Precision studies of ultracold $^7\text{Li}^{85}\text{Rb}$

I present spectroscopic studies of $^7\text{Li}^{85}\text{Rb}$ that develop the data to assemble a high-density gas of LiRb molecules which have a large internal dipole moment in the ground state. In the first part of these studies, I report on a resonantly coupled $2(1) - 4(1)$ photoassociation resonance which decays primarily to $X^1\Sigma^+ v = 43$, and careful spectroscopy reveals this resonance produces about 300 rotational, vibrational ground state molecules/second. In the second part of these studies, I discuss spectroscopy of the $d^3\Pi - D^1\Pi$ complex in LiRb, primarily searching for pathways to transfer population from weakly bound triplet states to deeply bound singlet states. These studies fill in two important unknowns: the first study fixes the ground state well depth and the second identifies a pathway to transfer population to the ground state.