

Building Single Molecules from Single Atoms

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Molecules in tweezers

Outline

1 Experiment overview

2 Atom state control

- Raman sideband cooling of Na atoms

3 Optical molecule creation

4 Conclusion

Experiment overview

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Raman sideband cooling

Outline

1 Experiment overview

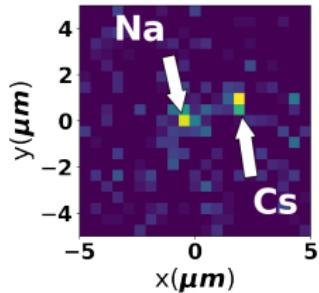
2 Atom state control

- Raman sideband cooling of Na atoms

3 Optical molecule creation

4 Conclusion

Loading

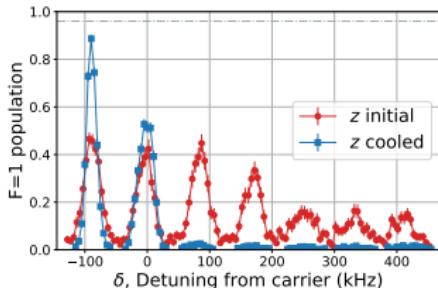


NJP. 19, 023007 (2017)

Merging

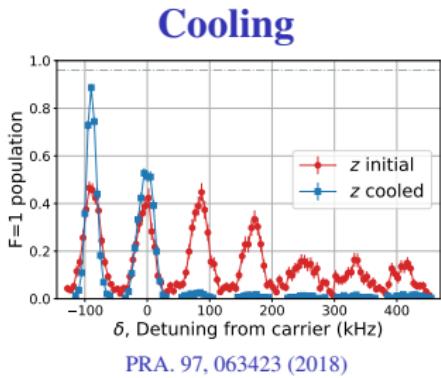
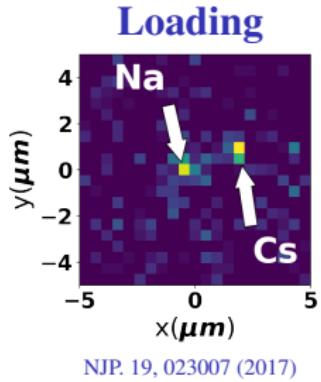


Cooling

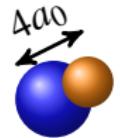
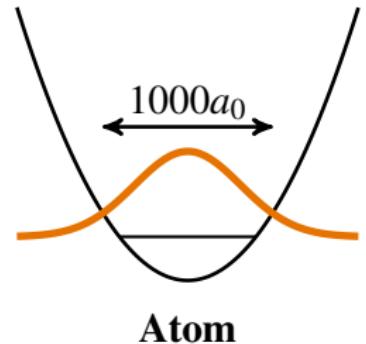
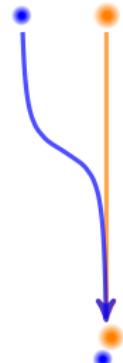


PRA. 97, 063423 (2018)

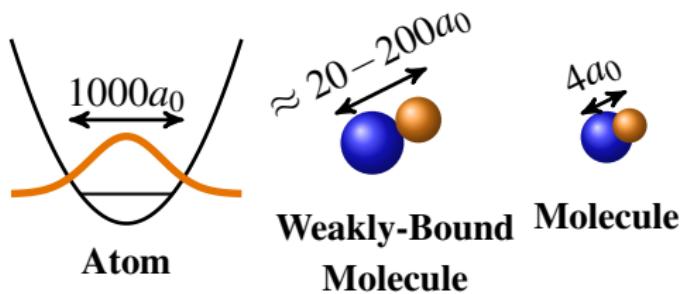
PRX. 9, 021039 (2019)

