Buffer Gas Cooling and Optical Cycling of Aluminum Monofluoride Molecules (AlF)

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PAPER

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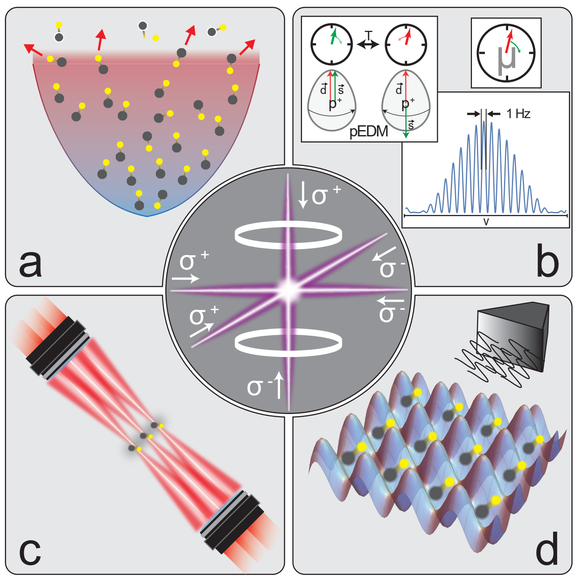
Optical cycling of AlF molecules

Introduction

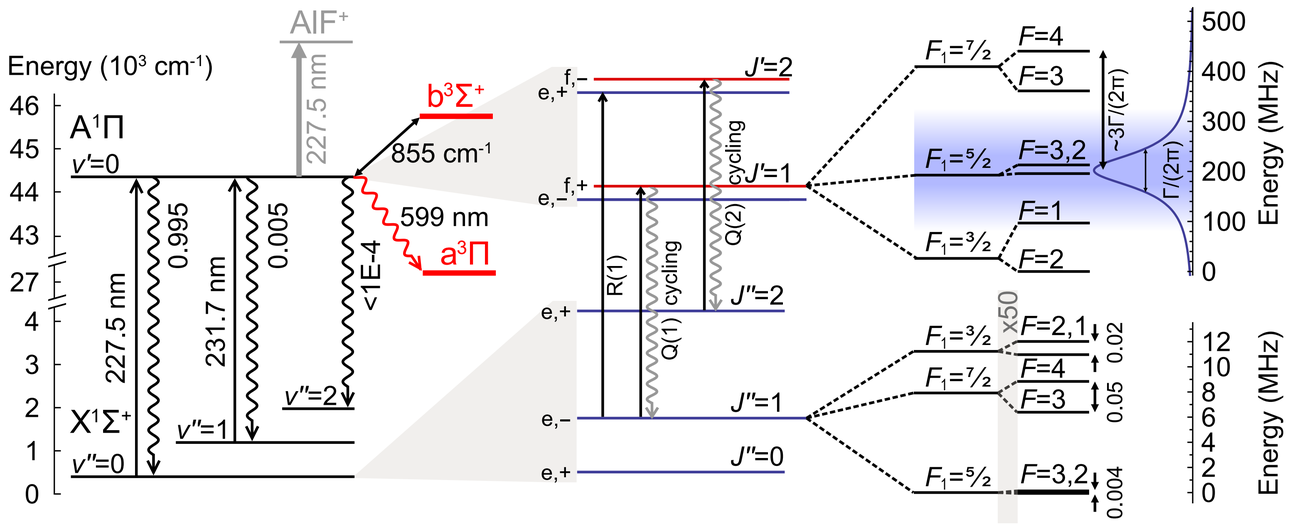
A magneto-optical trap (MOT) of **aluminum monofluoride** (AlF) is the starting point for many new applications in fundamental science.

Ultracold science tools:

