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Heteronuclear K-Rb mixtures with tunable interactions

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Quantum degenerate atomic mixtures with tunable interactions are promising for the production of quantum gases of polar molecules. These compound particles would enrich the physics of ultracold systems, since they have many more degrees of freedom than atoms and a controllable anisotropic, long range interaction. In this context, K-Rb mixtures are appealing, since both fermion-boson and boson-boson pairs are available, the main isotopic combinations present several Feshbach resonances, and the ground state dimer has a relatively large electric dipole moment. We have exhaustively characterized the scattering properties of different K-Rb systems by means of Feshbach spectroscopy. This has allowed us to construct an accurate near-threshold model for scattering and bound-state calculations able to determine precisely near threshold parameters for all K-Rb pairs. The model can be used to predict with high precision the behavior of still unexplored mixtures and, combining it with information about the short range part of the interaction potential, to develop schemes for efficient transfer of Feshbach molecules to their ground state. This work was carried out in collaboration with G. Modugno, C. D'Errico, M. Fattori, G. Roati, A. Simoni and M. Inguscio.