

MULTISTAGE ZEEMAN DECELERATION: STOPPING AND REFLECTING COLD BEAMS OF HYDROGEN

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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 μ s. 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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