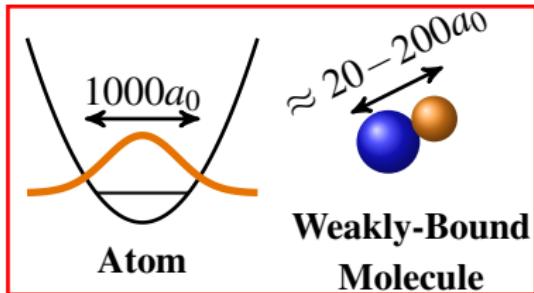


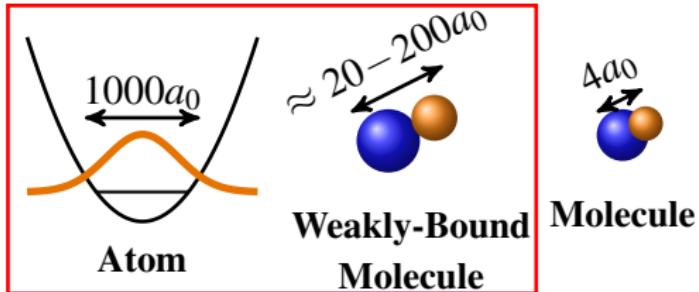
Merging



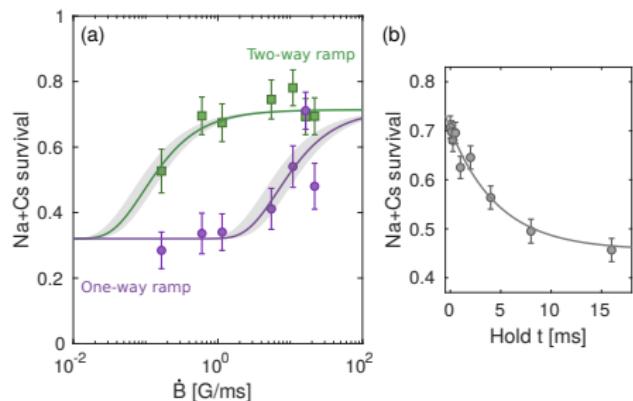
Molecule



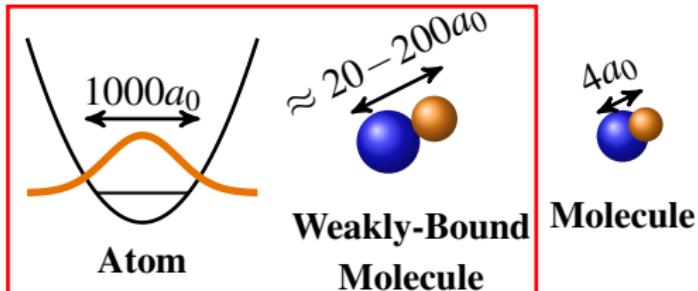




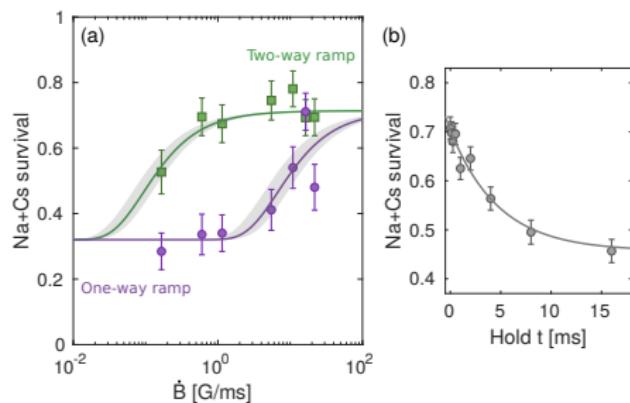
Feshbach molecule



PRL. 124, 253401 (2020)

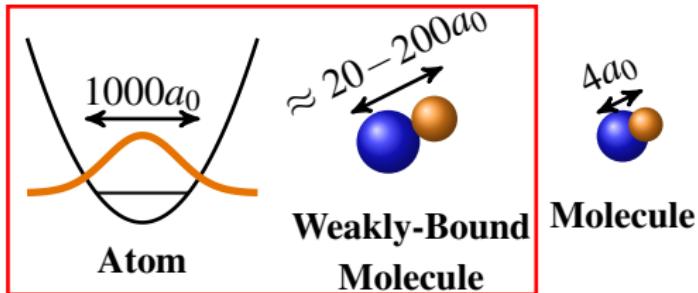


Feshbach molecule



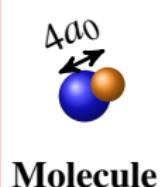
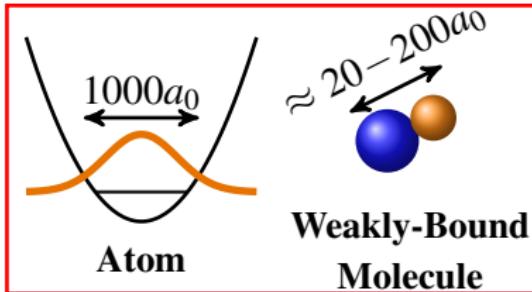
- Requires Feshbach resonance
- Usually large magnetic field

PRL. 124, 253401 (2020)



