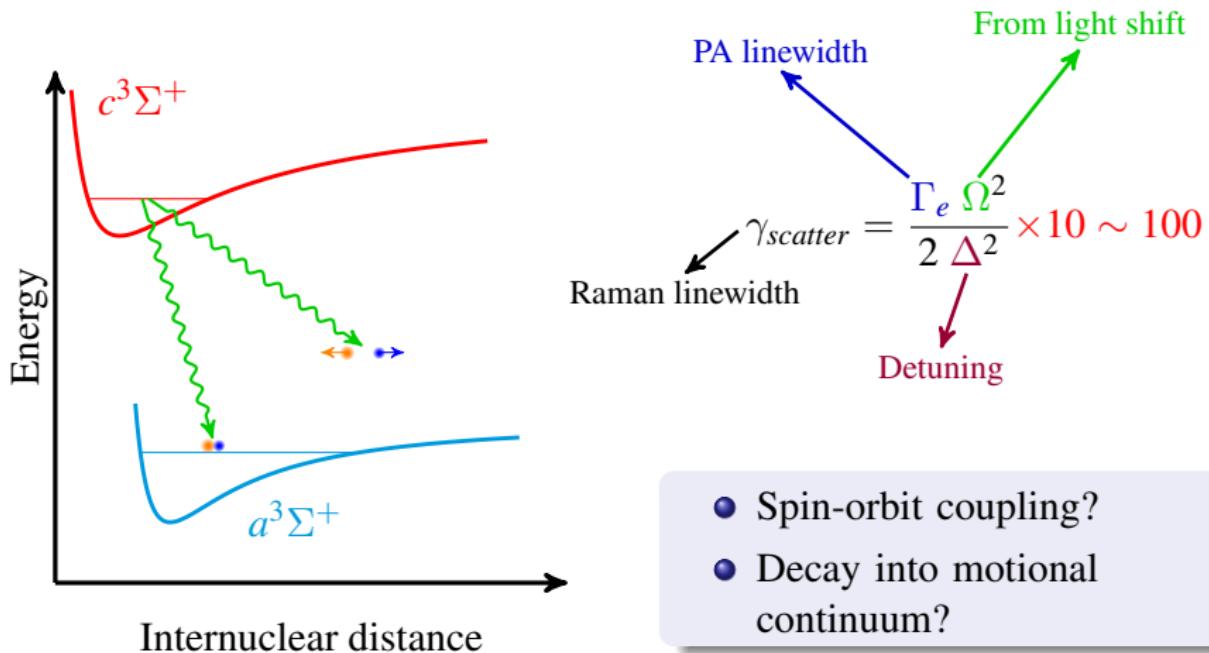
One photon scattering (i.e. the easy kind)



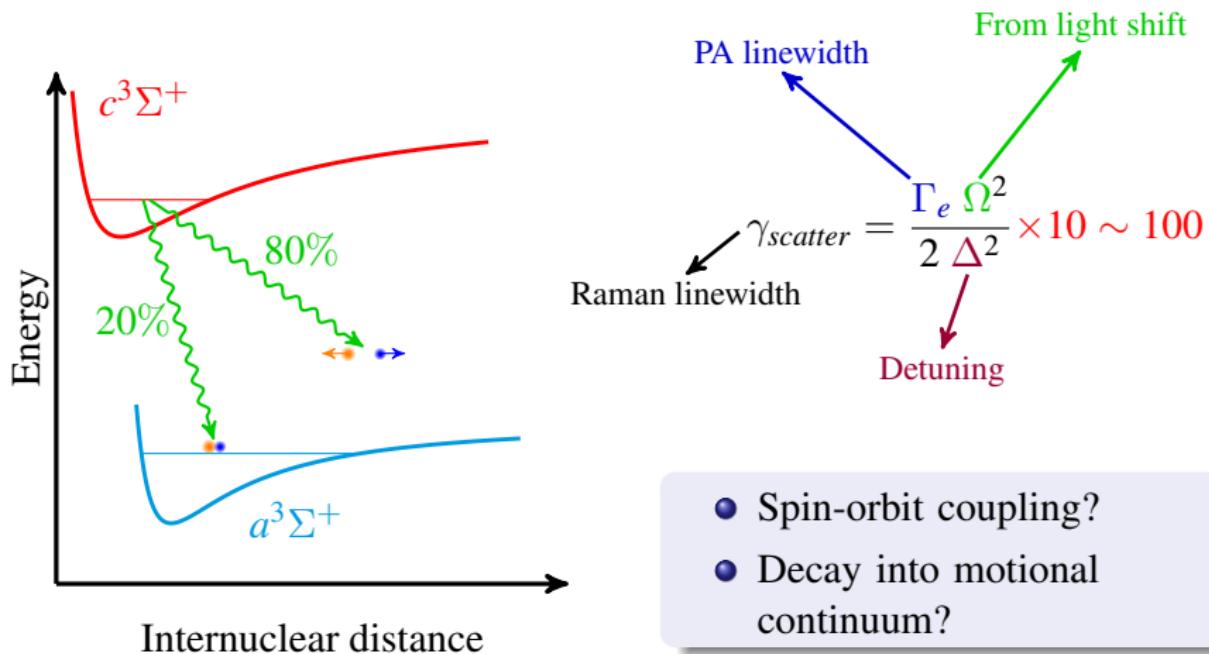
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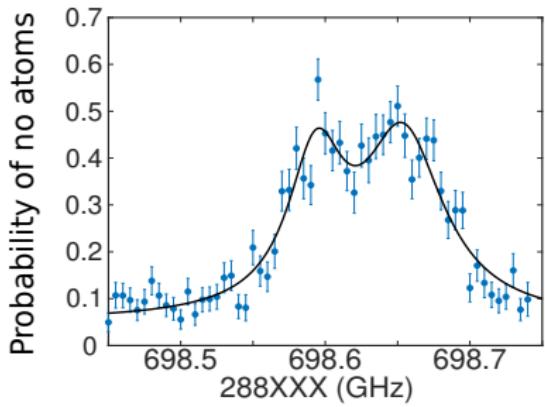
- Spin-orbit coupling?
- Decay into motional continuum?

