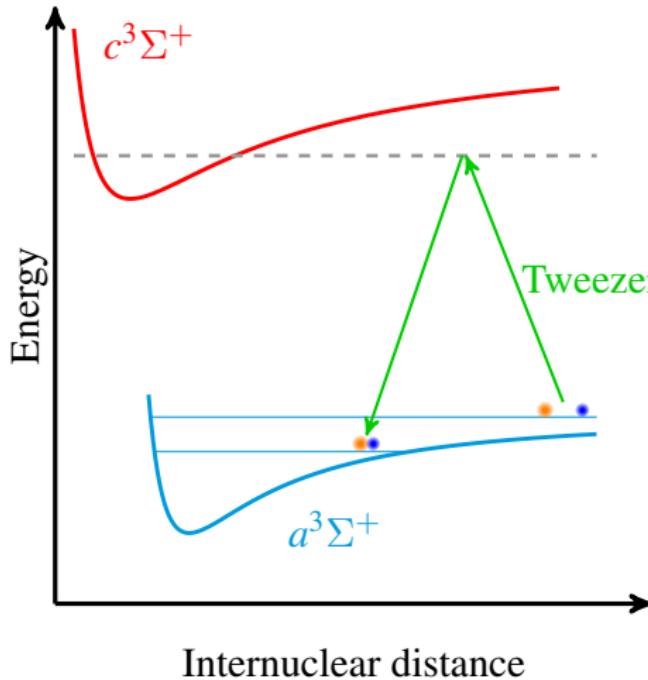


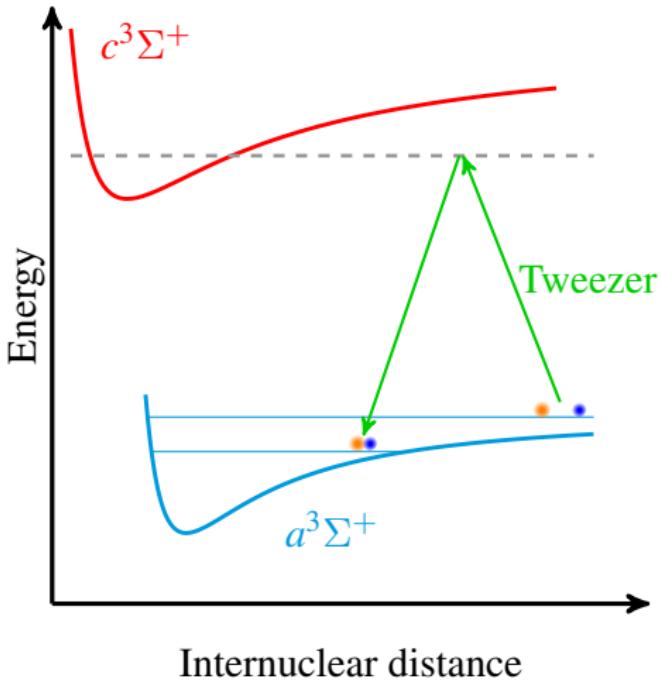
NaCs lab update

Yichao Yu

Ni Group

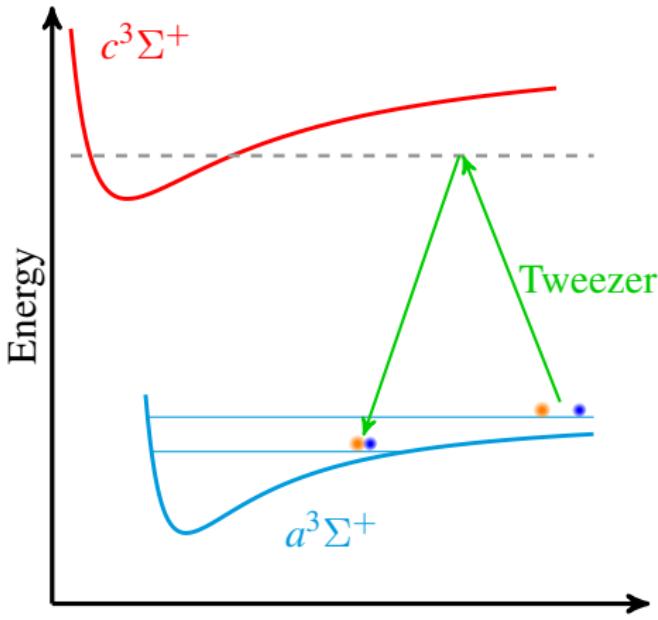
Feb. 21, 2020





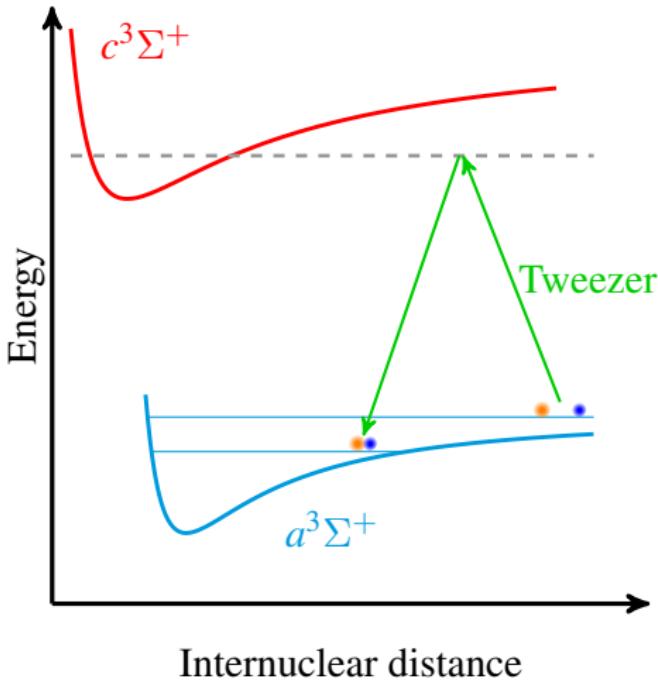
