

Single weakly-bound NaCs molecule in optical tweezers

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June 5, 2020

Molecules

- Dipole moment
- Rich internal states
- ...

Optical tweezers

- Single site imaging
- Single site addressing
- Flexible geometry
- ...

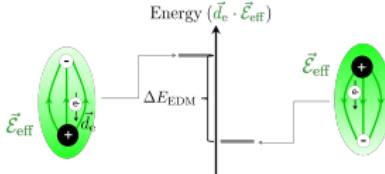
Molecules

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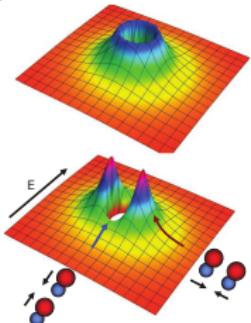
Optical tweezers

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Precision Measurement

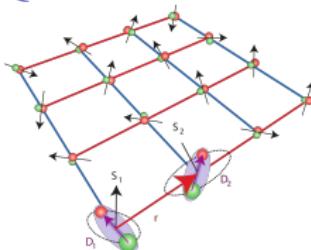


Science 343, p. 269-272 (2014)



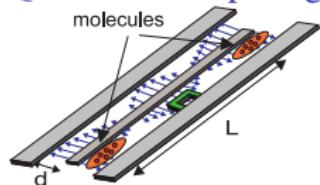
Nature 464, 1324 (2010)

Quantum Simulation



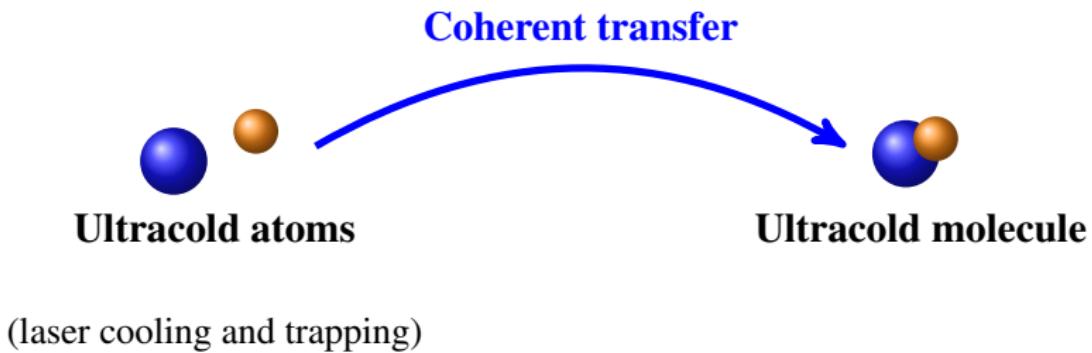
Nat. Phys. 2, 341 (2006)

Quantum Computing

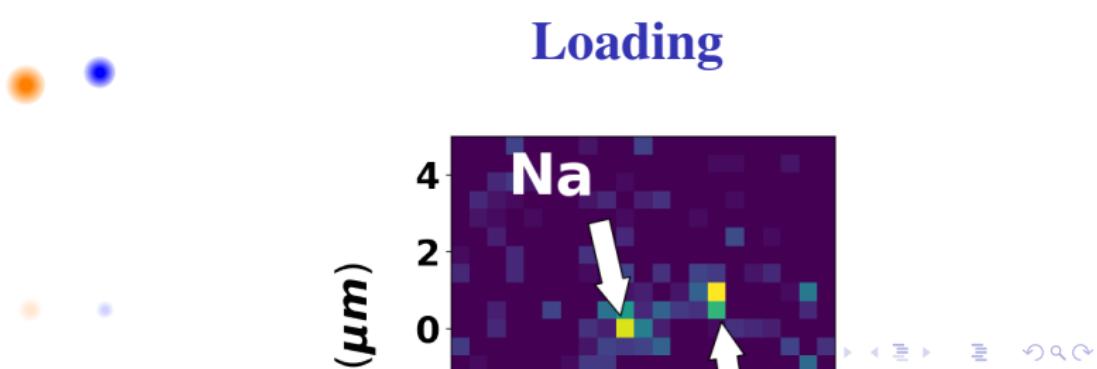


Phys. Rev. Lett. 97, 33003 (2006)

