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Stable mixtures of ^{6}Li fermions in the three lowest energy spin states J.R. WILLIAMS, J.H. HUCKANS, R.W. STITES, E.L. HAZLETT, K.M. O'HARA, The Pennsylvania State University, University Park, PA 16802 — Studies of strongly interacting ^{6}Li Fermi gases have focused exclusively on mixtures of atoms in the two lowest energy hyperfine states (states $|1\rangle$ and $|2\rangle$ which correspond to the states $|F = 1/2, m_F = \pm 1/2\rangle$ at zero field). Here we investigate mixtures of ^{6}Li atoms that include population in state $|3\rangle$ (corresponding to the $|F = 3/2, m_F = -3/2\rangle$ state at zero field). Mixtures of ^{6}Li atoms in states $|1\rangle, |2\rangle$ and $|3\rangle$ have several interesting features. Feshbach resonances occur in collisions between any two of these three states. Notably, a broad $|1\rangle - |3\rangle$ Feshbach resonance is predicted to occur at a significantly lower field (690 Gauss) compared to the broad $|1\rangle - |2\rangle$ and $|2\rangle - |3\rangle$ Feshbach resonances (at 834 G and 811 G respectively). Furthermore, at high magnetic fields the $|1\rangle - |3\rangle$ and $|2\rangle - |3\rangle$ mixtures only have a weak two-body decay channel via spin-dipole coupling. Finally, the energy of states $|1\rangle, |2\rangle$ and $|3\rangle$ tune at approximately the same rate as a function of magnetic field. We will report on our measurements of inelastic loss rates for these mixtures and useful applications for these three states in quantum information processing and investigations of the repulsive Hubbard model.

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