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Neutron Matter as a Composite Bose-Fermi Superfluid[1] GORAN ARBANAS, Oak Ridge National Laboratory, ARTHUR KERMAN[2], Massachusetts Institute of Technology, HAI AH NAM, Oak Ridge National Laboratory, JIRINA STONE[3], University of Oxford — We model infinite neutron matter as an interacting Bose-Fermi superfluid consisting of superconducting neutrons and a Bose-Einstein condensate of a six-quark Feshbach state. The interaction term in the many-body grand canonical Hamiltonian is defined by a coupling form-factor and a coupling strength that are determined by fitting an expression for neutron-neutron scattering (via the same Feshbach state) to the $^1S_0$ phase shift. Extremization of the expectation value of the grand canonical Hamiltonian in the ground state yields an equation of state for infinite neutron matter that we numerically solve for particle-number densities between 10^{-7} and 0.5 fm^{-3}. In the unitary limit (i.e., infinite scattering length and a zero effective range), we find the energy per particle to be 0.6 that of a free Fermi gas. The effect of random-phase-approximation corrections to our equation of state is addressed.

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