No Rabi oscillation





Still
No Rabi oscillation



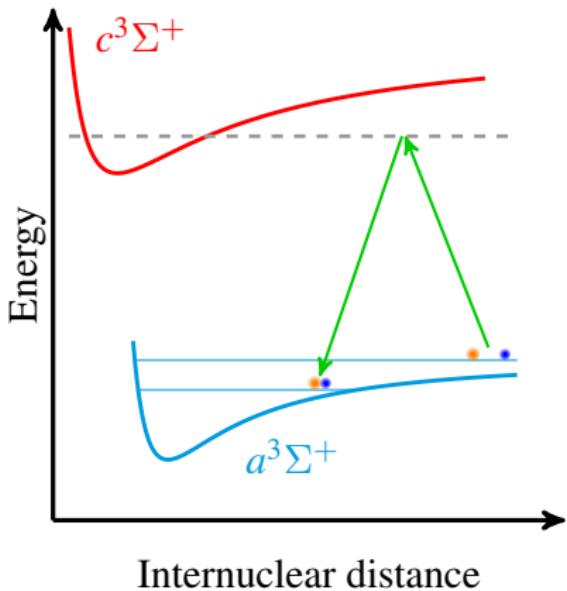


Still
No Rabi oscillation



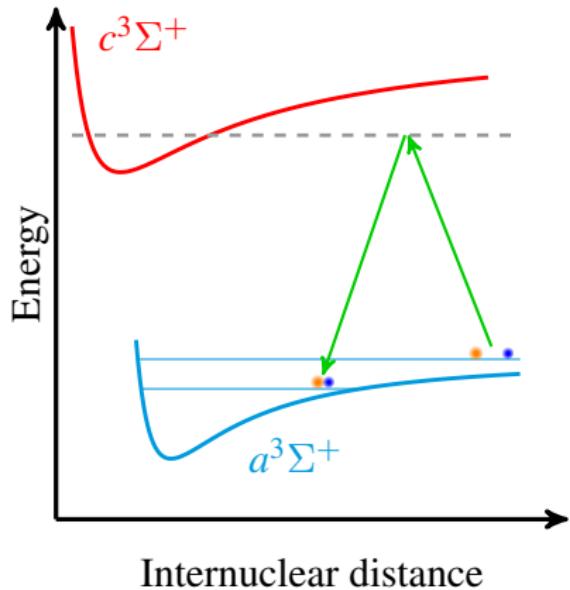
- Understand the issue
- Find a better approach

What can go wrong?



