

Half-life and β -feeding measurements of ^{207}Po by γ -spectroscopy method

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Introduction

Measurement of half-life of an unstable nuclear energy level of a parent nucleus and its subsequent β -decay feeding intensities into different energy levels of daughter nucleus are very important tools for both investigation on nuclear structure as well as applied nuclear physics research. In this work we measured the half-life of ^{207}Po nucleus [1] and β -feeding intensities [2] to different levels of daughter ^{207}Bi by gamma-ray spectroscopy method.

Experimental Details

The experiment was performed with 60 MeV α -beam delivered from the K130 Cyclotron at VECC. The fusion evaporation reaction $^{208}\text{Pb}(^4\text{He}, 5n)^{207}\text{Po}$ was used to produce ^{207}Po . The prompt γ -rays of ^{207}Po were recorded during the beam 'on' period of for about 80 hrs. and after that the decay γ -rays were recorded for ~ 6 hrs. after the beam was put off. The VENUS array, consists of six Compton suppressed HPGe Clover detectors placed in a horizontal plane around the target point, was used for the detection of γ -rays. Data were collected in list mode format using a VME based DAQ system (LAMPS) with high resolution Mesytec ADC. Several list mode data files, 10 minute duration each,

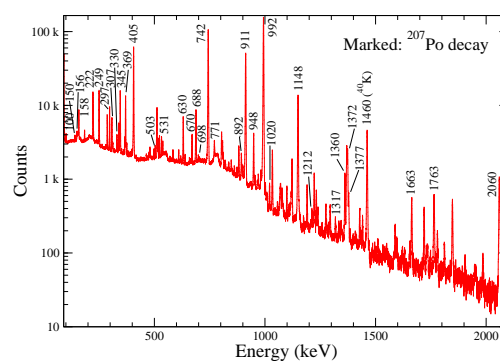


FIG. 1: Total decay spectrum from the experiment. Peaks marked are from ^{207}Po decay.

were collected after the beam was stopped.

Results and Discussions

A representative γ -ray spectrum of all data is shown in Fig. 1. For half-life measurements, the decay curves of four strong γ -transitions, *viz.* 405-, 742-, 911- and 992-keV corresponding to ^{207}Bi nucleus were measured with 30 min. interval, both in single crystal as well as add-back mode. Experimental points are obtained by normalizing with the known background γ -line (1460 keV) and the decay curves are plotted. Fig. 2 represents the decay curve for 992- and 911-keV γ -transitions. The measured $T_{1/2}$ values (both in single crystal and addback mode) for the above mentioned four strong γ -transitions are shown in Fig. 3

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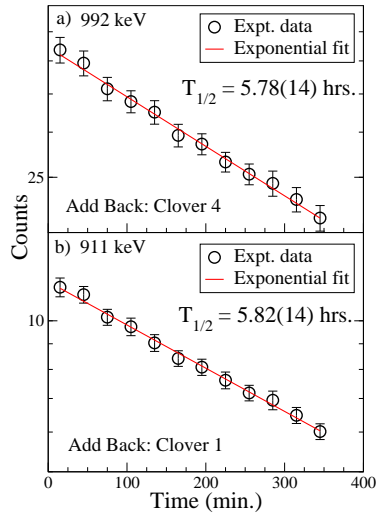


FIG. 2: Decay curves for a) 992 keV and b) 911 keV γ -rays.

with a weighted average of 5.77(6) hrs., which is in good agreement with the latest reported value of 5.79(2) hrs [3].

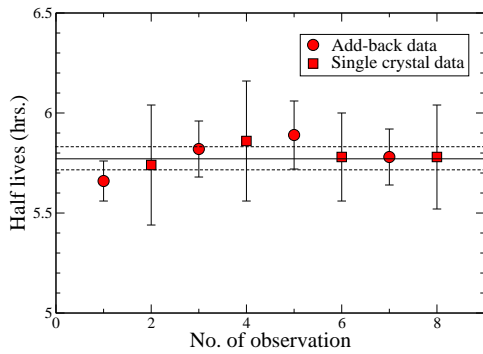


FIG. 3: Measured $T_{1/2}$ values for different γ -rays.

Intensity of each of the γ -rays are deduced taking into consideration of detector efficiency (relative) and total internal conversion corrections. β -feeding intensities (BFI) were obtained from the difference of feeding-in and feeding-out γ -ray intensities in each level [2]. The measured β -feeding intensities at each level of ^{207}Bi are consistent with the values

in [4]. However, for some of the levels significant BFI were observed in the present work for which there was no known BFI [4]. Some of the BFI are shown in Table I.

TABLE I:

J^π	E_{lev} (keV)	BFI (NNDC) [4]	BFI (addback) this work
$7/2^-$	742	11.1(7)	11.7(8)
$9/2^-$	892	-	0.30(7)
$7/2^-$	992	64.1(14)	63.3(18)
$5/2^-$	1148	< 0.4	0.10(5)
$9/2^-$	1211	-	0.07(1)
$(7/2)^-$	1360	0.047(24)	0.21(2)
$1/2^+$	1902	0.30(7)	0.08(4)
$3/2^+$	2060	21.2(5)	21.05(45)
$3/2^-$	2119	0.176(6)	0.25(1)
$5/2^+$	2405	3.12(9)	3.23(6)

Conclusion

The measured half-life value, 5.77(6) hr, of ^{207}Po is in consistent with the earlier measured [4] values. With the inclusion of the new BFI, the feeding intensities and the $\text{Log}ft$ values for each level would be modified and hence the spin-parity of a level may change. The detail analysis is in progress and the results will be discussed during the symposium.

Acknowledgments

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