2. RDDS lifetime measurement in ^{70,72}Se: no evidence for the prolate shape of the 2^+_1 state in ^{70}Se

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Lifetimes of 2^+_1, 4^+_1, 6^+_1 states in ^{70,72}Se were measured at the Laboratori Nazionali di Legnaro, Italy, using the recoil-distance Doppler shift method following the reactions ^{40}Ca(^{36}Ar,α2*p*)^{70}Se and ^{40}Ca(^{36}Ar,4*p*)^{72}Se at the beam energy of 136 MeV. Gamma rays were detected in the GASP array and the Cologne Plunger device was used to control the distance between the target (0.5 mg/cm^2 ^{40}Ca evaporated onto a 2.0 mg/cm^2 Au foil) and the stopper foil (10 mg/cm^2 Au). Data was collected for 12 distances between 8 μm and 400 μm with a trigger condition of at least two coincident γ rays. A more detailed description of the experimental procedure can be found in Ref. [1].

To obtain intensities of the stopped and Doppler-shifted components, in all cases a coincidence gate was placed on the shifted component of the transition directly feeding the state of interest, so that effects of unknown side feeding were eliminated. The lifetimes of the states were extracted from the intensities of both components as a function of the plunger distance using the differential decay-curve method [2].

Only the lifetimes of the 4^+_1 state in ^{70}Se and the 2^+_1 state in ^{72}Se agree with results of earlier measurements. The most likely reason for the disagreement of all other lifetimes with literature values are effects from unknown side feeding in the previous singles measurements. The revised lifetime of the 2^+_1 state in ^{70}Se has important consequences for the interpretation of the results obtained in a recent Coulomb excitation experiment [3]. The measured Coulex cross section, sensitive to the quadrupole moment via the reorientation effect, combined with old lifetime allowed to conclude that the shape of the 2^+_1 state in ^{70}Se is prolate. The present, much more precise value of the lifetime does not permit a precise determination of the quadrupole moment due to the relatively large error on the Coulomb excitation cross section and its relatively weak dependence on the quadrupole moment, but it clearly favours a positive value of the spectroscopic quadrupole moment.

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