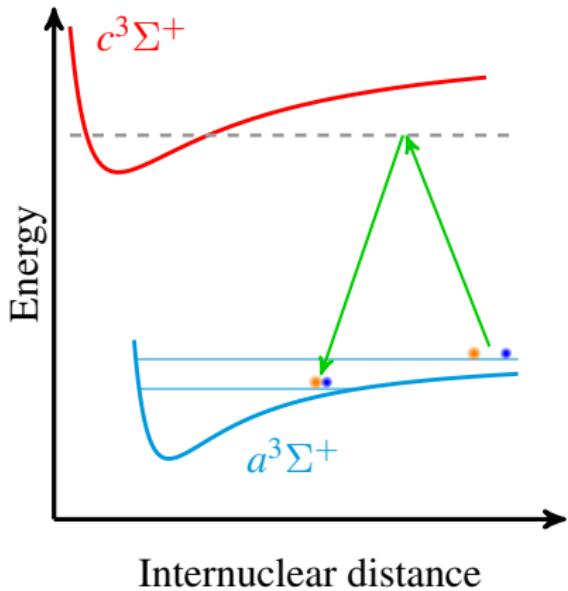
What can go wrong?

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



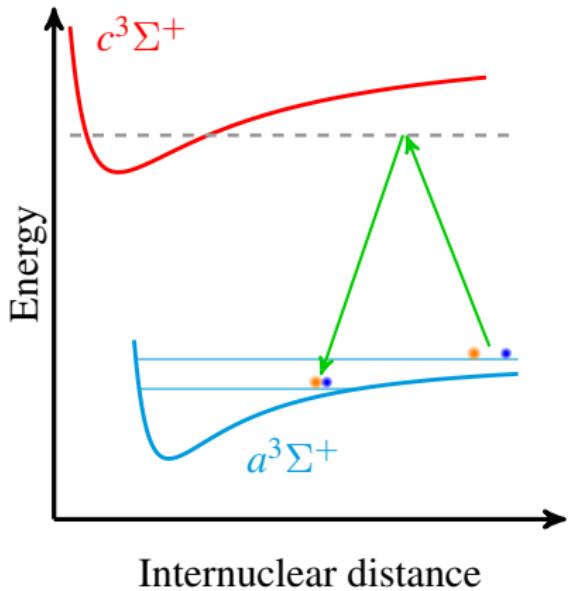
What can go wrong?

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



What can go wrong?

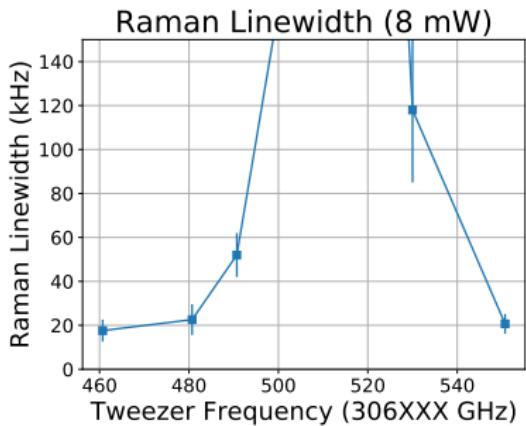
$$\frac{\Gamma_{\text{Line width}}}{\Omega_{\text{Rabi frequency}}}$$



What can go wrong?

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

- Single PA line effect
- Flucutation
- Scattering



What can go wrong?

