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Progress towards state detection of molecular ions using quantum logic techniques SHIQIAN DING, MENG GAO, ROLAND HABLUTZEL, DZMITRY MATSUKEVICH, Centre for Quantum Technologies and Department of Physics, National University of Singapore — The manipulation and detection of the internal (rovibrational) states of a single molecular ion via quantum logic techniques can be utilized for precision measurements, spectroscopy and studies of quantum mechanical aspects of chemical reactions. In our proposed scheme, we transfer the internal state of the single molecular ion to the state of the co-trapped single atomic ion via the excitation of the common modes of motion such that from the detected state of the atomic ion we can infer the internal state of our molecular ion. We report on the production of a sympathetically cooled SiO^+ molecular ion (co-trapped with a Yb^+ atomic ion) as verified by the measurement of the trap frequency. To decrease the Zeeman shifts of the molecular ion energy levels, we minimize bias magnetic field and destabilize the resulting $^{171}Yb^+$ dark states via polarization modulation of the laser beams. We also present our work towards the coupling of the internal state of the molecular ion to the motional state of the ions and preparation of a molecular state using broadband optical pumping.

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