Collisions in a quantum gas of bosonic $^{23}Na^{39}K$ molecules

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We present our experiments with quantum gases of polar $^{23}Na^{39}K$ molecules, discussing both atom-molecule and molecule-molecule collisions, as well as methods to obtain collisional control.

First, we study collisions between NaK and K in different hyperfine states [1] and share our observations of magnetically tunable resonances in these ensembles. Secondly, we focus on molecule-molecule collisions. Although $^{23}Na^{39}K$ is chemically stable against the exchange reaction $2NaK \rightarrow Na_2 + K_2$, the ensemble undergoes universal two-body loss. We investigate the origin of this molecular loss [2] and outline an alternative method for its suppression, namely two-photon optical shielding [3], which could replace previously demonstrated methods such as microwave shielding. The concept utilizes a coherent two-photon transition to create a potential barrier, which prevents the colliding molecules from reaching short range where interactions of the two molecules can lead to loss. Working at the point of the two-photon resonance $\delta = 0$ should simultaneously prevent additional scattering loss by the shielding light in the long range. Lastly, we discuss the experimental implementation of this method.

References

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