From atoms to molecules



From atoms to molecules



From atoms to molecules



Cooling

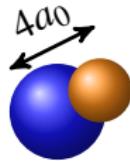


From atoms to molecules

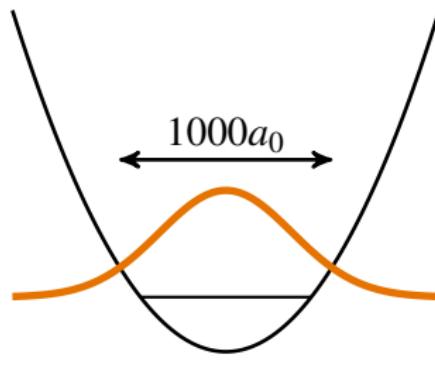
Merging



Wave function size mismatch

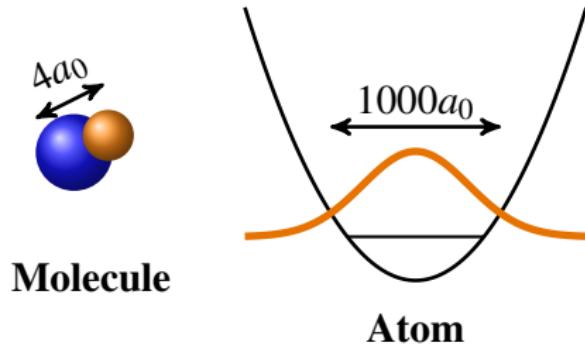


Molecule



Atom

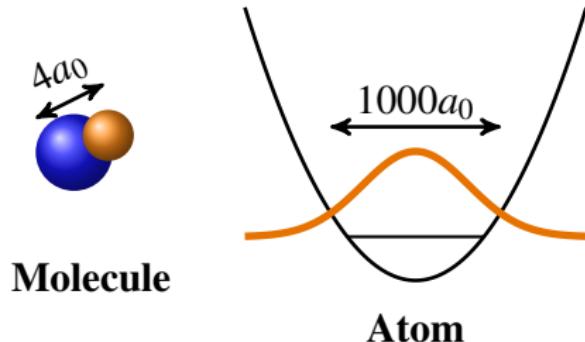
Wave function size mismatch



Feshbach molecule

- Requires Feshbach resonance
- Usually large magnetic field

Wave function size mismatch



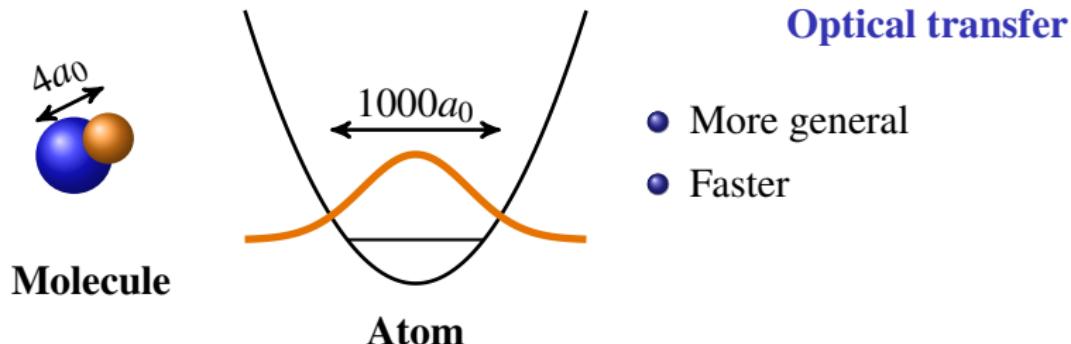
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Our implementation

