OPTIMIZING A STARK DECELERATOR BEAMLINE FOR THE TRAPPING OF COLD MOLECULES USING EVOLUTIONARY STRATEGIES

JOCHEN KÜPPER, JOOP J. GILIJAMSE, STEVEN HOEKSTRA, NICOLAS VANHAECKE, SEBASTIAAN Y. T. VAN DE MEERAKKER, and GERARD MEIJER, *Fritz-Haber-Institut der MPG, Faradayweg 4-6, 14195 Berlin, Germany*.

Analogous to the interaction of charged particles with electric fields in a linear accelerator, the interaction of neutral polar molecules with electric field gradients can be used in a Stark decelerator to accelerate, decelerate, or guide a molecular beam. Using arrays of electric field electrodes that are switched to high voltage at appropriate times, bunches of state-selected molecules with a computer-controlled velocity and with a low longitudinal temperature can be produced.[a] When combined with an electrostatic trap, the Stark deceleration technique offers the possibility to confine rovibronic ground-state molecules for times up to seconds.[b]
Here we demonstrate feedback control optimization for the Stark deceleration and trapping of neutral polar molecules using evolutionary strategies. In a Stark decelerator beamline pulsed electric fields are used to decelerate a beam of OH radicals and subsequently store them in an electrostatic trap. The efficiency of the deceleration and trapping process is determined by the exact timings of the applied electric field pulses. After automated optimization of these timings an increase of 40 % of the number of trapped OH radicals is obtained.

[a] H. L. Bethlem and G. Berden and G. Meijer, *Phys. Rev. Lett.* **83**, 1558 (1999)
[b] S. Y. T. van de Meerakker, P. H. M. Smeets, N. Vanhaecke, R. T. Jongma, and G. Meijer, *Phys. Rev. Lett.* **94**, 023004 (2005)