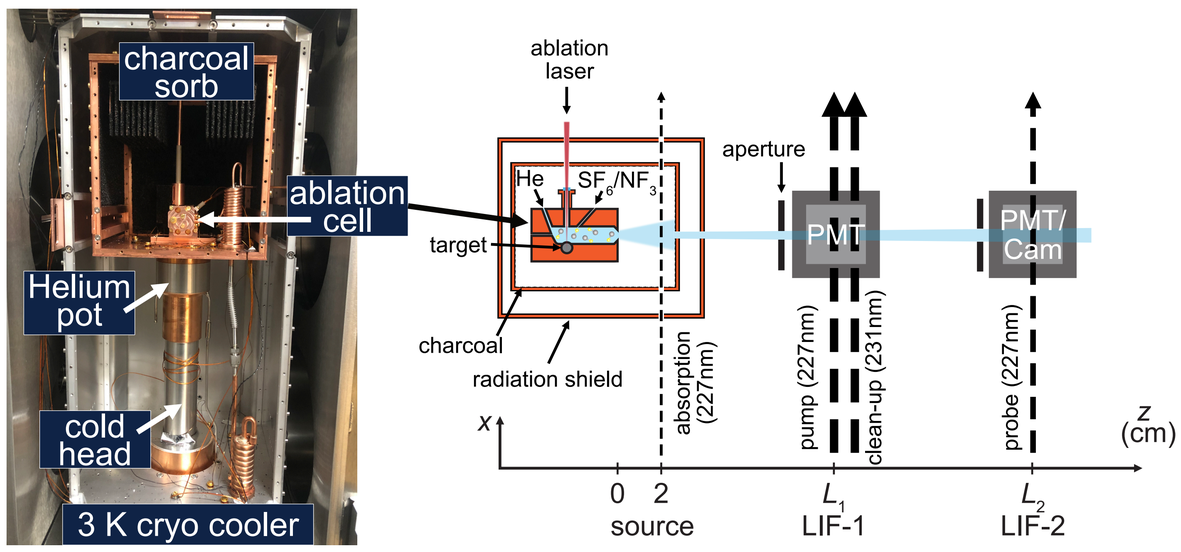
a) Ultracold collisions
b) Precision spectroscopy
c) Optical tweezers
d) Molecular quantum array



