Static trapping of molecules in a traveling wave decelerator

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We present data on decelerating and trapping molecules in a traveling wave decelerator. This decelerator uses a sequence of 336 ring-shaped electrodes, to which oscillating high voltages are applied, to create a true 3D trap for polar molecules [1]. By varying the frequencies of the applied voltages with an arbitrary waveform generator, the electric field trap can be moved at will.

Here we present data in which we decelerate the molecules to a standstill, and then hold them in the trap [2]. This scheme is a great improvement on previous trapping experiments, as the trapping is performed inside the decelerator, removing the losses associated with transferring the molecules to a separate trap.

We use a combination of a conventional Stark decelerator and the traveling wave decelerator to slow and trap NH_3 and ND_3 molecules. The conventional Stark decelerator slows the molecules from 300 m/s to 100 m/s. Below this speed conventional Stark decelerators suffer from severe losses, which we avoid by using the traveling wave decelerator to perform the remaining deceleration to standstill.

As well as showing static trapping for the first time, we illustrate the versatility of such a ring-type decelerator, and the great control it gives us over the molecules. We demonstrate phase-space manipulation by adiabatically cooling the molecules, and resonantly exciting their motion in the trap.

References:

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