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Nuclear Structure Investigations in the A ≈ 30 Mass Region

Content

Nuclear Structure Investigations in the A ≈ 30 Mass Region

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This presentation discusses experimental results concerning the structure of nuclei in the mass region around A = 30. The first part focuses on the mirror nuclei ^{31}S and ^{31}P, while the second addresses the structure of the N = Z nucleus ^{30}P.
Mirror Nuclei ^{31}S and ^{31}P: Excited states in the mirror nuclei ^{31}P and ^{31}S were populated via the 1p and 1n exit channels, respectively, in the nuclear reaction ^{20}Ne + ^{12}C at a beam energy of 33 MeV. The ^{20}Ne beam was provided for the first time by the Piave-Alpi accelerator at the Laboratori Nazionali di Legnaro (LNL). Angular correlations of coincident γ-rays and Doppler-shift attenuation lifetime measurements were performed using the GASP multi-detector array in conjunction with the EUCLIDES charged-particle detector [1]. Analysis of the observed B(E1) transition strengths revealed a significant isoscalar component, accounting for approximately 24% of the isovector strength. This observation provides strong evidence for isospin symmetry breaking in the A = 31 mass region. Self-consistent, beyond-mean-field calculations employing the Equation of Motion method, based on a chiral potential and including both two- and three-body forces, accurately reproduce the experimental B(E1) strengths, further supporting this conclusion. The observed effect appears to be well-explained by coherent mixing from higher-lying states, with contributions from the Giant Isovector Monopole Resonance [1].
N = Z Nucleus ^{30}P: New results for the branching ratios and angular correlations of coincident γ-rays within the positive-parity band of the N = Z nucleus ^{30}P will be presented. These data were obtained from the same LNL experiment, using the reaction ^{20}Ne(^{12}C, pn)^{30}P. Excited states of ^{30}P were populated via the strongest reaction channel observed. The high statistics of the data enable the determination of reliable branching ratios. Comparison with previously published theoretical predictions shows remarkable agreement between the experimental data and shell model calculations [2].
[1] D. Tonev et al., Phys. Lett. B 821, 136603 (2021).
[2] D. Tonev et. al. to be published.
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