THOMAS-FERMI THEORY FOR PAIRING IN FINITE FERMI SYSTEMS: THE WEAK COUPLING REGIME

M. Farine[4], P. Schuck[1,2], and X. Viñas[3]

[1] *Institut de Physique Nucl'eaire,CNRS,UMR8608,Orsay,F-91406,France*

[2] *Université Paris-Sud,Orsay,F-91505,France*

[3] *Departament d'Estructura i Constituents de la Matèria,*

Facultat de Física, Universitat de Barcelona,

Diagonal 647, E-08028 Barcelona, Spain

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I. ABSTRACT

It is shown that the validity of the Local Density Approximation (LDA) for the description of pairing in finite Fermi systems can considerably be improved in keeping in addition to the position dependence of the Fermi momentum also the size dependence of the matrix elements of the pairing force which in LDA is evaluated in the plane wave basis. This is achieved in taking the $\hbar \to 0$, i.e.the Thomas-Fermi (TF) limit of the gap equation written in the basis of the mean field (weak coupling). Numerical examples demonstrate that TF theory is applicable even for cases where $\Delta < \hbar\omega$, that is when the coherence length of Cooper pairs is larger than the oscillator length. Continuum states are correctly treated in this TF-BCS approach. Several examples typical for the nuclear situation underline the improvement of TF-BCS over LDA-BCS.