Equation of State of a Strongly Coupled Fermion System

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Equation of State of a Strongly Coupled Fermion System

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The graphical representation of the equation of state of a relativistic fermion system with a four-fermion interaction in the strong coupling regime is obtained as a function of the four-fermion coupling constant. It is shown, by increasing the coupling constant strength, how the crossover from a superconducting BCS regime to a Bose-Einstein-condensate (BEC) regime is manifested in the nature of the quasiparticles' energy spectrum. It is found that when the system has a distinguishable BEC nature its pressure becomes negative if the pair interaction is neglected. It is shown how the system can be stabilized by introducing the self-interaction of the Cooper pairs. We discuss the implications for astrophysics of the possible existence of a strongly coupled fermion system in the region of moderate-high density.