INSTITUTE OF PHYSICS PUBLISHING JOURNAL OF PHYSICS G: NUCLEAR AND PARTICLE PHYSICS

J. Phys. G: Nucl. Part. Phys. **30** (2004) 1287–1298 PII: S0954-3899(04)80957-5

Isospin and symmetry structure in the $f_{7/2}$ shell $^{44-48}$Ti isotopes

Falih H Al-Khudair[1,2], **Li Yan-Song**[1,2] **and Long Gui-Lu**[1,2,3,4]

[1] Department of Physics, Tsinghua University, Beijing 100084, People's Republic of China
[2] Key Laboratory For Quantum Information and Measurements, Beijing 100084, People's Republic of China
[3] Institute of Theoretical Physics, CAS, Beijing 100080, People's Republic of China
[4] Center of Nuclear Theory, Lanzhou Heavy Ion Accelerator National Laboratory, LanZhou 730000, People's Republic of China

Received 19 May 2004
Published 6 August 2004
Online at stacks.iop.org/JPhysG/30/1287
doi:10.1088/0954-3899/30/9/025

Abstract

The interacting boson model 3 has been used to study the nuclear level structures and electromagnetic transition probabilities for $^{44-48}$Ti isotopes. This helps us to identify some low-lying mixed symmetry states. We have analysed the wavefunctions and given the symmetry labelling of the states. The analysis is consistent with the available data. The isospin excitation states with $T > T_Z$ are also studied, and comparison with experimental data is given.

1. Introduction

Nuclei with $Z \simeq N$ have been a subject of intense interest during the last few years. The main reason is that the structure of these nuclei provides a sensitive test for the isospin symmetry of nuclear force. Nuclear forces favour in general the states of the lowest possible isospin, $T_Z = |N - Z|2$. Many experimental and theoretical works, e.g. [1–10], have been carried out recently for the investigation and understanding of $Z \simeq N$ nuclear structure. The neutron–proton correlations in the $T = 0$ channel are an interesting aspect of the $Z = N$ nuclei, where $T = 0$ pairing may lead to a new collective mode [11]. On one hand, the $T = 1$ pairing correlation has been studied extensively, the reduction of the moment of inertia as well as the backbending phenomenon are key signs of isovector superfluidity in atomic nuclei. Isovector neutron–proton pairing has been found to decrease fast with increasing neutron excess within an isotope chain [12]. In even–even $Z = N$ nuclei, where the 0^+_1, $T = 0$ ground state is separated from the excited $T = 1$ states by a reasonably large energy gap and isospin symmetry forces isovector pairing to be identical in all three $T = 1$ pairing channels, while in most odd–odd $Z = N$ nuclei for $A > 40$ have the $T = 1$ in the ground state and this symmetry is broken, where isovector proton–neutron pairing is the dominating mode in these nuclei. On the other hand, in the odd–odd $Z = N$ nuclei with $A < 40$, the $T = 0$ proton–neutron