arXiv:2003.07850 (accepted by PRL)
Poster Q01.00108

Wave function size mismatch



Optical transfer

- More general
- Faster

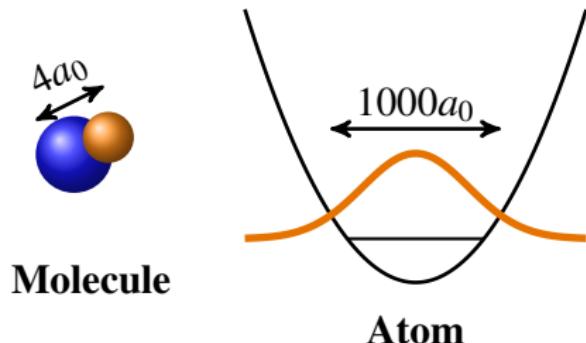
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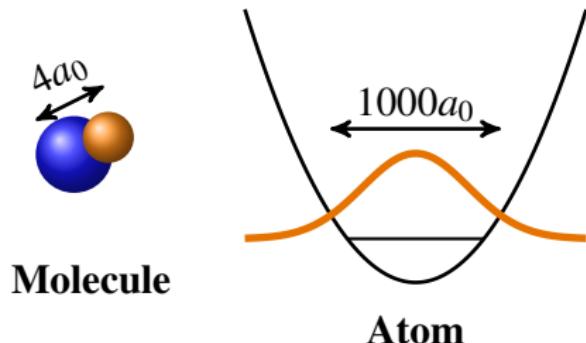
Previous results

- Rb + Rb
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- Sr + Sr

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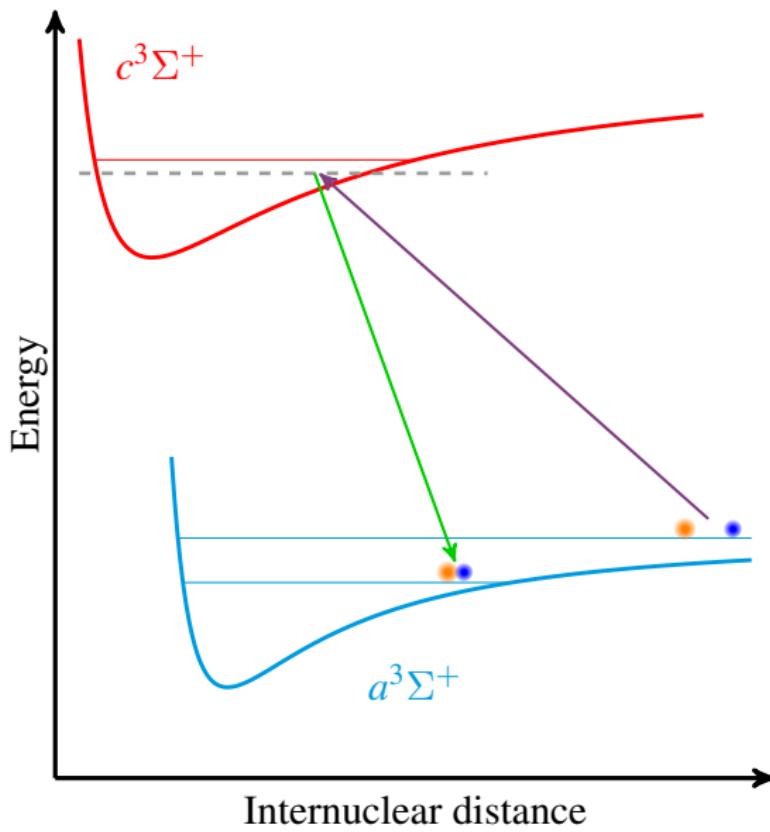
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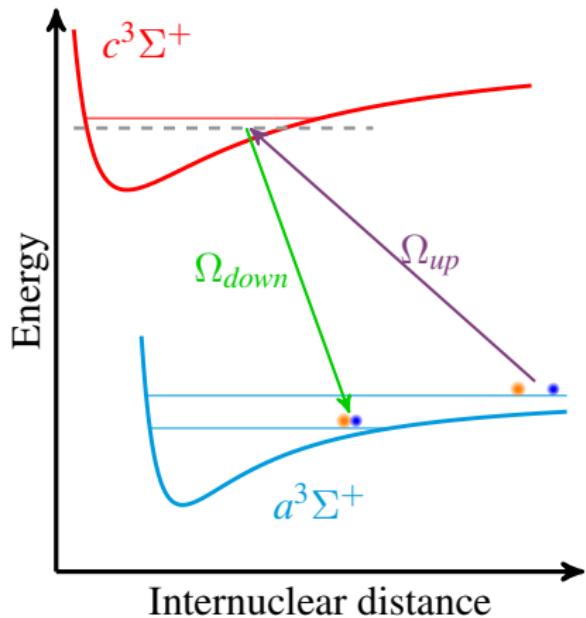
Limitations