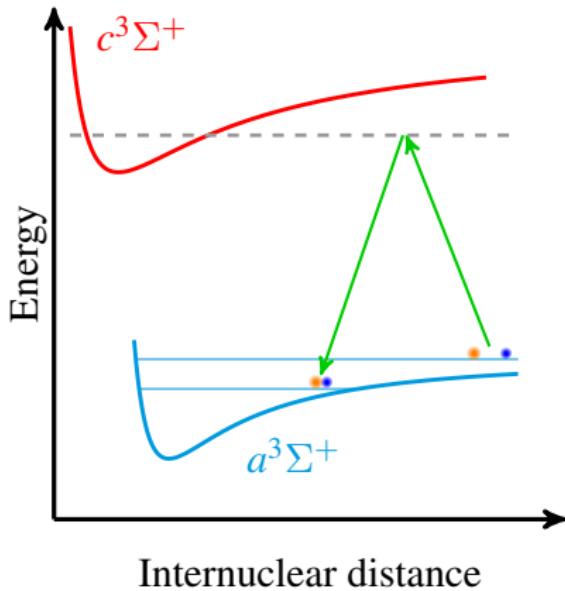
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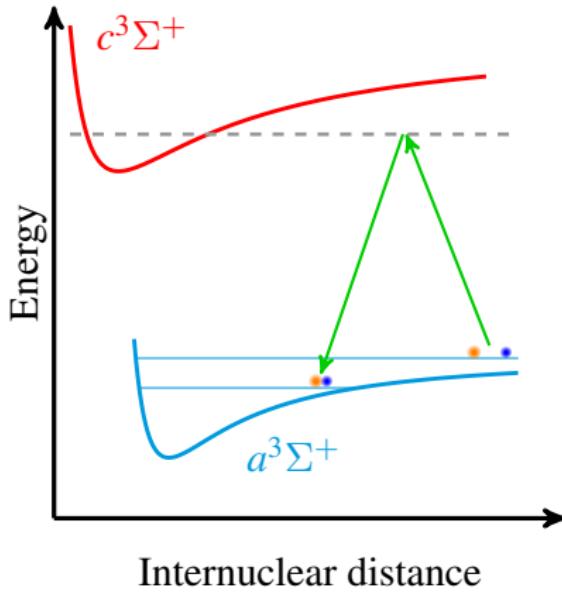
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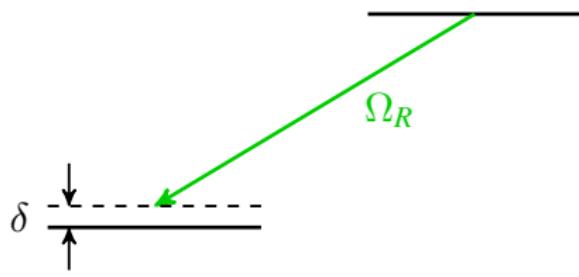
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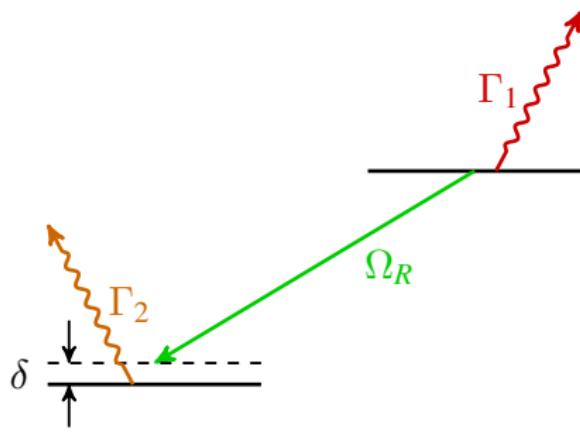
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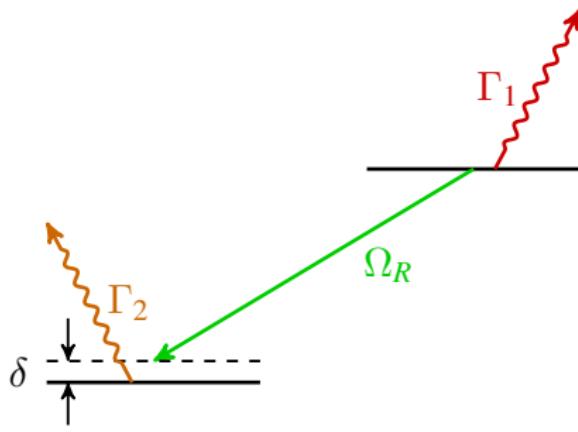
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- Flucutation
- Scattering



How many photons?





