**PECULIARITIES OF THE ENERGY SPECTRUM**

**OF THE 12C NUCLEUS IN A 3***α* **MODEL**

E. M. Tursunov1, I. Mazumdar2, M. M. Begijonov1

*1Institute of Nuclear Physics, Uzbekistan Academy of Sciences, 100214, Ulugbek, Tashkent, Uzbekistan; 2Dept. of Nuclear & Atomic Physics, Tata Institute of Fundamental Research, Mumbai 400 005, India*.

 E-mail: tursune@inp.uz

The aim of present work is to study peculiar properties of the 12C(0+) and 12C(2+) energy spectrum associated with removal of Pauli forbidden states from the 3*α* functional space. A deep *αα*-potential of BFW [1] will be employed which has two Pauli forbidden states in the *S* wave and a single forbidden state in the *D* wave. A variational method on symmetrized Gaussian basis is employed. For the elimination of the 3*α* Pauli forbidden states we use the same direct orthogonalization method from [2]. As a possible origin of non-analytical behavior of the 12C spectrum, consequences of the quantum phase transition (QPT) in the 12C nucleus will be discussed.

The direct orthogonalization method [2] is based on the separation of the complete Hilbert functional space into two parts. The first subspace *LQ*, which we call allowed subspace, is defined by the kernel of the complete three-body projector $\hat{P}. $The rest subspace *LP* contains 3*α* states forbidden by the Pauli principle. After the separation of the complete Hilbert functional space of 3*α* states into the *LQ* and *LP* subspaces, at next step we solve the three-body Schrödinger equation in *LQ*.

In Fig.1 we display the calculated lowest 0+ spectrum of the 12C nucleus as a function of *ϵ*, the maximal allowed eigen value of the Pauli projection operator.

 

*Fig. 1.  -* *Energy spectrum of 12C(0+) as a function of ϵ.*

As can be seen from the figure, there exist a special eigen value of the projector $\hat{P}$, which play a decisive role for the 0+ energy spectrum of the 12C nucleus. The corresponding eigen state of $ \hat{P}$ creates a ground state of 12C in a deep phase, while from the left side of this point the lowest energy is close to the energy of the Hoyle state. The situation in the 2+ spectrum is similar.

1. B. Buck, H. Friedrich, and C. Wheatley, Nucl. Phys.A **275**, 246 (1977).

2. H. Matsumura, M. Orabi, Y. Suzuki, and Y. Fujiwara, Nucl. Phys. A **776**, 1 (2006).