WEAK PAIRING CORRELATIONS WITHIN A SELF-CONSISTENT APPROACH CONSERVING EXPLICITELY THE PARTICLE NUMBER

N. Pillet[1)], T.L. Ha[1,2)], P. Quentin[1)] and J. Libert[3)]
[1)] CENBG (IN2P3/CNRS and U. Bordeaux I), Gradignan, France
[2)] Dept. Nucl. Phys. (Vietnam Nat. U. of Sciences), Hanoï, Vietnam
[3)] IPNO (IN2P3/CNRS and U. Paris XI), Orsay, France

The description of the structure and elementary excitations of atomic nuclei within the HFB or its BCS approximation, suffers from well-known deficiencies in weak pairing regimes. Such situations are encountered for instance at or near (sub-)shell closures, at high enough angular velocities and for quasi-particle states such as high-K isomers. These defects have been attributed to the particle number particle breaking inherent to the HFB approximation. In this contribution we would like to propose and illustrate a tractable method which is free from these difficulties in that it conserves explicitly the particle number yet preserves the computational environment of state of the art HFB or HF plus BCS calculations, using e.g. Skyrme or Gogny current parametrisations of the effective force. Its purpose may be summarized by qualifying it of highly truncated self-consistent deformed shell model calculations. It starts from the hamiltonian H = K + v, where K is the kinetic energy and v the 2-body effective force. Introducing a mean field *V* one may trivially rewrite H as H = K + *V* + w, where w = v – V is the residual interaction. The latter is diagonalized in a n-particle/n'-hole basis built on the sp eigenstates associated with the 1-body Hamiltonian *H* = K + *V*. The rate of convergence of the solution in terms of the complexity factors of the considered basis states (n or n') is of course contingent upon a judicious choice of *V*. This potential is defined as the convolution of the 1-body reduced density matrix ρ associated with the correlated wavefunction Ψ in a HF fashion, i.e. *V* = tr ρ v', where v' stands for the antisymetrized interaction v. The problem has thus to be solved self-consistently so as to incorporate in *V* all the 1-body properties associated with Ψ. We have performed such calculations using the standard SIII Skyrme force [1] for the p-h channel and a delta force fitted for BCS calculations for the p-p channel [2]. The discussion of our results will include some general aspects of our method as the fast convergence of the calculations. Indeed, for 0^+ solutions, we have shown that 3p-3h configurations do not add any significant physical results while pair transfers, in accordance with the physical ideas supporting the BCS ansatz, are found to be the dominant correlation mechanism. We will also show that near some shell closures, the pairing correlations which are vanishing in a BCS approach, are quenched yet still present in our approach. Various isomeric state energies of the ^{178}Hf nucleus are reproduced within 100-200 keV, demonstrating thus the ability of our approach to deal, using the **same** Hamiltonian, with strong pairing solutions as well as with solutions where the pairing correlations are reduced due to the well-known blocking effect in qp isomers. To conclude, we stress that the method which is presented here, while respecting an important conservation rule, appears to be both tractable and physically successful.

[1] M. Beiner et al., Nucl. Phys. A238 (1975) 29.
[2] S.J. Krieger et al., Nucl. Phys. A517 (1990) 275.