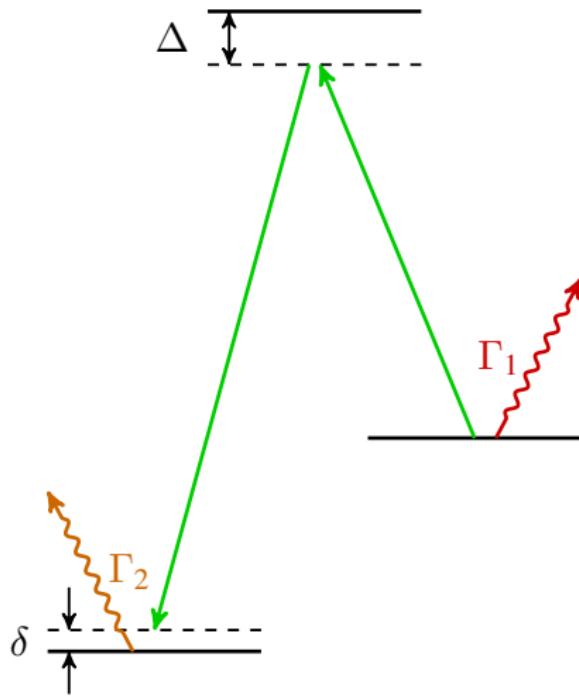


Γ_1 : PA rate

Γ_2 : Line width

Ω_R : Transfer/decay rate

δ : Resonance/line width

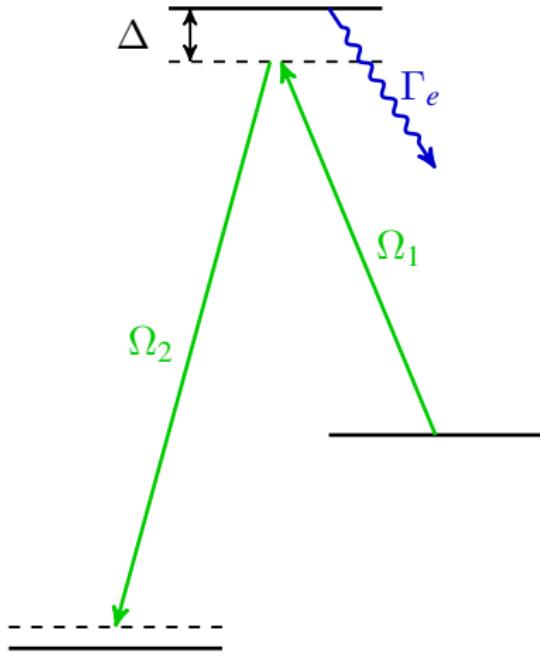


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Γ_1 : PA rate

Γ_2 : Line width

Ω_R : Transfer/decay rate

δ : Resonance/line width

$$\Delta \rightarrow \Gamma_e \Omega_1 \Omega_2$$

Detuning fluctuation

- Raman Rabi rate $\Omega_R \propto \frac{\Omega_1 \Omega_2}{\Delta}$

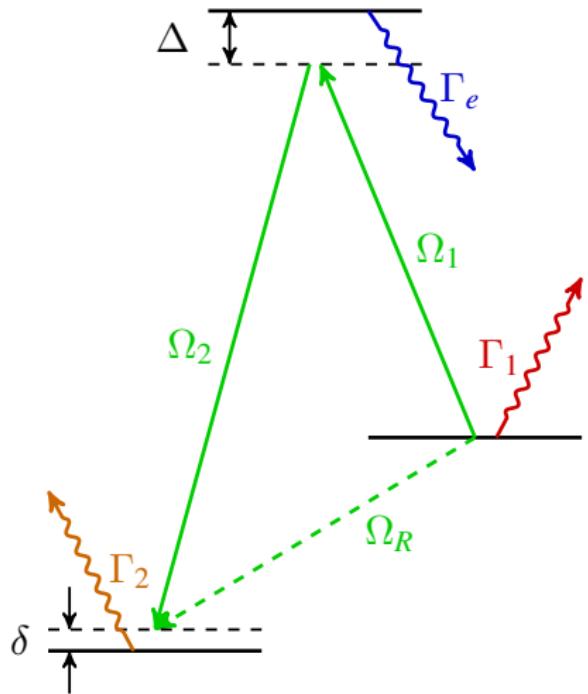
- Light shift $\delta_L \propto \frac{\Omega_1^2 + \Omega_2^2}{\Delta}$

- For $\Omega_2 \gg \Omega_1$

$$\frac{\delta_L}{\Omega_R} \approx \frac{\Omega_2}{\Omega_1} \gg 1$$

- Raman linewidth

$$\Gamma_2 \propto \frac{1}{\Delta^2} \text{ or } \frac{\delta_L}{\Gamma_2} \propto \Delta$$



