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Lifetime measurements in Zn, Ga and Ge isotopes around N=40

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The interplay between single-particle and collective degrees of freedom is one of the most important and debated features in the study of the nuclear structure of medium mass nuclei. For neutron-rich nuclei with protons in the *fp* shell, nuclear structure observables indicate an onset of collectivity for neutron number N∼40. Adding just a few particles/holes to the ^{68}Ni core leads to rapid structural changes.

This research mainly focuses on gallium isotopes, with three protons outside the ^{68}Ni core, while ^{73}Ga is of particular interest as in this isotope states $1/2^-$ and $3/2^-$ form a ground state doublet, unlike other neighbouring gallium isotopes which have a $3/2^-$ ground state [1,2]. Direct lifetime measurement of the first excited state can give information on the nature of the transition to the ground state and give additional proof for the existence of the doublet. Another point of interest are ^{70,72,74}Zn isotopes where we try to investigate systematic discrepancies appearing between B(E2;$4^+ \rightarrow 2^+$) values measured by Coulomb excitation [4] and plunger technique [3,5]. Lifetimes of low-lying states in germanium isotopes populated by the same reaction were also determined.

The experiment was performed in GANIL, Caen, France. The nuclei of interest were produced in deep-inelastic reaction in inverse kinematics with a ^{208}Pb beam at 6.63 MeV/A impinging on a 0.95 mg/cm^2 thick ^{76}Ge target deposited on a 1.2 mg/cm^2 Cu backing. Emitted gamma-rays were detected using the AGATA tracking array, consisting of 29 HPGe crystals, in coincidence with recoils identified by VAMOS++ spectrometer. The lifetimes were measured using the plunger technique with the Recoil-Distance Doppler-Shift (RDDS) method.

We have measured lifetimes of low-lying states in ^{73,75}Ga,^{70,72,74}Zn and $^{75-79}$Ge using γ singles data. Measured lifetime and deduced transition probabilities of the $5/2^-_1$ state in ^{73}Ga support the argument of M1 dominant nature of the $5/2^-_1 \rightarrow 1/2^-$ transition and further confirm the existence of a ground state doublet. Determined lifetimes and B(E2;$4^+ \rightarrow 2^+$) values in ^{70,72,74}Zn are in agreement with those of previous plunger experiments.

In $^{75-79}$Ge total of 28 lifetimes of low-lying states were determined, 23 of them being measured for the first time.

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