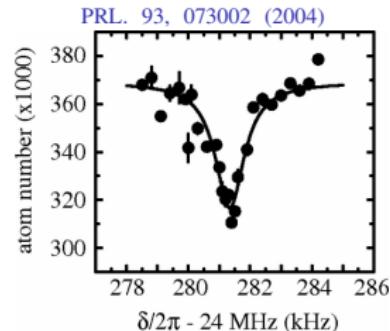
Optical transfer

- More general
- Faster



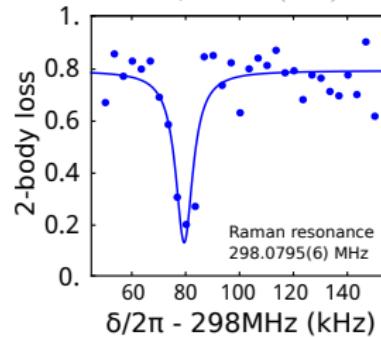
Previous results

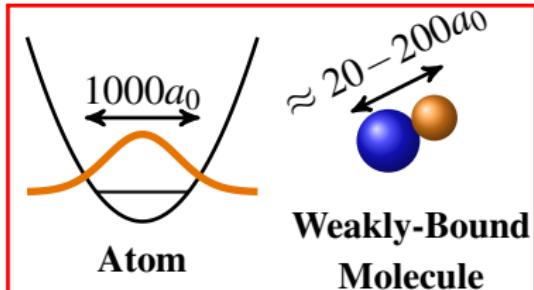
Rb_2 Science 287, p. 1016-1019 (2000)



Sr_2 PRL. 109, 115302 (2012)

NaCs PRX. 9, 021039 (2019)





Optical transfer

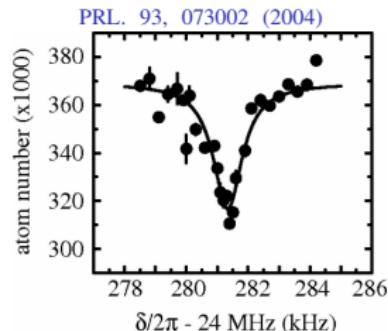
- More general
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Limitations so far

- Incoherent due to scattering
- Rely on narrow line optical transition

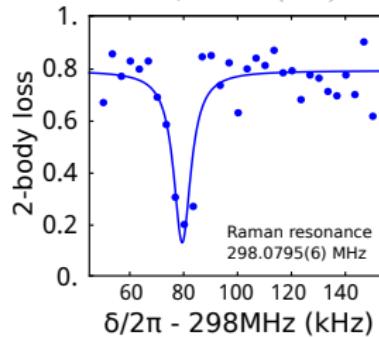
Previous results

Rb_2 Science 287, p. 1016-1019 (2000)

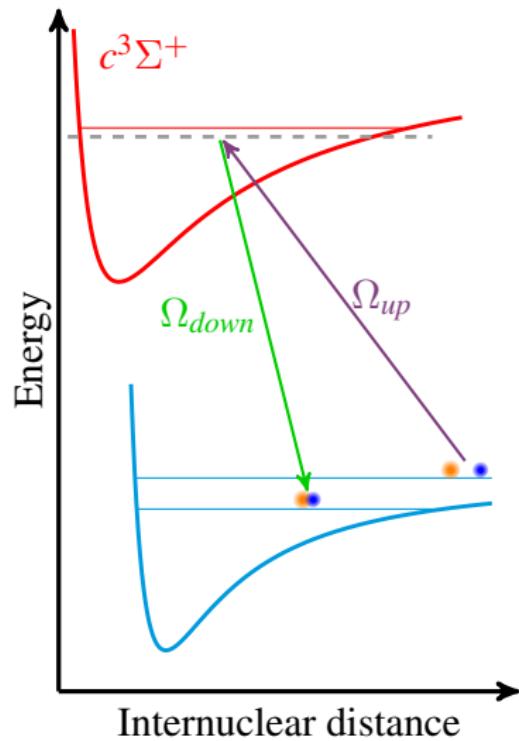


Sr_2 PRL. 109, 115302 (2012)

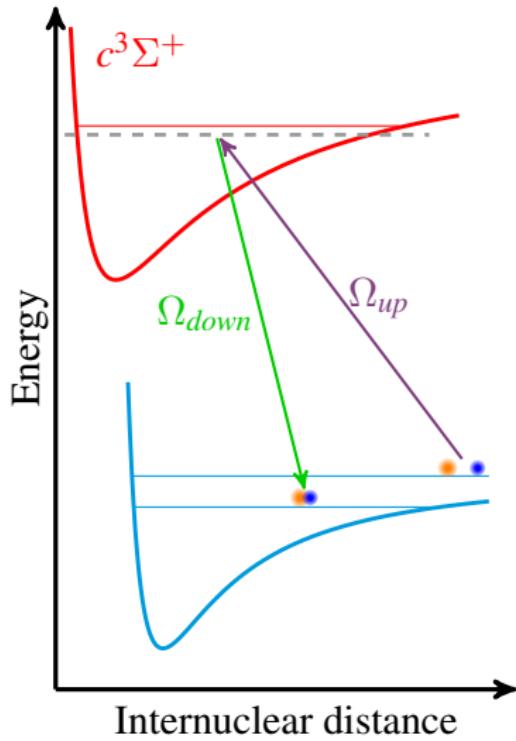
NaCs PRX. 9, 021039 (2019)



