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A protocol to synthesize ultracold polyatomic molecules using an optical lattice JIA YAO, KADEN R.A. HAZZARD, Rice University — We theoretically explored a technique of synthesizing four-atom molecules (tetramers) from ultracold diatomic molecules using an optical lattice or optical tweezers. Polyatomic molecules cooled down to ultracold temperature can drive interesting dynamics and phases of matter due to their rich rotational and vibrational bound states. However, the complexity of their internal structures remains as an obstacle for cooling tetramers with traditional laser cooling methods. Recently, long-lived, ground-state, diatomic, nonreactive molecules have been created in an optical lattice. We devise a technique to synthesize an excited tetramer molecule in a well-defined bound state by driving two diatomic, ground-state molecules, such as RbCs or NaK, from adjacent sites onto the same lattice site via a short period of tunneling. We numerically model the tunneling process, where two precooled molecules associate into a mixture of tetramer bound states. We demonstrate high probabilities of producing tetramers in a single excited bound state within an optimal range of lattice depths. Our approach of synthesizing excited tetramers opens a possible route towards ground-state tetramers.

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