Collisional loss of ultracold molecules

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The lifetime of nonreactive ultracold bialkali molecules was thought to be limited by sticky collisions that amplify three-body loss. We show that the sticking times were previously overestimated, and cannot explain the loss. Instead, we consider excitation of long-lived collision complexes by the trapping laser. We show typical excitation rates are two orders of magnitude faster than the dissociation rate. This leads to effective two-body loss, as observed in several experiments. Possible workarounds include the use of longer laser wavelengths, uniform box potentials created with blue-detuned trapping lasers, or shielding from molecular collisions.

Shielding may be achieved using microwaves that induce repulsive long-range interactions between ultracold polar molecules. The resulting shielding suppresses various loss mechanisms and provides large elastic cross sections. Hyperfine interactions limit the shielding under realistic conditions, but can be suppressed using a modest magnetic field.

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