- Incoherent due to scattering
- Using narrow line optical transition

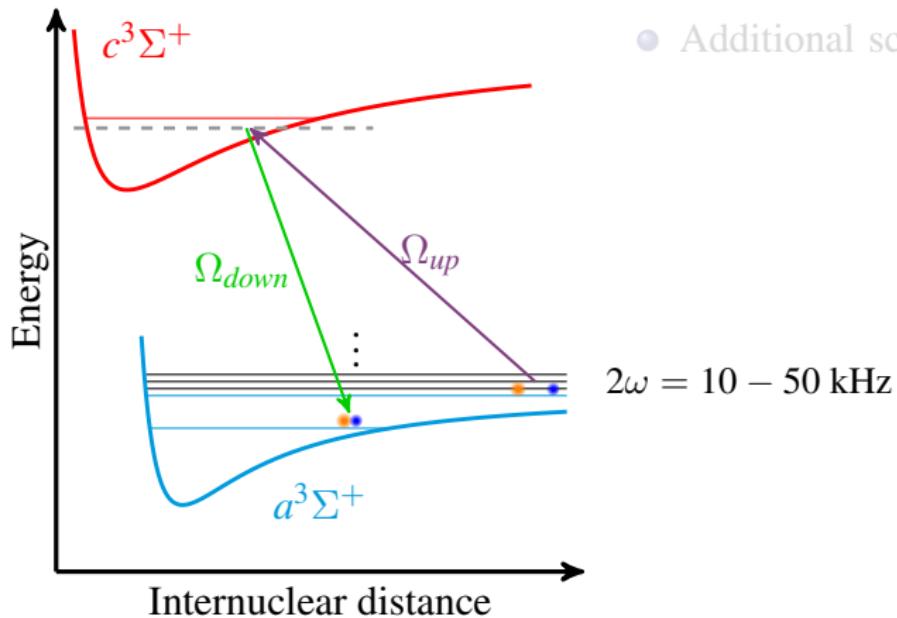
Raman transfer



Raman transfer

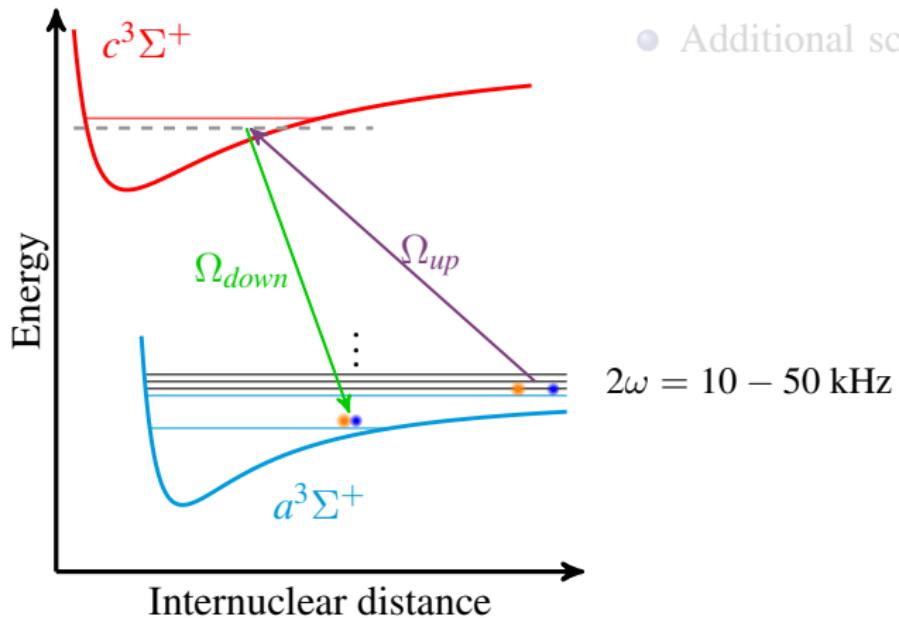


Raman transfer



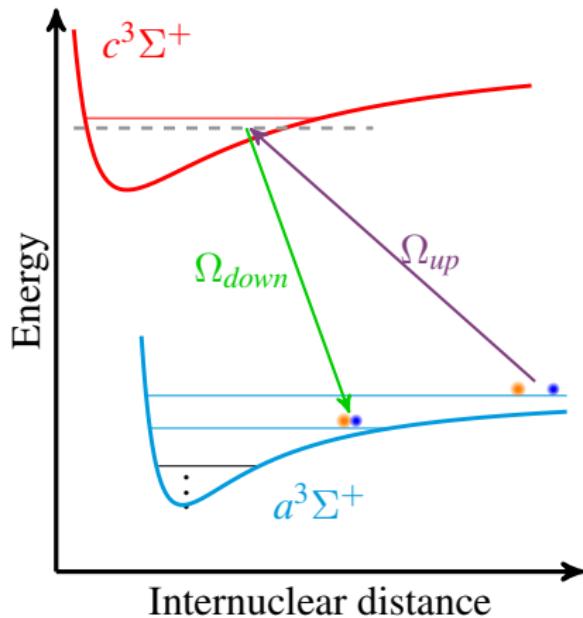
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- Additional scattering.

