Ultracold Atomic Collisions

RLE Groups
Atomic, Molecular and Optical Physics Group; MIT-Harvard Center for Ultracold Atoms

Principal Investigators
Professor Daniel Kleppner and Professor Thomas J. Greytak

Research Affiliates
Professor John Doyle (Harvard University)

Graduate Students
Yat Shan Au (Harvard University), Nathan Brahms (Harvard University), Cort Johnson, Bonna Newman

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We have been writing up the results of our most recent and final studies in the area of ultracold atoms. These studies were aimed at examining collisions between exotic atoms at temperatures so low that there is a reasonable chance of comparing the results with detailed theoretical predictions. We were particularly interested the role played by filled outer electron shells in shielding magnetic moments carried by unpaired inner electrons. A secondary goal of the research was to determine the suitability of these exotic atoms for evaporative cooling into the micro-kelvin regime.

In nickel we found the angular momentum changing collisions are suppressed in collisions with ^{3}He, but the degree of suppression is low compared to that in the rare-earth-metal elements. Our observations are consistent with a hypothesis of reduced collisional angular momentum transfer due to screening of the valence electrons by closed electron shells.

The spin relaxation rates in dysprosium-dysprosium collisions at low temperatures are greater than expected for the magnetic dipole-dipole interaction, suggesting that another mechanism, such as the anisotropic electrostatic interaction is responsible.

Publications

Zeeman relaxation of cold atomic iron and nickel in collisions with ^{3}He Cort Johnson, Bonna Newman, Nathan Brahms, John M. Doyle, Daniel Kleppner, and Thomas J. Greytak. Phys. Rev. A 81, 062706 (2010)

Magnetic relaxation in dysprosium-dysprosium collisions Bonna K. Newman, Nathan Brahms, Yat Shan Au, Cort Johnson, Colin B. Connolly, John M. Doyle, Daniel Kleppner, and Thomas J. Greytak. Submitted to Phys. Rev. A