Isomeric state in the odd-odd ^{68}Ga nucleus

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INTRODUCTION

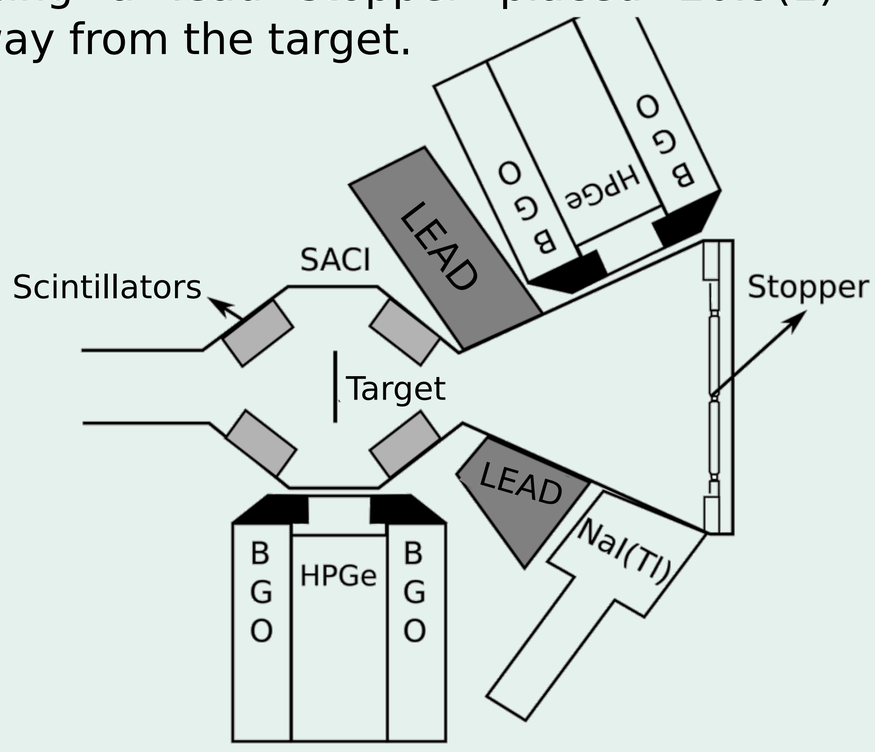
Among the properties of nuclear states, the half life is of special importance as, from this excited state property, the electrical (B(Eλ)) and magnetic (B(Mλ)) reduced transition probabilities can be determined. Such probabilities strongly depend on the nuclear state wave function and therefore represent a robust test for nuclear models. Isomeric states are nuclear states which decay with long lifetimes ($T_{1/2} \geq 1$ ns) [1]. In the region of mass A=60-70, several nuclei of Zn, Ga and Ge present isomeric states, and are a good tool to explore the interplay between single-particle and collective modes of excitation.

EXPERIMENTAL DETAILS

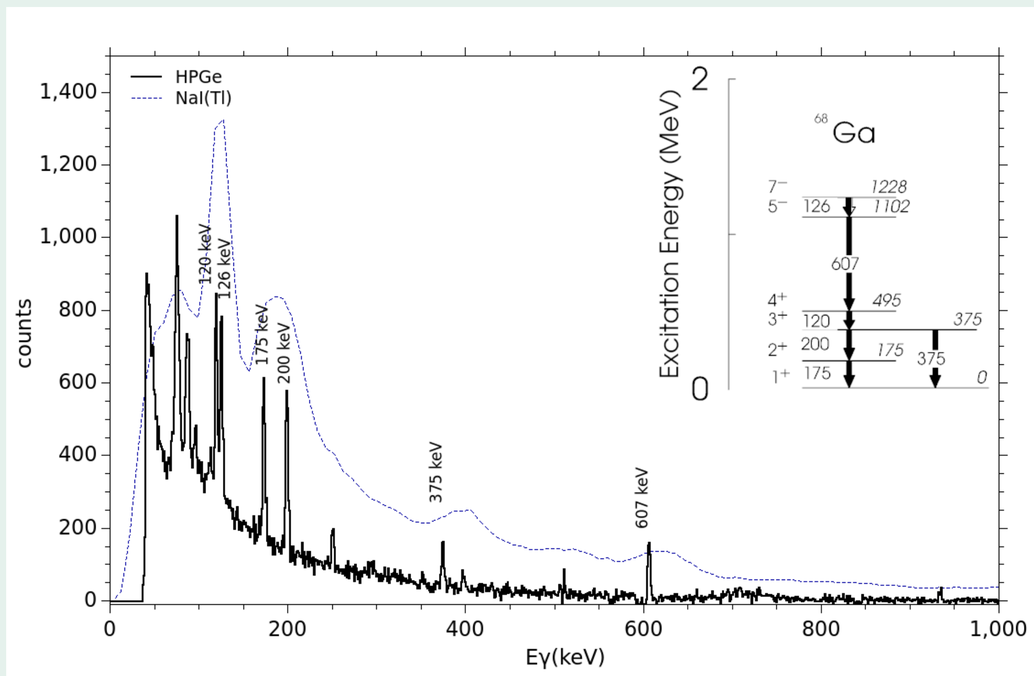
An experiment to measure the half life of the 7^- excited state of the ^{68}Ga nucleus has been performed using a fusion-evaporation reaction ^{55}Mn(^{16}O,2pn)^{68}Ga. The experiment employed the particle-γ delayed coincidence method to measure the isomeric state half life. Such a technique works by calculating the time interval between the detection of the evaporated particles, and the delayed gamma-ray, emitted by the isomeric state, making it possible to identify the gamma rays coming from the nucleus of interest and analyze the time evolution of the γ-ray events.

