Streszczenie w języku angielskim

The thesis presents the results of a study of the exotic, neutron-rich nuclei ^{107}Mo, ^{117}Ag, and ^{119}Ag, at the limits of contemporary experimental methods by means of trap-assisted spectroscopy. The studied nuclei were produced in proton-induced fission of a ^{238}U target. Protons were accelerated in the K-130 cyclotron at the Accelerator Laboratory of the University of Jyväskylä (Finland). The fission fragments were then stopped in a gas cell of the Ion Guide Isotope Separator Online (IGISOL) system. Next a dipole magnet separated an isobaric beam of a selected mass number A. Then the Penning-type ion trap called JYFLTRAP was used to select ions of a wanted element out of the isobaric beam, forming a so-called monoisotopic beam. β decays of the monoisotopic samples populated levels in their daughter nuclei (the nuclei of interest in this work). The γ quanta and β particles following β-decay were recorded using germanium Low-Energy Germanium detectors and a thin plastic scintillator, respectively.

The nuclei ^{107}Mo, ^{117}Ag and ^{119}Ag were studied via $\beta\gamma$ coincidence methods. As a result 28 new γ transitions for the nucleus ^{107}Mo, 17 new γ transitions for the ^{117}Ag nucleus, and 58 new γ transitions for the ^{119}Ag nucleus were discovered. The energy of the isomeric state in ^{119}Ag was determined to be 33.4 keV. The observed β half-lives range from 0.27 ± 0.02 s for the β decay of ^{107}Nb to ^{107}Mo, to 0.87 ± 0.02 s for the β decay of ^{119}Pd to ^{119}Ag.

A spin and parity assignment of $1/2^+$ is proposed for the ground state of ^{107}Mo, replacing the previous assignment. The first excited level at 65.4 keV has been assigned $5/2^+$. Moreover the placement of the $(1/2^-)$ level above the $(7/2^+)$ ground state in ^{117}Ag is proposed, supported by data from spontaneous fission. Two distinct nuclear-level structures were observed in ^{117}Ag, built on the $1/2^-$ and $7/2^+$ isomers. Experimental results were interpreted using a deformed shell model.

Experimental data on exotic nuclei like these are essential for calculating the correct path of the astrophysical r-process. Over the years, many astrophysical sites have been proposed for the r-process, but its actual location remains uncertain. In addition, providing new experimental data from exotic nuclei is crucial for testing existing theoretical models.

By combining γ-spectroscopy, which provides information on nuclear properties, with optical methods, which map the electron distribution and enable the determination of key nuclear parameters such as masses, isomeric energies, spins, and magnetic dipole and electric quadrupole moments, it might be possible to determine r-process site with greater accuracy. This view is supported by the fact that the energy and spin of the isomeric state in ^{119}Ag, determined independently through γ and optical spectroscopy, were found to be identical.