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Proton-neutron pairing, α-like quartetting and ground/excited states of nuclei close to N=Z line

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Various studies have shown that the proton-neutron (pn) pairing correlations can be accurately described not by a condensate of Cooper pairs, as considered in the majority of mean-field calculations [1, 2], but by a condensate of α-like quartets [3, 4, 5, 6, 7]. After a short review of the quartet condensate model (QCM), I shall discuss the effect of the pn pairing on the ground states of nuclei with N-Z=0.2,4, analyzed recently in the framework of Skyrme-HF+QCM calculations [9]. An interesting aspect pointed out by these calculations is the strong interdependence between all types of pairing correlations. In particular, when the isoscalar pn pairing channel is switched on, the pairing correlations are redistributed among all the pairing channels without changing significantly the total pairing energy. Due to this reason, for the majority of N ≈ Z nuclei, the binding energy is not affected much when the isoscalar pairing channel is switched on. Yet, in all calculations which include both the isovector and the isoscalar pairing forces, the isoscalar pairing correlations contribute significantly to the binding energies and coexist always with the isovector pn pairing. Finally I will present a recent extension of the QCM approach to the excited stated of pn pairing Hamiltonians [8]. It will be shown that the low-lying excited states of N = Z systems can be described by breaking a quartet from the ground state condensate and replacing it with an "excited"quartet, an approach which is analogous to the one-broken-pair approximation employed for like-particle pairing.

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