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Production of Ultracold Lithium Triplet Dimers by STIRAP

Ultra-cold atomic ensembles have enabled experimental studies of few and many-body quantum phenomena including topological insulators, many-body pairing phenomena, and superfluidity. The use of ultra-cold molecular ensembles is expected to provide access to even richer phenomena than atoms due to their complex internal structure. Cold molecules are also key to studying and understanding chemistry near T=0 where reactions are dominated by quantum effects. Motivated by this, we have developed an experimental apparatus that can produce Li dimers from laser-cooled Li atoms and, eventually, LiRb molecules from Li+Rb atomic ensembles. Beginning with a gas of Li atoms, we form loosely bound Feshbach dimers by evaporation near a Feshbach resonance. We then manipulate the internal state of these molecules, transferring them into deeply bound ro-vibrational levels of the $a(1^3\Sigma_u^+)$ triplet potential using stimulated Raman adiabatic passage (STIRAP). Having the possibility to transfer an ultra-cold molecular ensemble to different quantum states immediately opens the window for studies in ultra-cold chemistry.

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