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**Quantum state dependent chemistry of ultra-cold $^6Li_2$ dimers**[1]
ERIK FRIELING, GENE POLOVY, DENIS UHLAND, University of British Columbia, JULIAN SCHMIDT, Albert-Ludwigs-Universitt Freiburg, KIRK MADISON, University of British Columbia — Starting from an ultra-cold ensemble of $^6Li_2$ Feshbach molecules, we produce deeply bound molecules by STIRAP in the lowest energy levels of the $v = 0,\ 5,\ 8$ and 9 vibrational manifolds of the $a(1^3\Sigma_u^+)$ potential. The ensemble lifetime is found to be limited by two-body collisions with a loss rate near the universal rate for three of these states and, remarkably, below universality for the $|v = 9, N = 0\rangle$ state. In addition, unlike all prior experimental work with ultra-cold molecules, we observe a rotational state dependence of the reaction rate. We observe that molecules in the absolute lowest triplet level are unstable. Because of the suppression of spin-changing collisions and absence of other inelastic collision channels, we conclude this instability is primarily due to trimer formation, consistent with theoretical predictions.

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