Raman transfer



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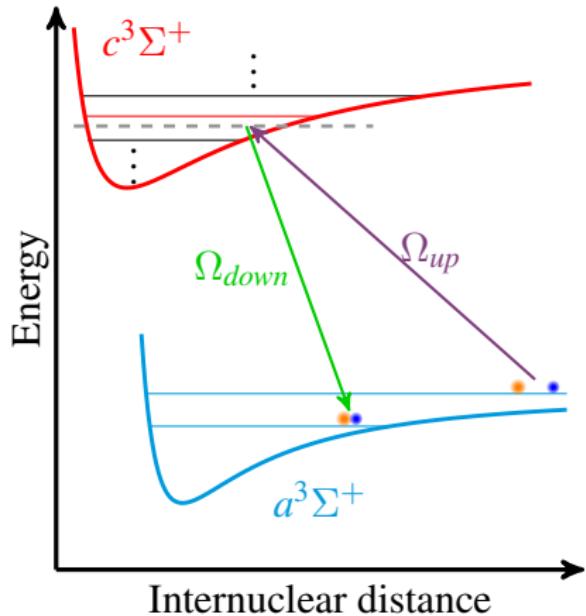
Raman transfer



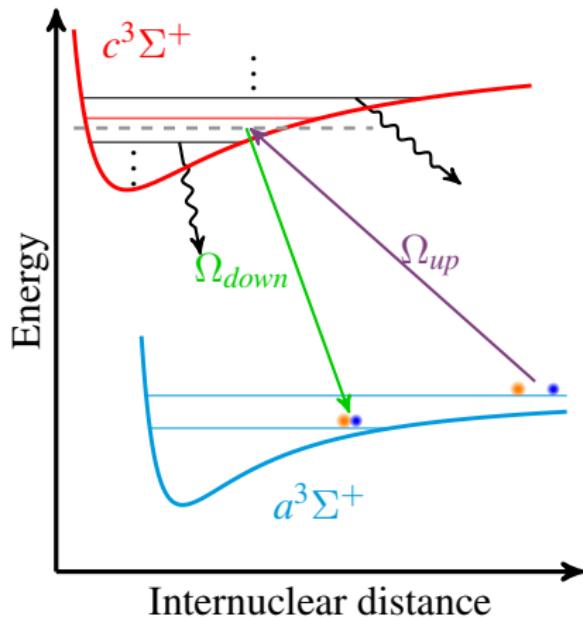
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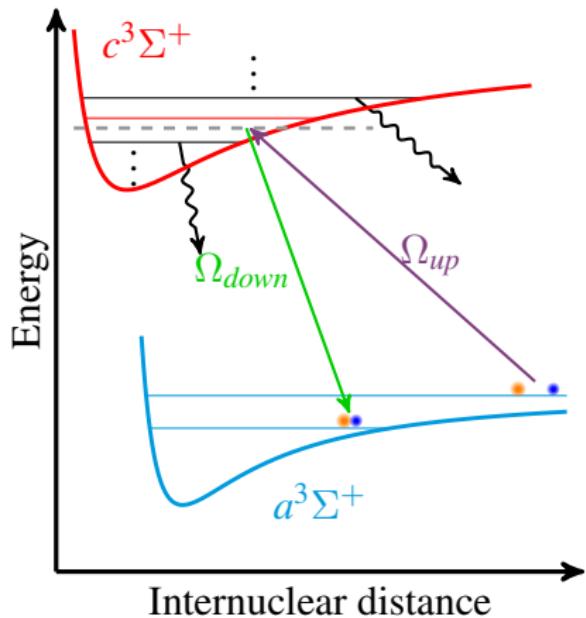


