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**Coherent formation of ultracold molecules in the ground rovibrational state** ELENA KUZNETSOVA, University of Connecticut, ITAMP Harvard-Smithsonian Center for Astrophysics, MARCO GACESA, PHILIPPE PELLEGRINI, ROBIN CÔTÉ, Department of Physics, University of Connecticut, MIKHAIL D. LUKIN, Department of Physics, Harvard University, SUSANNE F. YELIN, Department of Physics, University of Connecticut, ITAMP Harvard-Smithsonian Center for Astrophysics — Ultracold molecular gases can provide new insights into fundamental physics and lead to exciting applications. Dense samples of polar molecules in the ground rovibrational state v=0, J=0 are required for many of these studies. We discuss several coherent techniques, based on Stimulated Raman Adiabatic Passage (STIRAP), to produce molecular gases in v=0, J=0 state starting from either a bound Feshbach state or directly from atomic scattering states. The coherent formation process is highly efficient and preserves high phase-space density of an initial atomic gas. In one of the techniques a Feshbach molecule is brought to v=0, J=0 state through several intermediate vibrational states coupled by Raman transitions. It avoids the difficulty of finding an intermediate electronically excited state with favorable wave function overlap with both a highly delocalized Feshbach and a tightly localized v=0 state, and minimizes population in all intermediate levels. In another approach STIRAP is combined with photoassociation close to a Feshbach resonance, allowing to convert nearly the entire atomic population to v=0, J=0 molecules using low intensity laser pulses.

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