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33Mg: determination of a negative parity intruder ground state via nuclear moments

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Since introduced in nuclear physics, the concept of shell structure and magic numbers has governed our understanding of nuclear matter in atomic nuclei close to stability. Experimental research in 30Ne, 31Na and 32Mg, systems with a closed neutron sd shell (N=20), provided evidence for a ground state deformation in these nuclei. The observed phenomenon is understood as an inversion of the normal spherical ground state configuration, expected according to the traditional shell model, with deformed states governed by particle-hole excitations over the N=20 shell gap. The properties of nuclei in the "Island of inversion"are of particular importance for the theoretical modelling of the region. The research taking place at the collinear laser spectroscopy setup COLLAPS at ISOLDE - CERN makes an intriguing contribution in this aspect. For the first time an unambiguous determination of the nuclear ground state spin and parity of 33Mg will be reported. A measurement of the hyperfine structure and the nuclear g-factor will be presented, illustrating the importance of the technique of nuclear magnetic resonance in combination with laser spectroscopy. The results will be discussed in the frame of the spherical shell model, showing the intruder nature of the ground state, associating it with negative parity. Inconsistencies in the interpretation of former experimental studies will be discussed and based on the firm ground state spin-parity assignment a new set of spins and parities for the lowest excited states will be proposed. The coexistence of different particle-hole excitations in the low lying energy spectrum of 33Mg will be demonstrated. A parallel interpretation will be given within the deformed shell model. A review of recent results, obtained at COLLAPS, in the vicinity of the island of inversion will be given and future prospects will be discussed.
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