

# Universal properties of Bose-Fermi mixtures with a pairing interaction

A. Guidini<sup>1</sup>, G. Bertaina<sup>2</sup>, D. Galli<sup>2</sup>, and P. Pieri<sup>1</sup>

<sup>1</sup>*School of Science and Technology, Physics Division, University of Camerino,  
Via Madonna delle Carceri 9, I-62032 Camerino, Italy*

<sup>2</sup>*Dipartimento di Fisica, Università degli Studi di Milano,  
Via Celoria 16, I-20133 Milano, Italy  
pierbiagio.pieri@unicam.it*

I will present a many-body diagrammatic formalism that is able to describe the condensed phase of a Bose-Fermi mixture in the presence of a contact pairing interaction between bosons and fermions, from weak to strong boson-fermion couplings. This approach will be validated by comparing it with previous [1] and new dedicated fixed-node diffusion Monte Carlo calculations. By using both methods, a universal behavior of the condensate fraction and bosonic momentum distribution with respect to the boson concentration  $n_B/n_F$  will be unveiled, which extends from unitary concentration down to the limit of vanishing boson density. This universality connects some important properties of a Bose-Fermi mixture with corresponding properties of the polaron problem, which much attention has received in the context of strongly-interacting polarized Fermi gases. Finally, I will discuss an interesting effect occurring in the molecular limit of the boson-fermion coupling, where the condensation is completely suppressed [2]. This phenomenon is an indirect effect on the bosons of the Pauli exclusion principle acting on the fermions, and is the counterpart in a Bose-Fermi mixture of the so called “Sarma phase” discussed for polarized Fermi gases.

[1] G. Bertaina, E. Fratini, S. Giorgini, and P. Pieri, *Phys. Rev. Lett.* **110**, 115303 (2013).

[2] A. Guidini, G. Bertaina, E. Fratini, and P. Pieri, *Phys. Rev. A* **89**, 023634 (2014).