Level scheme of ^{114}Pd

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Introduction

The even-*A* neutron-rich Palladium isotopes are known to show interesting structural features. The energy of the yrast 2^+ state decreases smoothly from 512 keV for ^{106}Pd to 332 keV for ^{114}Pd suggesting a transition from a weakly deformed to a moderately deformed structure. However, the presence of additional states with spin 2^+, 3^+, 4^+, etc. indicates that the γ-deformation degree of freedom is also important in the even-even Pd nuclei. Experimental results on ^{110}Pd have recently been published by the present group [1] where the ground-state band is reported up to (14^+) and the γ-band up to (8^+). An attempt is made to study the positive-parity states in ^{114}Pd in the present work from fusion-fission reaction.

Experimental Results

The experiment was performed using a 90-MeV ^{18}O beam, with a beam current of about 1.5 pnA, on a self-supporting 30-mg/cm^2 enriched (99.3%) ^{208}Pb foil at the BARC-TIFR Pelletron LINAC facility at Mumbai, India. The γ rays emitted by the fission fragments from the compound nucleus ^{226}Th were detected using the Indian National Gamma Array (INGA) comprising 20 Compton-suppressed clover HPGe detectors. A fast digital data acquisition system was used to record three- and higher-fold coincidence events. About 2.9×10^8 three-fold events were available for analysis using the software package RADWARE [2].

While the low-spin states in ^{114}Pd have been previously studied from β-decay [3], the high-spin levels have been studied reported from the spontaneous fission of ^{252}Cf [4, 5]. Aryaeinejad et al. [4] reported only the ground-state band (g.s.b.) up to a spin of 12^+. Subsequently, Butler-Moore [5] reported a detailed level scheme wherein the g.s.b. was observed up to tentative spin of (16^+) and the γ-band up to (13^+).

The level scheme of ^{114}Pd obtained in the present work is shown in Fig. 1. Spin and parity assignments are based on earlier work [4, 5]. The g.s.b. is the same as that reported in Ref. [5] up to spin (14^+). The (14^+) state, first reported in Ref. [5] is confirmed in the present work. The 864.1 keV transition feeding into the (14^+) state, reported by Butler-Moore [5], could not be observed in the present work. Instead, a 742 keV transition is found to feed the (14^+) state in the yrast band, giving rise to the new level at 4884.2 keV with a tentative spin of (16^+). The middle panel in Fig. 2 with gates on the new 742 keV and the 519 keV transitions shows most of the other γ-rays in the band, lending support to the placement of the 742 keV γ-ray in the band. It is possible that the previously reported 864.1 keV transition [5] could not be observed due to a limitation in the data statistics. The lower panel in Fig. 2 (sum of the two double-gated spectra with gates on (332 + 519) keV and (332 + 714) keV) shows all transitions in the yrast band de-exciting states with spins up to (14^+).

All transitions previously reported in the γ-band up to spin (13^+) [5] have been observed in the present work. The upper panel in Fig 2 lends support to the placement of the transitions in the γ-band with odd-spins. In addition, the figure (upper panel in Fig 2) also shows the presence of the 889 and 992 keV γ-rays. While the 889 keV

transition has been previously observed to depopulate a (6^-) state [5], the 992 keV γ-ray is observed for the first time. The latter transition is shown to feed the 2519.6 keV level that depopulates by the 889 keV γ-ray in Fig. 1. However, a firm evidence for this placement could not be obtained from the present work and it is possible that both 889 and the 992 keV transitions feed the 1630.6 keV, 5^+ state.

It may be noted that only the 3^+ member of the odd-spin sequence of the γ-band could be observed in ^{110}Pd [1]. In comparison, states up to (13^+) are been observed in ^{114}Pd. Furthermore, the relative intensities (not presented here) of the transitions in the odd-spin sequence are observed to be significantly more than those of the transitions in the even-spin sequence.

Further experiments with improved data statistics are necessary for a more detailed study of the level scheme of ^{114}Pd.

The first author (P.B.) gratefully acknowledges the financial support provided by Council of Scientific and Industrial Research (CSIR), vide Project No. 21(0943)/12/EMR-II, for the Emeritus Scientist scheme. The authors thank the INGA collaboration for setting up the array of clover detectors at the BARC-TIFR Pelletron LINAC facility at the TIFR, Mumbai, India. One of the authors (S.G.) acknowledges the financial support provided by the UGC-DAE-CSR-KC vide Project No. UGC-DAE-CSR-KC/CRS/13/NP06/.

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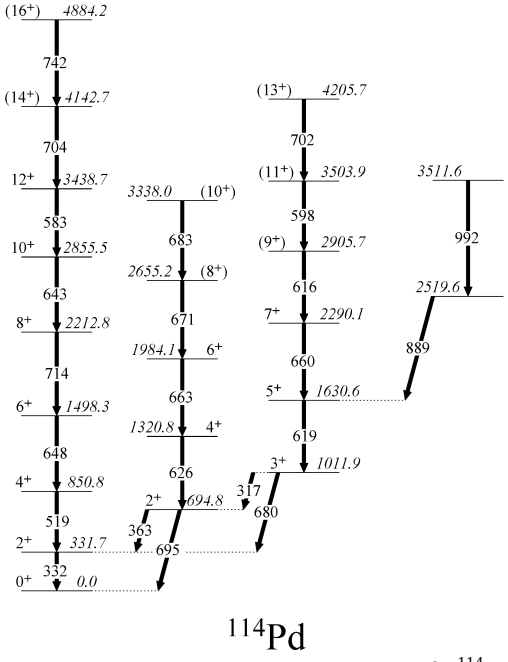

Fig. 1. Partial level scheme of ^{114}Pd obtained in the present work.

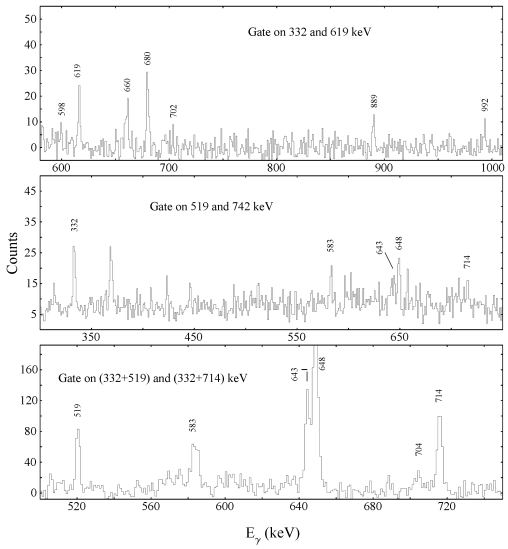

Fig. 2. Double-gated spectra for assignment of γ-rays in ^{114}Pd. Gates were set on transitions as indicated in each panel.