

# Mixing between single particle and intruder states towards the N=20 island of inversion: lifetimes in $^{37}\text{S}$

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The disappearance of the N=20 shell closure in the so-called “island of inversion” around  $^{32}\text{Mg}$  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  $^{37}\text{S}$  [1], suggesting that they mix significantly, contrary to the notion of  $^{37}\text{S}$  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 [2], 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  $^{37}\text{S}$  nucleus has been produced via the  $^{36}\text{S}(d,p)$  reaction in inverse kinematics, detecting the recoiling protons in the silicon array SPIDER to obtain an accurate reconstruction of the excitation energy of  $^{37}\text{S}$ . 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  $p_{3/2}$ - $p_{1/2}$  single-particle strength distribution in  $^{37}\text{S}$ .

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