Raman transfer



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Raman transfer

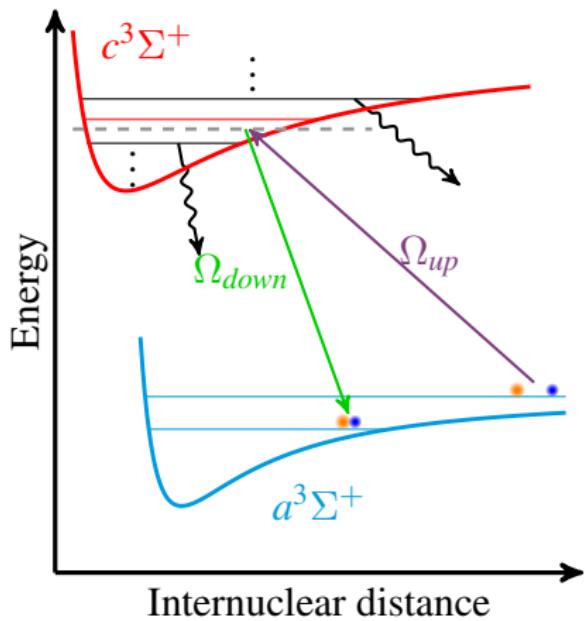


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Near threshold states

- Closely spaced
- Stronger coupling (Ω_{up})
- Easier to find

Raman transfer



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Deeply states

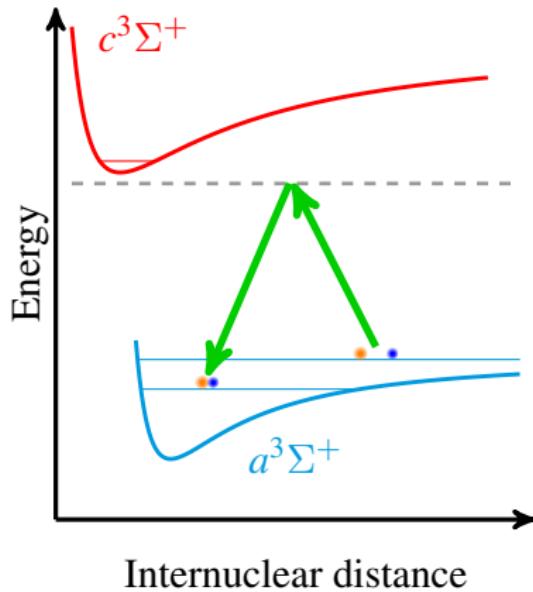
- Sparsely spaced
- Allow larger detuning
- Lower scattering

