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Rotational Spectroscopy on Ultracold $^{23}Na^{40}K$ Ground State Molecules SEBASTIAN WILL, JEE WOO PARK, ZOE YAN, HUANQIAN LOH, MARTIN ZWIERLEIN, Massachusetts Institute of Technology — Ultracold molecules with controllable dipolar long-range interactions will open up new routes for quantum simulation and the creation of novel states of matter. In particular, the molecules rich internal degrees of freedom allow for versatile control of intermolecular interactions by applying static electric and microwave fields. Starting from an ultracold, spin-polarized ensemble of trapped fermionic $^{23}Na^{40}K$ molecules in the absolute ground state, we perform microwave spectroscopy on the first rotationally excited state for a range of magnetic and electric fields. Extracting the rotational and hyperfine coupling constants, we comprehensively understand the observed spectra. Following the coherent transfer of the entire ensemble of chemically stable $^{23}Na^{40}K$ molecules to the first rotationally excited state, we observe a lifetime of more than 3 sec, comparable to the lifetime in the rovibrational ground state. The collisional stability of excited rotational states opens up intriguing prospects for the control of intermolecular van-der-Waals interactions via electric fields.

Sebastian Will
Massachusetts Institute of Technology

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