Isomeric states in ^{66}As

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New type of the experiments performed at LISE spectrometer is related to the search for the isomers with a microsecond lifetime. An experimental method sensitive to such isomers has been applied for the first time in the series of experiments [1, 2, 3, 4] with ^{112}Sn 63AMeV beam, resulting in the detection of over forty known isomers. The principle of this experimental technique is based on the time correlation between the detected gamma radiation and implantation of identified fragment, as described in [1].

Among other results, the signature for the decay of new ^{66m}As state has been observed in the experiment with the ^{112}Sn beam. The low resolution of BGO gamma detectors and low production rate of this particular nucleus excluded more precise measurement of the isomeric decay properties. The latter have been measured in the similar experiment, but with much better rate of ^{66}As ions achieved by using neutron deficient ^{78}Kr beam. Although main objective of the latter experiment was to serch for new proton-rich isotopes [5] and the spectroscopy of beta delayed protons [6], the isomeric decays have been also investigated. There was a setup of five high efficiency germanium detectors mounted around the implantation silicon stack detectors allowing to study the properties of isomeric decays. In addition, the important role of gamma-detection setup was the independent confirmation of the identification of the implanted nuclei by using known isomeric decays of ^{69m,71m}Se.

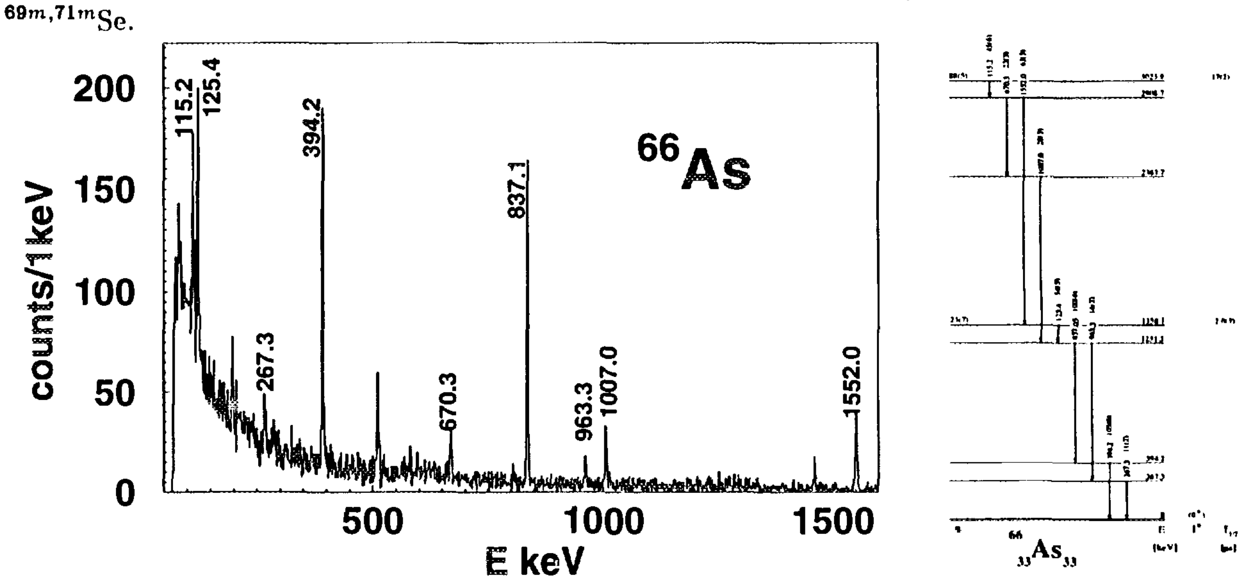

Figure 1: Energy spectrum of gamma radiation obtained in correlation with implanted ^{66}As fragments. The preliminary decay scheme deduced from measiured γ-energies and intensities as well as from γ-γ coincidence relations is also given. The intensities are normalized to the 393 keV transition. The relative population of the isomers is indicated.

As for the most of the counting time the spectrometers ALPHA/LISE were optimized for the transmission of N=Z and more exotic nuclei around Z=32, the ^{66}As was one of the most frequently implanted fragments [5] (about 173000 ions). This allowed for the spectroscopy of isomeric states in ^{66}As, including gamma-gamma coincidences and the analysis of time periods between heavy-ion and gamma events resulting in the half-life determination. The measured energy spectrum for the gamma radiation correlated with ^{66}As implanted ions in the range of 50 μs is presented in the fig 1. The preliminary decay scheme, deduced from the analysis of the gamma spectra, is also given there. Two isomeric states were found in the ^{66m}As nucleus: at E^*=3024 keV excitation energy having $T_{1/2}$ of 17(2)μs, and at E^*=1357 keV having $T_{1/2}$ of 2.0(3)μs. Both isomeric states are populated directly in the reaction, however the deexcitation of the upper one populates low-lying isomer. The isomeric ratio for the production of the 3024 keV isomer (i.e. number of ions in this isomeric state vs total number of implanted ^{66}As ions) was 21$\pm$3%. The study of ^{66m}As demonstrates that the heavy ion - gamma correlation method applied to the fragmentation products is an efficient spectroscopy tool providing the information on the excited levels in nuclei at the limits of the nuclear stability.

References

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