Superfluidity without Symmetry-Breaking: The Time-Dependent Hartree-Fock Approximation H.A. FER-TIG, CHANG-HUA ZHANG, Indiana University — We develop a time-dependent Hartree-Fock approximation that is appropriate for Bose-condensed systems. In order to explicitly capture the exchange energy for interactions between the condensate and single- particle excitations, we work with an ensemble with a fixed condensate particle number, so that there is no breaking of gauge symmetry in our approach. Defining a "depletion Green's function" allows the construction of condensate and depletion particle densities from eigenstates of a single time-dependent Hamiltonian, guaranteeing that our approach is a conserving approximation. We show that its application to the infinite uniform system produces the expected superfluid mode, and discuss the structure of the density response function.

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