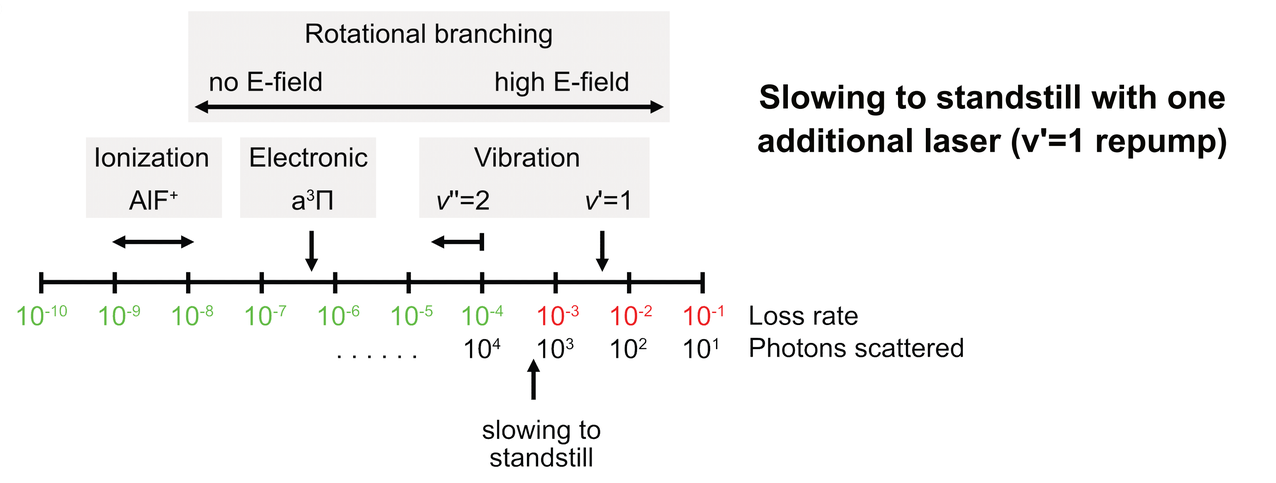
Energy Diagram



Molecular Beam Characterization



Loss Channel Analysis

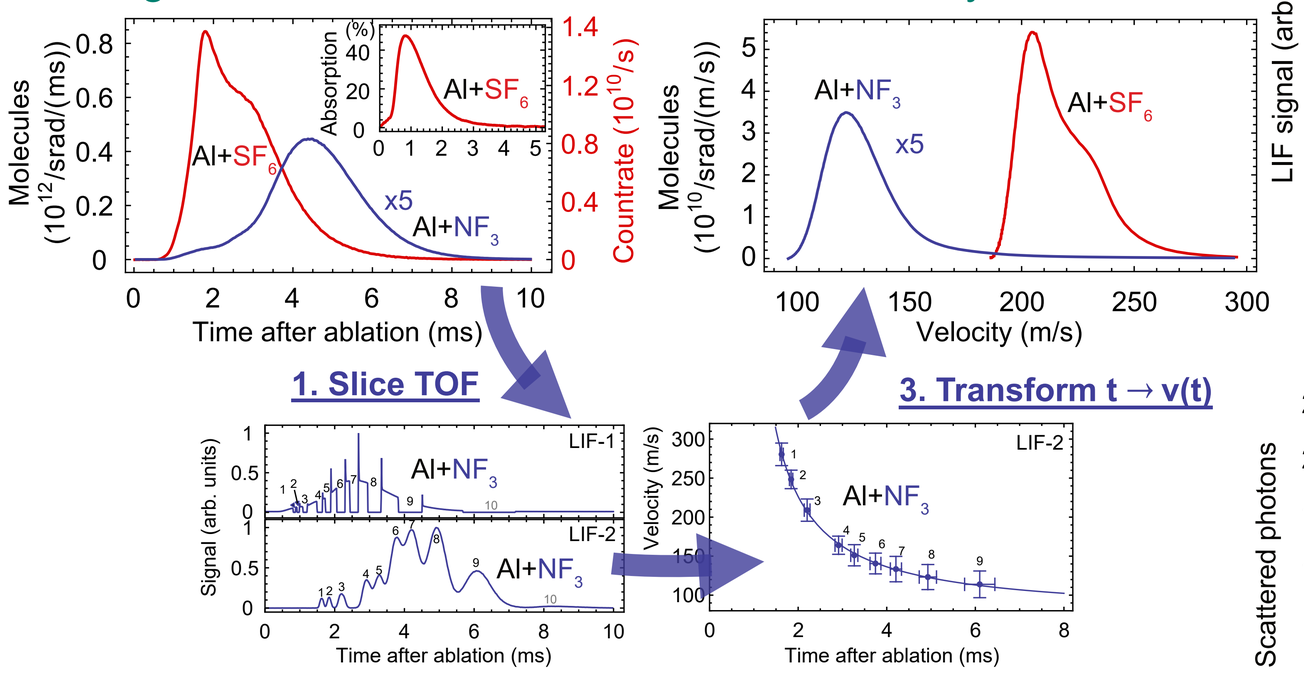


Slowing to standstill with one additional laser (v'=1 repump)

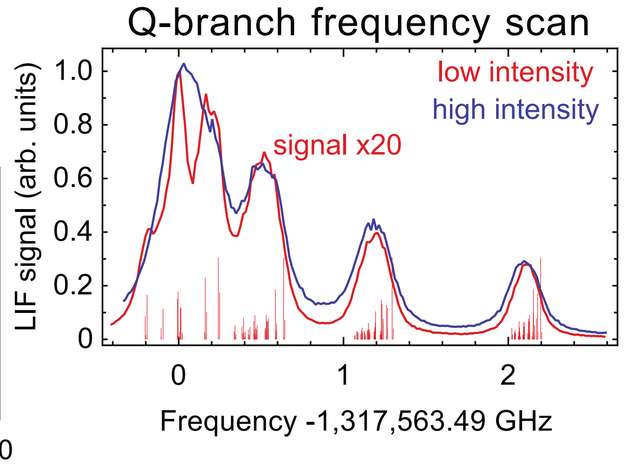
Optical Cycling

$A^1\Pi \leftrightarrow X^1\Sigma^+$

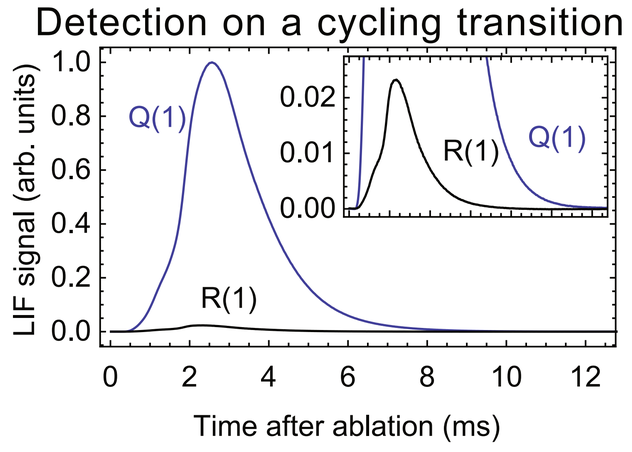
Buffer gas source characterization and velocity distribution



