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Study of Intruder States towards ^{78}Ni with Lifetimes Measurements Following ^{82}Se(d,p)^{83}Se

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Intruder states that originate from the promotion of neutrons across the N=50 shell gap are observed along the N=49 isotones (^{79}Zn, ^{81}Ge, ^{83}Se, ^{85}Kr), with the lowest energy in ^{83}Se. The reduction of the N=50 shell gap towards ^{78}Ni favors the lowering in the energy of these states. Moreover, since the ^{83}Se nucleus (Z=34) is in the middle of the proton fp-shell (28<Z<40), it should have the maximum quadrupole correlations, lowering further the energy of these deformed configurations. This makes ^{83}Se a good candidate for understanding the collectivity of the particle-hole intruder states in this region. Such information could also be used as a testing ground for theoretical models aiming to describe the region in the vicinity of ^{78}Ni.

The nucleus of interest was populated using a (d,p) reaction in a recent experiment performed at the Laboratori Nazionali di Legnaro. The GALILEO γ-ray array at the phase II configuration was coupled to the SPIDER silicon array, allowing one to obtain the needed channel selectivity through coincidence measurements between γ rays and the protons from the (d,p) reaction. This work reports on the lifetime of the 540-keV $1/2^+$ and 1100-keV $3/2^+$ intruder states of ^{83}Se measured by using the Recoil Distance Doppler-Shift method (RDDS) and Doppler-Shift Attenuation Method (DSAM), respectively. The experimental outcome will be discussed in the framework of shell-model calculations and mean-field approaches. The present results challenge current theoretical models in this region.

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