MULTISTAGE ZEEMAN DECELERATION: STOPPING AND REFLECTING COLD BEAMS OF HYDROGEN

A. W. WIEDERKEHR, S. D. HOGAN, H. SCHMUTZ, M. ANDRIST, B. LAMBILLOTTE, and F. MERKT,
Laboratorium für Physikalische Chemie, ETH Zürich, 8093 Zurich, Switzerland.

With the goals of: (i) performing ultra-high resolution spectroscopy with long interaction times between a cloud of cold atoms or molecules and a narrow bandwidth radiation field, and (ii) studying cold reactive collisions in which the kinetic energies and quantum states of the colliding particles may be controlled to a high degree, a multistage Zeeman decelerator for neutral radicals has recently been developed in our laboratory[a]. This instrument relies on the same concept of phase stability as employed in charged particle accelerators[b] and multistage Stark decelerators[c] and can be used to decelerate cold samples of radicals in supersonic beams.
The results of a recent series of experiments in which we have decelerated ground state H and D atoms will be presented. In these experiments magnetic fields of 1-2 T were pulsed in each coil for tens of microseconds, with rise and fall times shorter than 5 μs. We have studied the influence Majorana spin-flip transitions on the deceleration process and made systematic studies of the deceleration behavior as a function of the phase angle, the magnitude of the pulsed magnetic fields and the initial velocity of the beam. Finally we have shown that a supersonic beam of H atoms initially moving at 435 m/s can be stopped and reflected at the end of a 12-stage decelerator.

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