Detuning fluctuation

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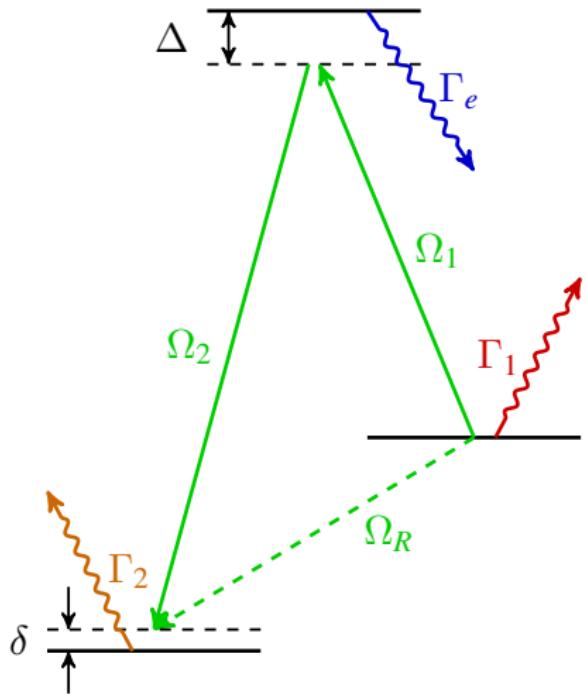
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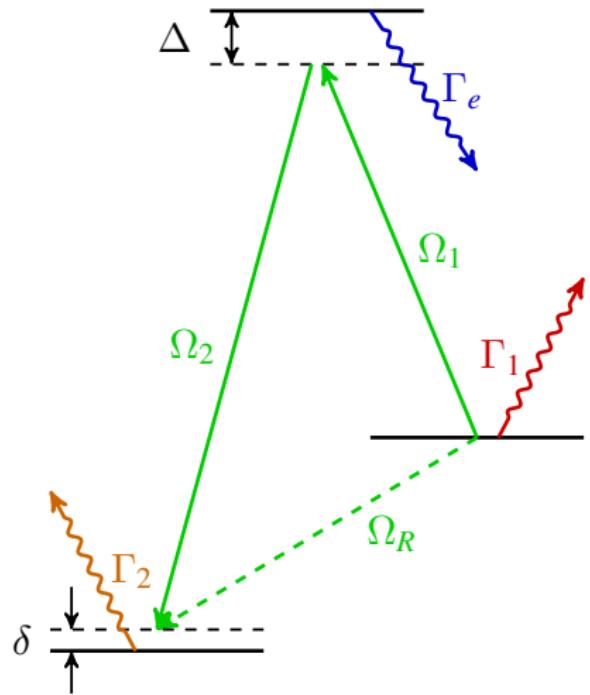
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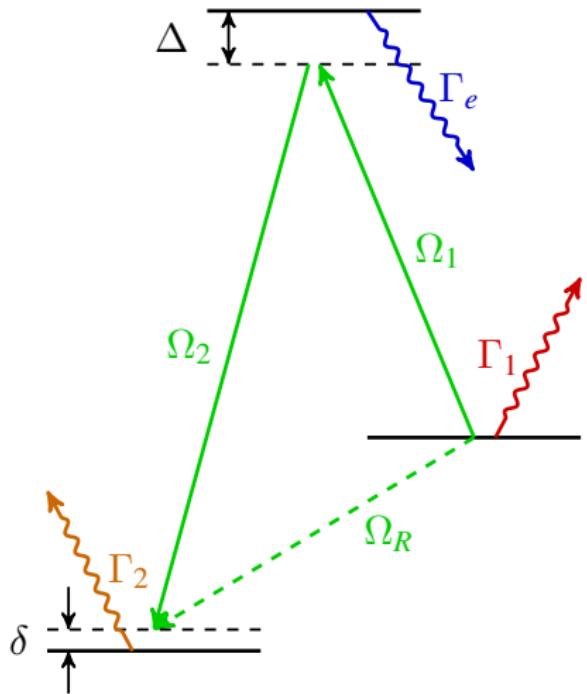
- Light shift $\delta_L \propto \frac{\Omega_1^2 + \Omega_2^2}{\Lambda}$

