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Lifetimes in ^{37}S

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The disappearance of the $N = 20$ shell closure in the so-called "island of inversion"around ^{32}Mg is one of the most striking examples of the strength of nucleon-nucleon correlations. In this region, the quadrupole-deformed intruder configuration (based on a multi-particle multi-hole configuration) becomes the ground state, subverting the expected shell ordering predicted by a harmonic oscillator plus spin-orbit term. The odd $N = 21$ isotonic chain provides the possibility to study the single-particle and intruder states as a function of decreasing Z. Available spectroscopic evidence points out the appearance of strong branching ratios among the single-particle and collective intruder configurations in ^{37}S, suggesting that they mix significantly, contrary to the notion of ^{37}S being well out the island of inversion. However, a precise quantification of this phenomenon in terms of transition strength is still lacking. The first excited state ($3/2^-$ state at 646 keV) is the only one with a measured lifetime, but no transition probability has been firmly determined for the intruder states, in particular those decaying to the a priori spherical single-particle states. A combined DSAM+RDDS measurement has been performed to measure such transition probabilities, in particular for the 2p-1h $3/2^+$ state at 1397 keV and the 3p-2h $7/2^-$ at 2023 keV, exploiting the performance of the AGATA spectrometer in terms of energy and angular resolutions. The 37S nucleus has been produced via the ^{36}S(d,p) reaction in inverse kinematics, detecting the recoiling protons in the silicon array SPIDER to obtain an accurate reconstruction of the excitation energy of ^{37}S. The short lifetimes measured point to large M1 and/or E2 strengths connecting the intruder and spherical states. This would imply a significant mixing between the configurations, arising questions about the determination of the neutron p3/2-p1/2 single-particle strength distribution in ^{37}S.

Primary author: ZAGO, Luca (Istituto Nazionale di Fisica Nucleare)

Presenter: ZAGO, Luca (Istituto Nazionale di Fisica Nucleare)

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