Raman transfer



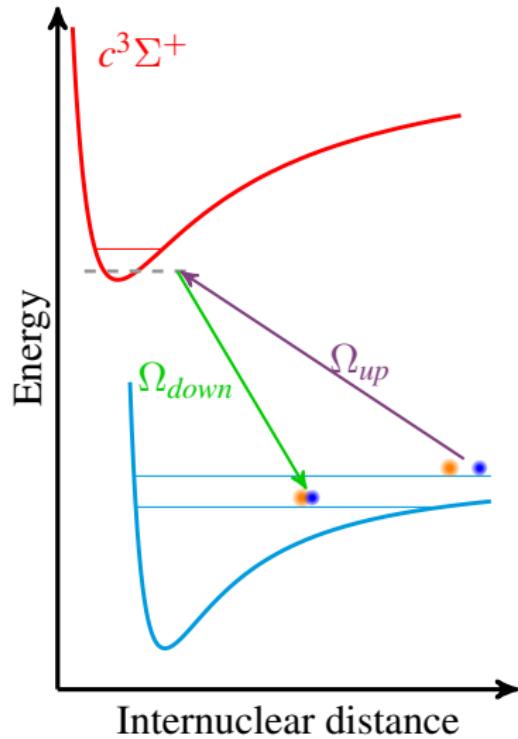
Raman transfer



Near threshold states

- Stronger coupling (Ω_{up} and Ω_{down})
- Closely spaced
- Fast scattering

Raman transfer



Near threshold states

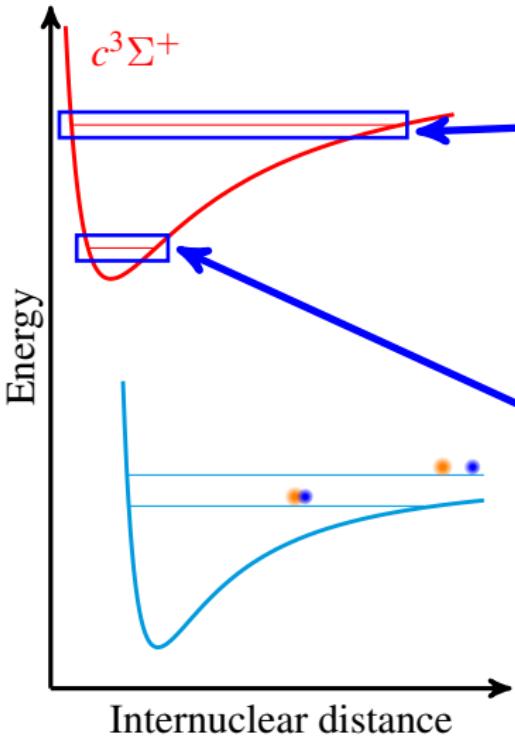
- Stronger coupling (Ω_{up} and Ω_{down})
- Closely spaced
- Fast scattering

Deeply bound states

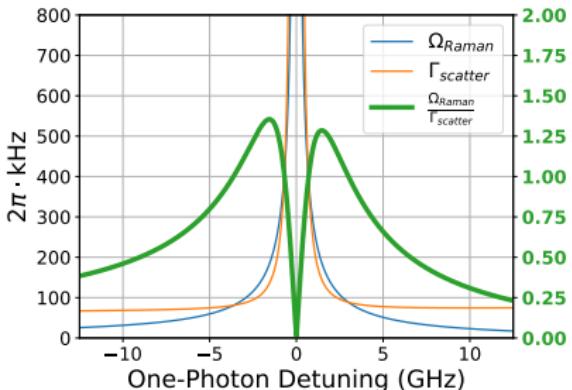
- Weaker coupling
- Sparsely spaced
- Allow larger detuning
- Slower scattering

arXiv:1701.03121(2017)

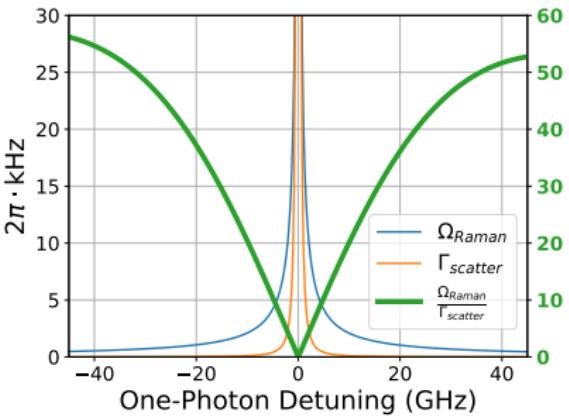
Raman transfer



Near threshold states



Deeply bound states



Conclusion

