Hot topic presentation

Magneto-optical trapping of aluminium monofluoride

Wright S.C.[1,†], **Padilla-Castillo J.E.**[1], **Cai J.**[1,2], **Thomas R.S.**[1], **Kray S.**[1], **Sartakov B.**[1], **Truppe S.**[2], **Meijer G.**[1]

[1] *Fritz Haber Institute of the Max Planck Society, Berlin, Germany*

[2] *Centre for Cold Matter, Imperial College London, London, UK*

[†] sidwright@fhi-berlin.mpg.de

Magneto-optical trapping of molecules has thus far been restricted to molecules with $^2\Sigma$ or $^2\Sigma$-like electronic ground states. These species are normally chemically reactive and difficult to produce, and in the case of diatomic molecules with $^2\Sigma^+$ ground states, a simple laser cooling scheme exists only for the first excited rotational level.

In this talk, I will present the first magneto-optical trap (MOT) for a $^1\Sigma^+$ ground state molecule, the diatomic species aluminium monofluoride (AlF). The intense $A^1\Pi \leftarrow X^1\Sigma^+$ transition in AlF enables efficient optical cycling on any Q(J) rotational line, and we take advantage of this fact by demonstrating a MOT for three different excited rotational levels. Our results represent the shortest wavelength magneto-optical trap for any atom or molecule to date, and pave the way to highly precise spectroscopy on the spin-forbidden $a^3\Pi \leftarrow X^1\Sigma^+$ transition in AlF.

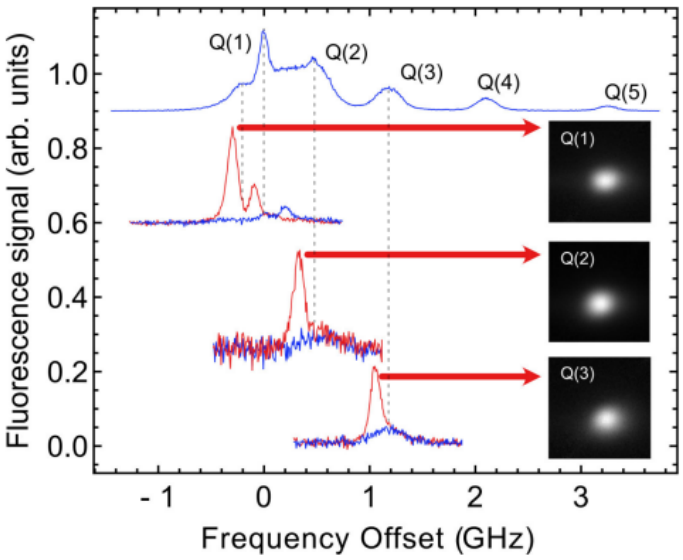

Figure 1: Magneto-optical trapping of AlF molecules. Upper spectrum: molecular beam fluorescence spectroscopy of the $A^1\Pi, v = 0 \rightarrow X^1\Sigma^+, v = 0$ transition in AlF, showing the five lowest Q(J) lines. Lower spectra: fluorescence spectra of the MOT for three different rotational states. Red, solid lines: spectra with the circular polarisations of the trapping light configured for the MOT. Blue, solid lines: spectra with the circular polarisations of all trapping beams reversed. Dashed, grey lines show the position of resonance lines measured in the molecular beam. Insets show camera fluorescence images at the position of the fluorescence peak, for the MOT polarisation configuration.