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Mediated interactions in a dilute Bose-Einstein condensate and Fermi gas mixture DEBORAH SANTAMORE, Department of Physics, Temple University, Philadelphia, PA 10122, EDDY TIMMERMANS, CNLS, Theoretical Division, Los Alamos National Laboratory, Los Alamos, NM, 87545 — We develop a diagrammatic perturbation treatment to calculate the zero-temperature equation of state of the dilute gas mixture of a single spin component Bose-Einstein condensate (BEC) and a normal Fermi gas of single spin fermion particles. We find that the mean-field description breaks down near the mechanical instability related to the phase separation phenomenon. Our analysis shows that the instability is caused by the competition of the usual short-range and fermion-mediated boson-boson interactions, which result in a boson compressibility that diverges. In the low BEC-density limit, we show that the diagrammatic analysis simplifies, we sum part of the higher order diagrams, and we discuss the effects of other higher-order contributions. Our results suggest that careful experimental measurements near the phase separation transition of fermion-boson mixtures can explore fundamentally interesting quantum many-body behavior.

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