Investigation of isomers around mass 200 region

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Introduction

Investigation of isomers in nuclei near shell closures is important to understand the active configurations of single particle orbitals, which are further treated as essential ingredients of model calculations. Several isomers have been reported in nuclei near Z=82 in mass 190-200 region. Spin isomers originating from the yrast traps are common in those nuclei which are spherical or weakly deformed [1].

Study of high spin structure of ^{200,201}Tl is carried out by the fusion evaporation reaction ^{198}Pt(^{7}Li,xn) using 45MeV ^{7}Li beam at the BARC – TIFR Pelletron, LINAC facility, Mumbai, India [2]. Due to the weakly bound nature of the projectile, ^{7}Li can break up in different clusters like ^{4}He and ^{3}H. Reactions with Alpha and triton with ^{198}Pt can populate Hg (mainly ^{200}Hg) and Au (mainly ^{198}Au) isotopes respectively. Therefore, the target projectile combination leads to the population of various nuclei. We have investigated the presence of isomers in Au, Tl, Hg isotopes populated in above reaction, using the time stamped gamma-gamma coincidence data obtained with digital data acquisition system.

Analysis and Results

Time difference spectrum is obtained by sorting the list mode time stamped data with the help of the MARCOS program, developed at TIFR for Indian National Gamma Array (INGA) set up [3]. The detail procedure of extracting lifetime can be found in Ref. [3]. In order to find the time difference between two transitions (E1 and E2) in a cascade, corresponding time difference spectra are generated considering the relevant photopeaks and its background. To subtract contributions from different correlated background the following expression was used.

$T(i) = T_{p1p2}(i) - T_{p1bg2}(i) - T_{bg1p2}(i) + T_{bg1bg2}(i)$

T_{p1p2} represents the time difference spectrum after gating around the peaks of E1 and E2 transitions. T_{p1bg2} is the time difference spectra constructed by gating around the peak of E1 and background of E2 transition while T_{bg1p2} represents the reverse case. The last term is the time difference spectrum after gating around the backgrounds of the both transitions. The lifetime can be extracted from the slope of the background corrected time spectrum.

Several isomers in even and odd Tl isotopes have been reported earlier using pulsed beam-gamma technique [4]. In case of ^{200}Tl, a lifetime of 330(50) ns of the 762 keV level is reported [5], which is the intermediate level of the 262-221keV cascade transitions. The relevant portion of the level scheme of ^{200}Tl is shown in fig 1.

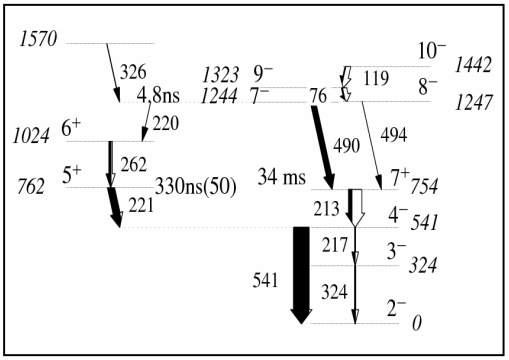

Fig 1. Partial level scheme of ^{200}Tl

Fig 2 represents the time spectrum obtained for the decay of 762 keV level in ^{200}Tl. The lifetime of the corresponding state was extracted as

349(12) ns which close to 330(50) ns, quoted in Ref 5.

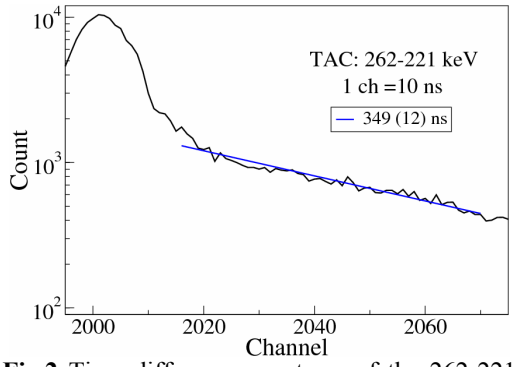

Fig.2 Time difference spectrum of the 262-221 keV cascade in ^{200}Tl.

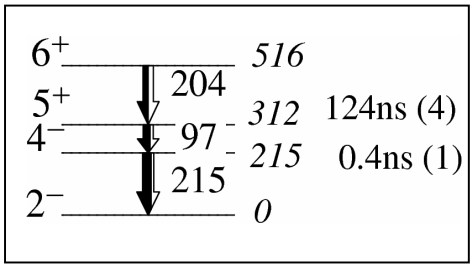

Fig 3. Partial level scheme of ^{198}Au

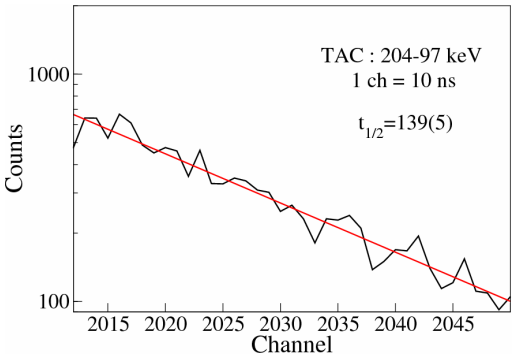

Fig. 4 Time difference spectrum of 204-97 keV cascade in ^{198}Au.

An isomer of 124(4) ns is known in ^{198}Au, for the 312keV state from prompt-delay spectroscopy [6]. Relevant part of the level scheme is shown in fig 3. The lifetime of this level is obtained from our time stamped data and the time difference spectrum of 97-204 keV transitions is shown in Fig 4. The value of the half-life of 312 keV state is obtained as 139(5) ns from our data.

Summary

Lifetime measurement of nuclei around mass region 200 is carried out from time stamped coincidence data obtained with Clover HPGe detectors of Indian National Gamma Array and digital data acquisition system [6]. A target-projectile combination of ^{198}Pt - ^{7}Li at 45MeV beam energy leads to the population of various nuclei around mass 200 because of the complete and incomplete fusion channels. We have reproduced the lifetime of two isomers in ^{200}Tl and ^{198}Au respectively. Further investigation in search for other isomers in this region is in progress.

Acknowledgments

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