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ZEEMAN EFFECT IN NUCLEI

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Wigner Function Moments method is applied to solve Time Dependent Hartree-Fock-Bogoliubov equations. The dynamical equations for the second rank irreducible tensors are derived. Their solution for ^{164}Dy produces fourteen energy levels: ten high lying ones with $E > 10$ MeV (including isoscalar and isovector Giant Quadrupole Resonances) and four low lying $K^\pi = 1^+$ ones with $E < 4$ MeV. Three low lying levels represent three types of nuclear scissors modes: orbital (conventional) one and two spin ones. Fourth level is disposed below all scissors modes and has the electrical (non magnetic) feature. Its nature can be understood after solving dynamical equations for irreducible tensors with $K^\pi = 2^+$ and $K^\pi = 0^+$ and studying the deformation dependence of the found low-lying levels. The results of calculations for ^{164}Dy demonstrate in an obvious way that the lowest 1^+ state is just one of three ($K^\pi = 0^+, 1^+, 2^+$) branches of $I^\pi = 2^+$ state, which can exist in a spherical nucleus (and which is split due to deformation into these three branches). It is discovered that the antiferromagnetic properties of nuclei predicted in [1], where they were called as "intrinsic angular momenta", lead to the splitting of 2^+ states already at the zero deformation. So, we predict the existence inside of nucleus the phenomenon, which is known in atomic physics as the Zeeman effect [2]!

[1] E. B. Balbutsev, I.V. Molodtsova, P. Schuck, Phys. Rev. C **91**, 064312 (2015).
[2] E. B. Balbutsev, I.V. Molodtsova, Eur. Phys. J. A **59**, 207 (2023).

Section

Nuclear structure: theory and experiment

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