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Detailed studies of 12C structure and reactions

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We have investigated both algebraic models and geometric cluster models of alpha clusters in 12C, focusing on the structure of ground state, the first excited 0+ state and the second excited 2+ state in particular with the purpoese a establishing if the rotational bands are compatible with rigid structures or rather if they are quantum mixture of different configurations.
In a first series of paper [1,2], we assume a rigid equailateral triangle shape and study in detail several properties that descend from the algebraic framework, such as the energy spectrum, electromagnetic observables and calculate the transition densities in order to extract elastic and inelastic cross-sections for various processes.
In a second series of papers [3,4], we solve the three-body Schrödinger equation with orthogonality conditions using the stochastic variational method with correlated Gaussian basis functions. The two-body density distributions indicate that the main configurations of both the second 0+ and 2+ states are acute iscosceles triangle shapes coming from 8Be(0+)+α configurations and find some hints that the second 2+ state is not an ideal rigid rotational band member of the Hoyle state band.

[1] A. Vitturi, J. Casal, L. Fortunato, and E. G. Lanza, Phys. Rev. C 101, 014315 (2020)
[2] J. Casal, L. Fortunato, E.G. Lanza, A. Vitturi, Eur. Phys. J. A (2021) 57:33
[3] H.Moriya, W. Horiuchi, J. Casal, L. Fortunato, Few-Body Syst (2021) 62:46
[4] H.Moriya, W. Horiuchi, J. Casal, L. Fortunato, Eur. Phys. J. A (2023) 59:37

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