Contribution ID: **92**

Type: **Oral**

Quartet structure of self-conjugate nuclei

Thursday, 16 May 2019 17:30 (20 minutes)

The treatment of proton-neutron pairing in self-conjugate nuclei in terms of conventional BCS-type approaches has revealed to be problematic. We have shown [1-4] that this form of pairing can be very well accounted for in a formalism of $J = 0, T = 0$ quartets. We have extended the quartet formalism to the treatment of realistic interactions both in the case of even-even [5,6] and odd-odd [7] self-conjugate nuclei. The role of quartets other than $J = 0, T = 0$ in the description of these systems has been investigated and it will be illustrated.

The difficulties associated with a microscopic treatment of $N = Z$ nuclei in a formalism of quartets rapidly grow with increasing the number of active nucleons. To make this formalism accessible also to large systems, we have recently explored an approach where elementary bosons replace quartets with $J = 0, T = 0$ and $J = 2, T = 0$. This boson architecture, which is clearly analogous to that of the Interacting Boson Model in its simplest formulation (IBM-1), has been employed for an analysis of ^{28}Si [8]. The boson Hamiltonian has been derived with the help of a mapping procedure and the resulting spectrum and $E2$ scheme have been compared with the experimental data. As a peculiarity, the potential energy surface of this nucleus turns out to be that expected at the critical point of the U(5)-$\overline{\mathrm{SU}(3)}$ phase transition of the IBM structural diagram.

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Session Classification: Session XX (Parallel Session)