Raman transfer

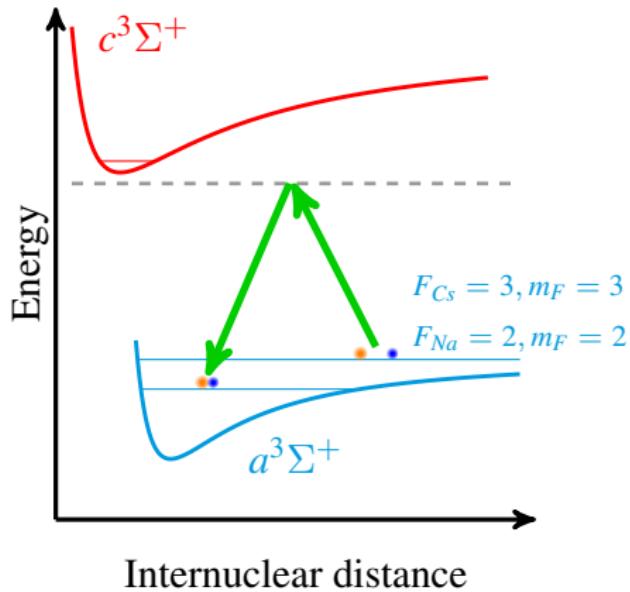
Near threshold states

Deeply bound states

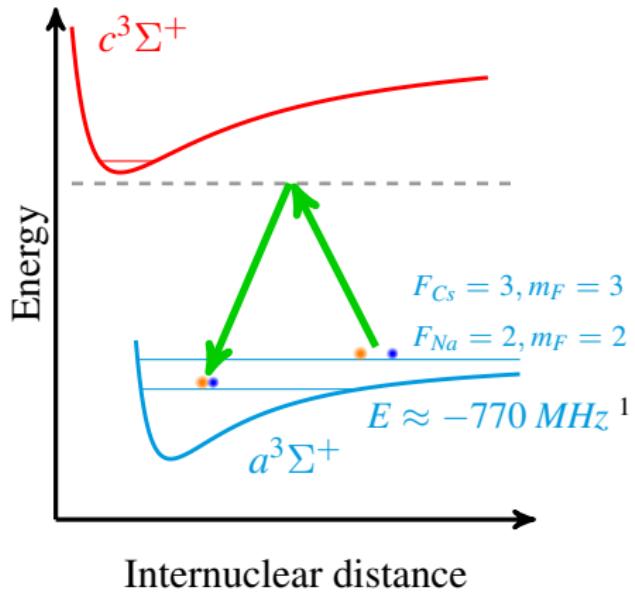
Experiment



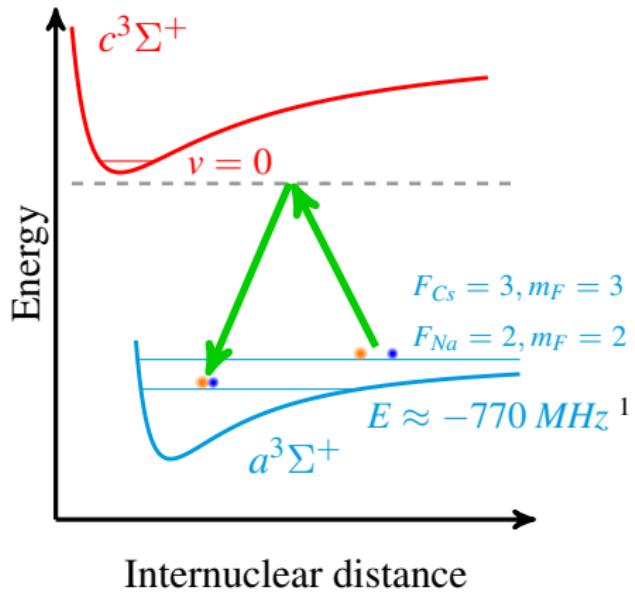
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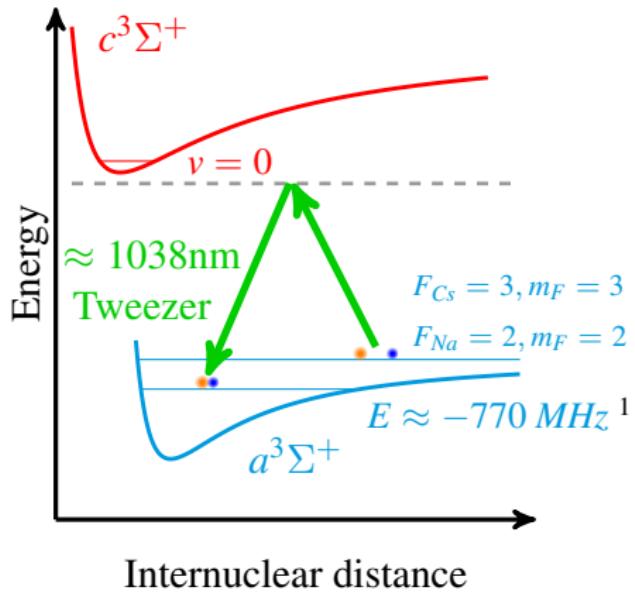


Experiment



¹Phys. Rev. Research 2, 023108 (2020)

Experiment



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Outlook

