Towards cold ammonia collisions

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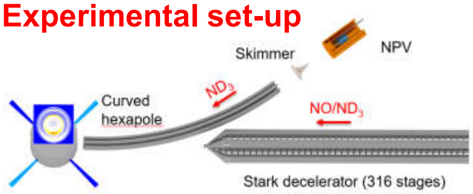
Introduction

In the last decades, huge steps have been made towards understanding molecular collisions [1]. We are interested in cold collisions between two dipoles, because the anisotropic and long-range nature of the interaction allows for interesting collision phenomena and experiments [2]. By combining a Stark decelerator and curved hexapole in a merged-beam set-up we have been able to study high-resolution inelastic ND_3-NO collisions between ND_3 (J_K p=1_1-) and NO (j=1/2,*f*) at energies down to 10mK. We would like to extend this research to ND_3-ND_3 collisions. Currently we are investigating the effect of the curved hexapole field on the Stark beam.

Experimental set-up

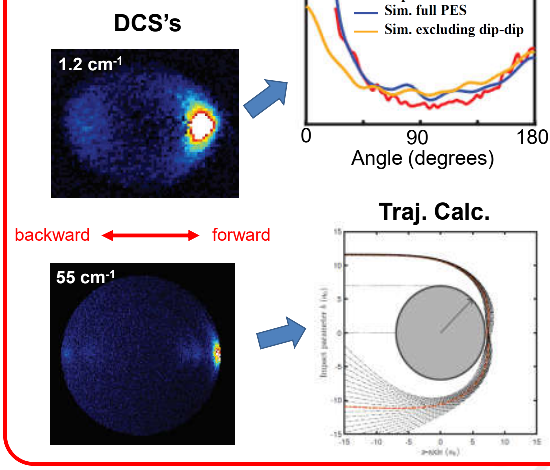


Stark decelerator
- Excellent control of polar molecules due to Stark effect
- High state selectivity
- Small beam spreads

Hexapole
- Guides molecules through the bend

Low collision angle → low E_{coll} !

NO-ND_3 results

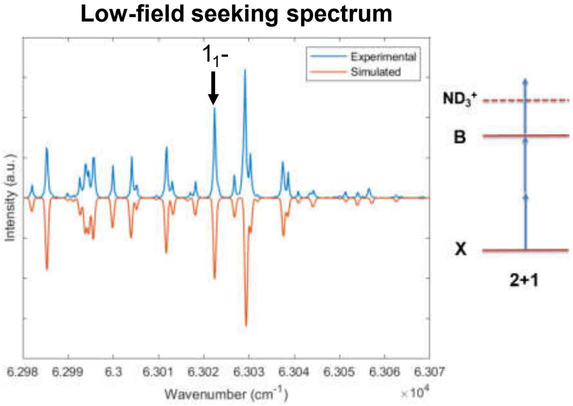


Dipole-dipole interaction causes long-range glancing collisions, observed at forward scattering

@High E_{coll}, the strong NO-ND_3 interaction causes Soft-Collision Back-Scattering (SCBS) at specific impact parameters

REMPI spectrum $^{15}ND_3$

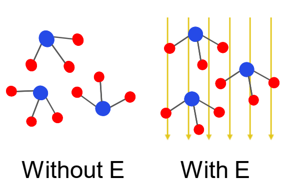
Low-field seeking spectrum

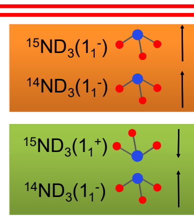


Use $^{15}ND_3$ and $^{14}ND_3$ for spectroscopic separation
→ find suitable $^{15}ND_3$ 1_1- and 1_1+ REMPI transition

Outlook

Control collisions in E-field!

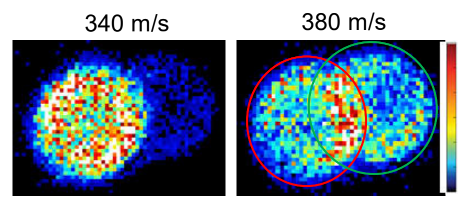


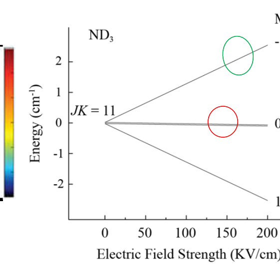


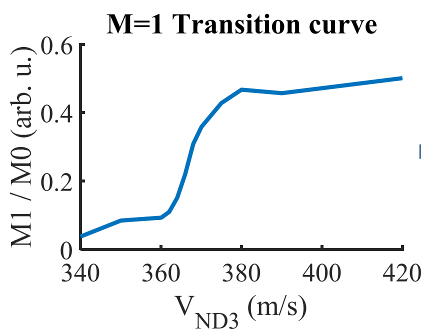
Pumping to 11+ with microwaves to study orientation effect

Hexapole influence

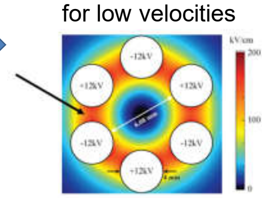
Hexapole (partly) deflects Stark beamspot due to its E-field

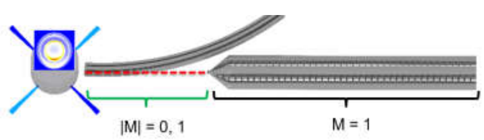






Hexapole acts as a potential barrier for low velocities





Field-free region mixes M-states!

No clean collision experiment conditions!

Acknowledgements

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References

[1] Onvlee, J., Vogels, S.N., von Zastrow, A. *et al*. Molecular collisions coming into focus. *Phys. Chem. Chem. Phys.* **16,** 15768-15779 (2014)
[2] Ni, KK., Ospelkaus, S., Wang, D. *et al.* Dipolar collisions of polar molecules in the quantum regime. *Nature* **464,** 1324–1328 (2010).