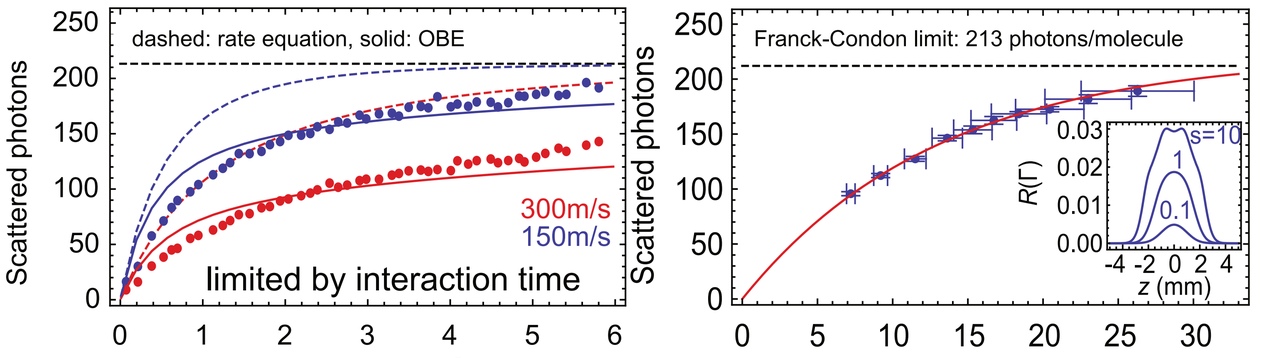
Q-branch frequency scan



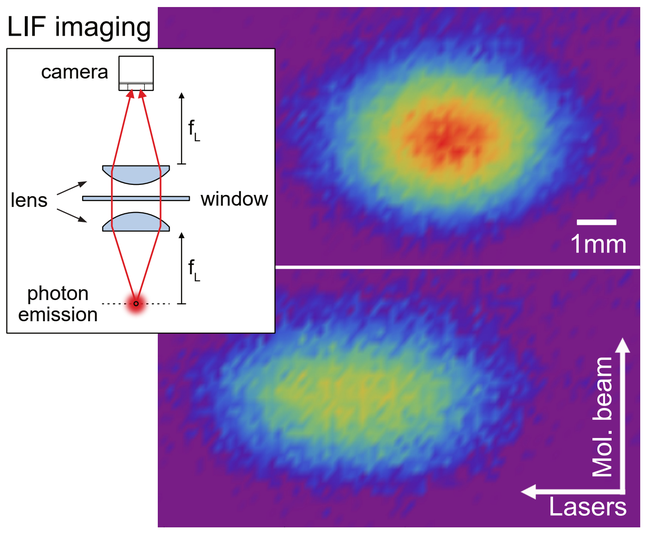
Detection on a cycling transition

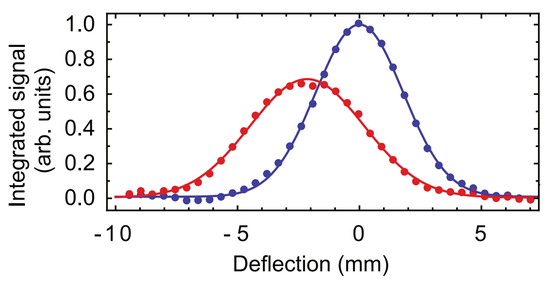


Saturation of the cycling transition on **Q(1)**



Transverse deflection by radiation pressure

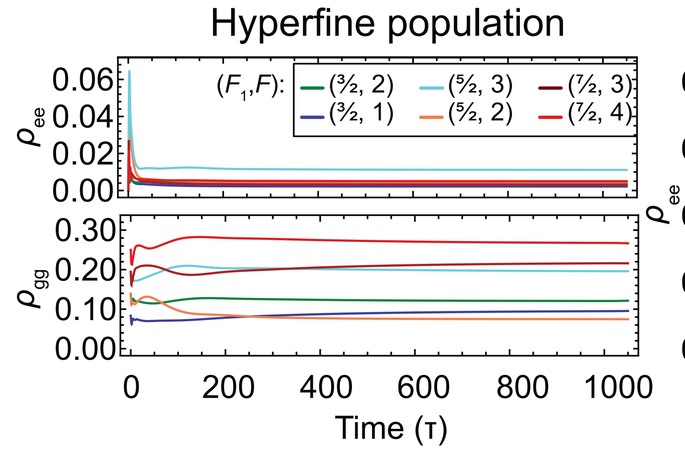




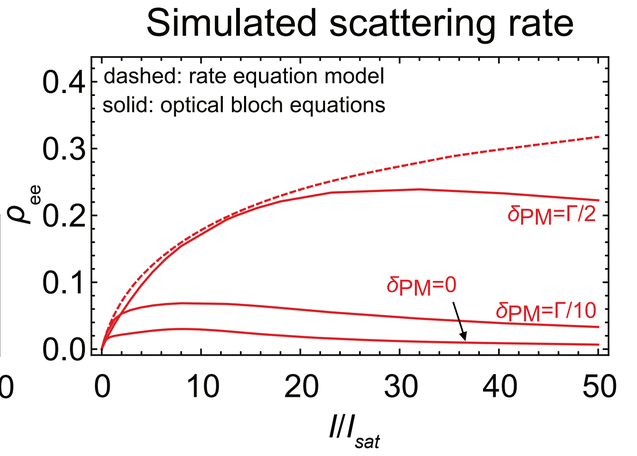
Transverse photon momentum transfer
Δv=3.8 cm/s per photon

Acceleration of 8.7(1.5) × 10^5 m/s²

Hyperfine population



Simulated scattering rate



Polarization modulation (PM) increases the scattering rate

Acknowledgements

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[3] Hofsäss et al., New J. Phys. (2021): 23 075001