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A Beyond Mean Field Description of Atomic Nuclei

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Traditionally effective interactions like Skyrme, Gogny or relativistic interactions have been used in basic mean field
approaches to describe with great success bulk properties
of ground states of nuclei, such as masses, quadrupole moments, radii, etc. However, recent developments in beyond
mean field calculations, with particle number and angular momentum projection in conjunction with the Generator Coordinate
Method (with the deformations (β, γ), pairing gaps (Δ_Z, Δ_N) and angular frequency as generator coordinates) have shown that the Gogny force [1,2] is also able to provide high quality nuclear spectroscopy. This approach has recently been extended to odd-even nuclei [3] allowing thereby to perform isotopic (isotonic) studies of nuclear properties. The strong point of this approach is the ability to simultaneously provide a good description of bulk properties, like binding energies and multipole moments, as well as an accurate and detailed account of excitation energies and transition probabilities.

As a validation of the theory in this talk we present a study of the Magnesium isotopic chain. We obtain an outstanding description of the ground-state properties, in particular binding energies, odd-even mass differences, mass radii and electromagnetic moments among others. At the same time a comprehensive study of the spectroscopic properties of ^{25}Mg is discussed.
These studies, together with the spectrum and the transition probabilities of the
nuclei ^{42}Si and ^{44}S, show that these calculations provide an accuracy comparable with state-of-the-art shell model calculations with tuned interactions. The advantages of the present approach as compared to the shell-model one are the added value of the intrinsic system interpretation and that the interaction, the Gogny force, is well known for its predictive power and good performance for bulk properties all over the chart of nuclides.

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2.- J. L. Egido, M. Borrajo and T. R. Rodriguez, Phys. Rev. Lett. 116 (2016) 052502.

3.- M. Borrajo and J. L. Egido, Phys. Lett. B 764 (2017) 328–334

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