DAMOP19-2019-000523

Abstract for an Invited Paper
for the DAMOP19 Meeting of
the American Physical Society

Interaction driven dynamics of few atoms in an optical tweezer[1]

MIKKEL ANDERSEN, Dodd-Walls Centre for Photonic and Quantum Technologies, Department of Physics, University of Otago

An enduring ambition in atomic physics is to build an understanding of interacting macroscopic systems from knowledge of the underlying microscopic dynamics. We use a bottom-up approach to assemble individual few-atom systems in an optical micro-tweezer and study their dynamics. This allows for interrogation of atoms with collisional properties that are unfavorable for many-body experiments as well as direct observation of effects that get hidden by ensemble averaging. The talk will focus on our recent studies of spin-dynamics of two thermal spin-two atoms undergoing spin-changing collisions in the optical tweezer . We see that the it leaves the magnetic sub-levels of the atoms strongly correlated with relative number fluctuations 11.9 dB below quantum shot noise. The spin populations display relaxation dynamics contrary to the coherent spin waves witnessed in finite-temperature many-body experiments and zero-temperature two-body experiments. The observed dynamics may provide a route for thermally robust entanglement generation. In an experiment with a cold Rb-85 triad we observe three-body recombination. Our ability to directly observe the number of atoms remaining after individual loss events allows us to discriminate between one- two- and three-body loss events. We confirm that three-body recombination leads to all three atoms being lost. However, we also observe that the three-body recombination rate is strongly suppressed relative to the expected rate for non-interacting atoms. This could indicate that interactions between the atoms induces correlations that suppress three-body recombination despite Rb-85 having effective attractive interactions with a negative scattering length.

[1]This work was supported by the Marsden Fund Council from government funding, administered by the Royal Society of New Zealand