- Rabi frequencies (Ω_R , Ω_1 , Ω_2) and light shift (δ_L) matches theory.
- Scattering is faster than expected.
- $\Gamma_e \approx 2\pi \cdot 300\text{MHz}$

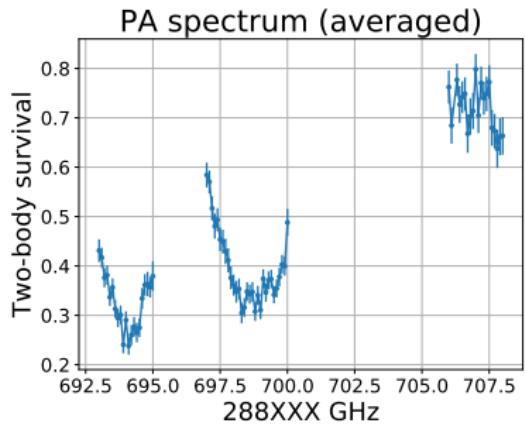
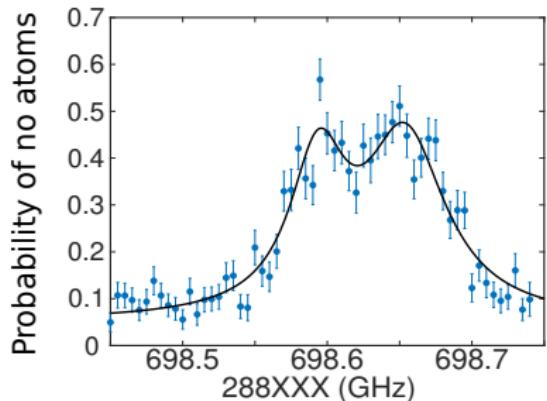
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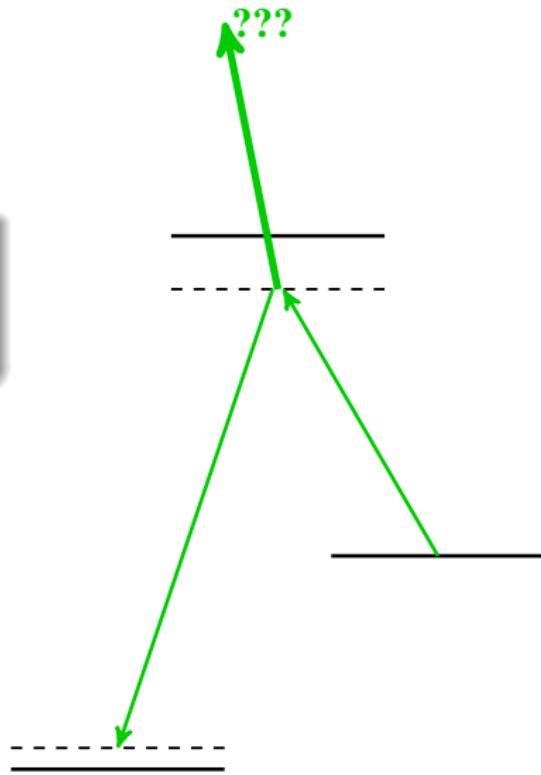


Cause

- PA beam size?
- Two photon process?

Cause

- PA beam size?
- Two photon process?



Cause

- PA beam size?
- Two photon process?

Alternative

- Different wavelength (976nm?)
- Different transfer path (singlet?)

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