- For $\Omega_2 \gg \Omega_1$

$$\frac{\delta_L}{\Omega_R} \approx \frac{\Omega_2}{\Omega_1} \gg 1$$

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$$\Gamma_2 \propto \frac{1}{\Delta^2} \text{ or } \frac{\delta_L}{\Gamma_2} \propto \Delta$$

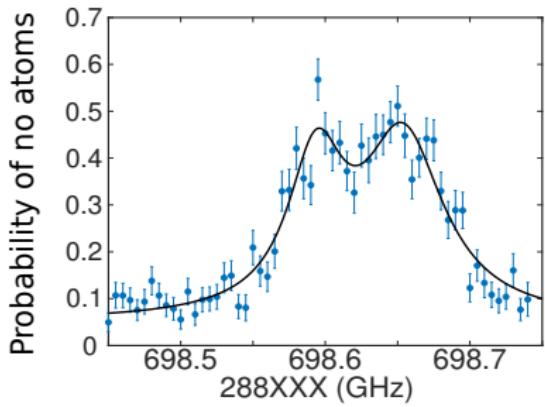


- Rabi frequencies (Ω_R , Ω_1 , Ω_2) and light shift (δ_L) matches theory.
- Scattering is faster than expected.
- $\Gamma_e \approx 2\pi \cdot 300\text{MHz}$

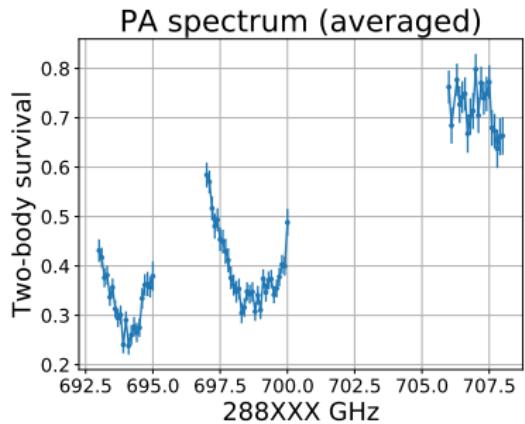
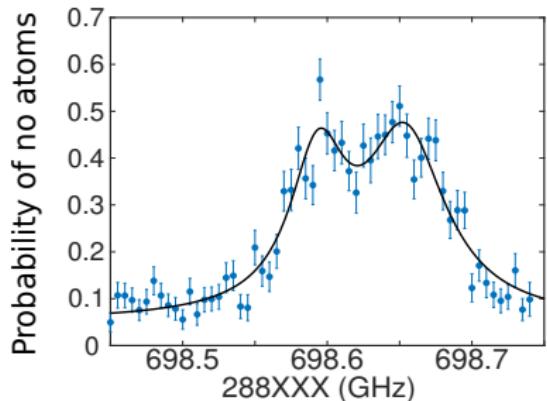
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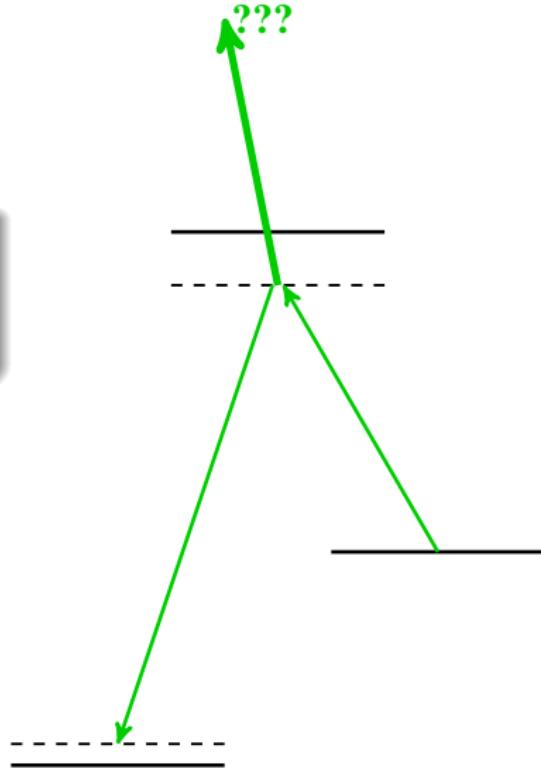


Cause

- PA beam size?
- Two photon process?

Cause

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Cause

- PA beam size?
- Two photon process?

Alternative

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

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