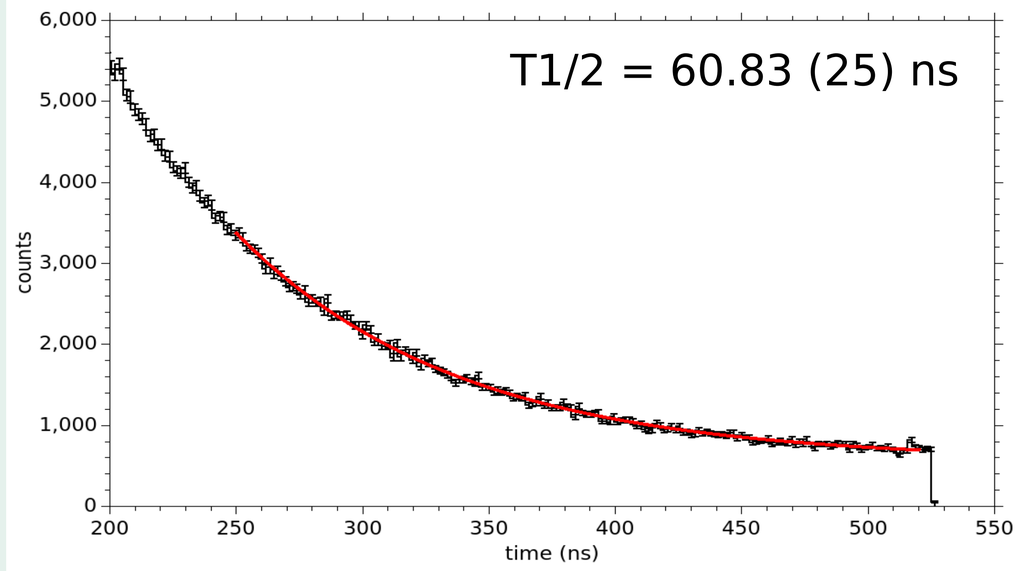
SISMEI

The measurement was performed using a system called SISMEI [2] (System for the Measurement of Isomeric States. SISMEI is composed of 10 phoswich-type particle detectors and two gamma-ray detectors, facing a lead stopper placed 20.9(1) cm away from the target.



GAMMA-RAY SPECTRA

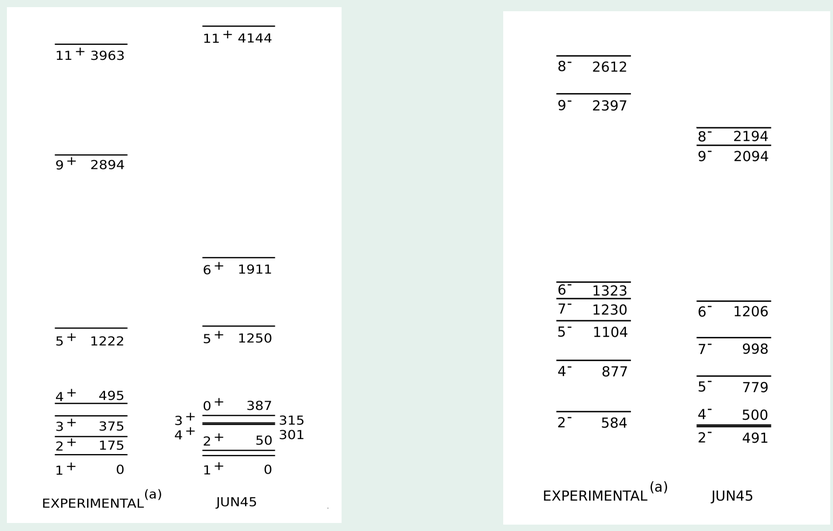




The data was sorted into proton coincidence gamma-time matrix. By gating on gamma-ray transitions that depopulates the 7^- isomeric state, it is possible to retrieve the time spectrum that contains the corresponding decay curve.

SHELL MODEL CALCULATIONS

Shell model calculations were performed with the ANTOINE code [3], using the JUN45 [4] effective interaction and a ^{56}Ni inert core. The calculations allowing 3 protons and 9 neutrons to interact in the f_5g_9 space.



CONCLUSION

The obtained value ($T_{1/2}$ = 60.83(25) ns) for the 7^- isomeric state half life is compatible with previously known states in literature. The experimental $B(E2)_{exp}$ = 284(17) e^2fm^4 is significantly different from the one found with SM ($B(E2)_{SM}$ = 142 e^2fm^4). This may arise from the limited amount of interacting nucleons in the valence space or effects not taken into account by the residual interaction.

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[3] E Caurier. Acta Physica Polonica, 30:705, 1999.
[4] M Honma. Physical Review C, 80(6):064323, 2009.