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Ground state energy of dilute gas fermion/Bose-Eintein Condensate mixtures[1] DEBORAH SANTAMORE, Harvard University, EDDY TIMMERMANS, Los Alamos National Laboratory — The properties of distinguishable neutral atoms embedded in a Bose-Einstein condensate (BEC) are modified by their interactions with the surrounding superfluid - the atoms act as polarons. In addition, when the density of the atoms is high, the atoms have BEC-mediated interactions. If these atoms are indistinguishable fermions, the mediated interactions may be the only inter-particle interactions since the short-range atom-atom interactions are suppressed by the Pauli-exclusion principle. We have studied the many-body energy of the mixture using perturbation theory to uncover the effects of the polaron physics and those of mediated interactions. At low BEC density the mediated interactions are very weak, and at high density the interaction range becomes so short that the Pauli-exclusion principle reduces the effect. We try to find the optimal mixtures for studying correlation physics in cold atom fermion/BEC mixtures. We calculate the ground state energy as a function of the ratio of the BEC-sound velocity, c, and the Fermi velocity, v_F. When $c << v_F$, the ground state energy shift is constant and depends only on the fermion-boson mass ratio (m_F/m_B). On the other hand, when $c > v_F$, the energy shift is almost linear to c/v_F with the proportionality $1.35/(m_F/m_B)$.

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