The Projected Shell Model Description of the Yrast Bands in Superdeformed Thallium Nuclei

L. M. Chen¹ and R. S. Guo^2

¹Department of Computer and Communication, Shu-Te University, Kaohsiung, Taiwan, R. O. C. ²Department of Physics, National Kaohsiung Normal University, Kaohsiung, Taiwan, R.O.C. (Received September 18, 2008)

Systematic calculations of the yrast superdeformed (SD) bands in ^{189–193}Tl nuclei using the projected shell model (PSM) are presented. The calculated $\Delta I = 1$ and $\Delta I = 2$ energy transitions, including the γ -ray energies, moment of inertia, and E(I) - E(I-1) transitions, are compared with the experimental data for which spins are assigned. Excellent agreement between the calculated results and available data indicates a microscopic understanding of those measured nuclei. The flattened $J^{(2)}$ behavior of ¹⁹²Tl and the signature splitting of ^{191,193}Tl are also discussed.

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I. INTRODUCTION

Most of the nuclei in the nuclear chart are deformed except for those in the vicinity of the magic numbers. Recently, experimental data such as $E_{\gamma}, Q_t, M1$ on superdeformed nuclei have accumulated rapidly. However, it is still difficult to obtain accurate determinations of spin for most of the SD bands. Among the many existing theoretical models for SD studies [1–8], the projected shell model (PSM) [6–8] deserves special attention. The PSM is essentially a truncated shell model obtained by angular momentum projection from the deformed mean field. This approach gives reasonable results for the SD bands without readjustment of the parameters except that pairing has to be properly treated. It is well known that ¹⁹⁴Hg and ¹⁹⁴Pb are two SD nuclei in the mass A \sim 190 region for which the γ -ray energy for each spin of the SD bands has been assigned precisely by experimental measurements [9, 10]. In our previous studies [11, 12], the SD bands of Pb isotopes, Hg isotopes, and N = 114 isotones nuclei were studied systematically via the projected shell model. With its excellent agreement between the calculated results and available data, the projected shell model is able to provide insight into the origin of the energetic and structural properties of SD nuclei. Besides, we also found the odd-proton (even-odd) nuclei are somewhat different from the odd-neutron (odd-even) nuclei microscopically. For example, the blocking effect for the 3-qp $(1\pi \otimes 2\nu)$ by the single proton state is seen and results in the slow increase of $J^{(2)}$ and nearly constant Q_t distribution in ¹⁹⁵Tl. Whether there is a similar blocking effect in odd-proton (both even-odd and odd-odd) Tl isotopes nuclei is interesting. What will be the role and effect of the odd-neutron in odd-odd nuclei? In this work, systematic studies of the SD bands in ^{189–194}Tl isotopes based on the PSM were

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