MAR08-2007-020222

Abstract for an Invited Paper
for the MAR08 Meeting of
the American Physical Society

Heteronuclear Molecules in a 3D Optical Lattice

CHRISTIAN OSPELKAUS, National Institute of Standards and Technology, 325 Broadway, Boulder, CO 80305, USA and Institut fuer Laser-Physik, Universitaet Hamburg. Germany

The production of ultracold polar molecular samples is a long standing goal of AMO and ultracold physics. The interest is motivated by novel quantum gases with anisotropic interactions between these polar molecules, by applications in quantum computation and simulation which benefit from the long-range interaction as well as by perspectives of measuring a T-violating permanent electric dipole moment of the electron in such a polar molecular system. While a lot of work has been done on direct cooling of polar molecules, a second proposed route to the production of ultracold polar molecules starts with ultracold atomic samples, where tremendous progress has been made in recent years, and assembles an ultracold atom mixture into weakly bound heteronuclear Feshbach molecules. These could then be transferred into the absolute internal molecular ground state using coherent Raman schemes. As a crucial step in this approach, we report on the first production of ultracold long-lived heteronuclear molecules. The molecules are associated from a quantum degenerate mixture of fermionic ^{40}K and bosonic ^{87}Rb atoms loaded into a 3D optical lattice. The binding energy of the heteronuclear molecules is precisely determined by rf spectroscopy and compared to a theoretical model based on a pseudopotential approach. We also characterize both the lifetime of the sample and the efficiency of rf association; comparison to the pseudopotential model results in excellent agreement.