



Contribution ID: 77

Type: **Contributed Oral Presentation**

Spectroscopic study of the unnatural parity levels in ^{49}V

Tuesday, 27 May 2025 12:35 (15 minutes)

The study of the $1f_{7/2}$ -shell nuclei gives us a unique opportunity to investigate the interplay between single particle and collective excitations. Strong collectivity near ground state, rotational like band structure, shape transitions towards triaxial and non-collective deformations in the natural (positive for even nuclei and negative for odd nuclei) parity bands have been observed in ^{48}Cr and in a few nuclei around ^{48}Cr and interpret them successfully through shell model calculations [1]. However, the spectroscopic investigations for the unnatural (negative for even nuclei and positive for odd nuclei) parity bands are limited.

The level scheme of the unnatural (positive) parity levels in ^{49}V was extended up to the band terminating state, $J\pi = (31/2^+)$. However, the spins and parities of levels above the $11/2^+$ level were not confirmed and the lifetime data are only available up to the $11/2^+$ level with large uncertainties ($> 100\%$ in some cases) [2]. It was, therefore, felt necessary to re-measure them in order to corroborate the available spectroscopic data and to expand them to include information on high spins.

^{49}V , populated through $^{48}\text{Ti}(^4\text{He}, 2n)^{49}\text{V}$ reaction with 48 MeV ^4He beam at VECC Kolkata, was studied very recently by our group using INGA facility, focusing on its natural (negative) parity levels [3]. The present work is an extension to include the results for a few unnatural parity levels. From the analysis, two positive parity signature partner bands were confirmed in ^{49}V and two new γ 's linking these bands were found. In addition, the lifetimes of four levels were measured for the first time, and the lifetimes of two other levels were remeasured to validate our measurements. Multipole mixing ratio (δ) of a few dipole transitions was also measured. Large basis shell model (LBSM) calculations were performed using the code NUSHELLX [4] and SDPFMWPN [5] interaction to interpret the experimental observation. In the calculation only one particle (either proton or neutron) is allowed to excite from the $1d_{3/2}$ to the particle restricted pf orbitals. Calculated energies and the transition strengths agreed well with the corresponding experimental values. Based on the measured lifetimes, calculated wave functions and the Q_s values, evolution of nuclear shape with angular momentum has been established.

[1] S. M. Lenzi, Phys. Rev. C 56, 1313 (1997); N. H. Medina et. al., Heavy Ion Physics 16, 65 (2002); J. A. Cameron et. al., Phys. Rev. C 58, 808 (1998).

[2] D. Rodrigues et. al., Phys. Rev. C 92, 024323 (2015); B. Haas et. al., Phys. Rev. C 11, 1179 (1975).

[3] Y. Sapkota et al., Phys. Rev. C 105, 044304 (2022).

[4] NuShellX@MSU, B. A. Brown et. al., <http://www.nsl.msui.edu/~brown/resources/resources.html>; NuShellX, W. D. M. Rae, <http://www.garsington.eclipse.co.uk/>.

[5] E. K. Warburton, J. A. Becker, and B. A. Brown, Phys. Rev. C 41, 1147 (1990).

Primary author: BISOI, ABHIJIT (Indian Institute of Engineering Science and Technology Shibpur)

Co-authors: ADHIKARI, A (Indian Institute of Engineering Science and Technology Shibpur); BERA, A (Indian Institute of Engineering Science and Technology Shibpur); DAS, A (Dream Institute of Technology, Samali, Kolkata 700104, India); GUPTA, A (Institute of Engineering and Management, UEM, Kolkata 700160, India); PRAMANIK, D (Haldia Institute of Technology, Haldia, 721657, India); MUKHERJEE, G (Variable Energy Cyclotron Centre, 1/AF Bidhannagar, Kolkata 700064, India); GHOSH, H (Indian Institute of Engineering Science and Technology Shibpur); RAHAMAN, R (Indian Institute of Engineering Science and Technology Shibpur); RAUT, R (UGC-DAE Consortium for Scientific Research, Kolkata Centre, Kolkata 700098, India); BHATTACHARYA, S (Variable Energy Cyclotron Centre, 1/AF Bidhannagar, Kolkata 700064, India); BHATTACHARYA, S (Variable Energy Cyclotron Centre, 1/AF Bidhannagar, Kolkata 700064, India); CHATTERJEE, S (UGC-DAE Consortium for Scientific Research, Kolkata Centre, Kolkata 700098, India); DAR, S (Variable Energy Cyclotron Centre, 1/AF Bidhannagar,

Kolkata 700064, India); DAS, S (UGC-DAE Consortium for Scientific Research, Kolkata Centre, Kolkata 700098, India); DAS, S (Indian Institute of Engineering Science and Technology Shibpur); KUMAR, S (INDIAN INSTITUTE OF ENGINEERING SCIENCE AND TECHNOLOGY SHIBPUR); NANDI, S (Variable Energy Cyclotron Centre, 1/AF Bidhannagar, Kolkata 700064, India); RAY, S (Amity Institute of Nuclear Science and Technology, Amity University, Noida 201313, India); SAMANTA, S (Adamas University, Kolkata 700 126, India); SARKAR, S (INDIAN INSTITUTE OF ENGINEERING SCIENCE AND TECHNOLOGY SHIBPUR); SHARMA, S (Department of Physics, Manipal University Jaipur, Jaipur - 303007, India); GHUGRE, S.S (UGC-DAE Consortium for Scientific Research, Kolkata Centre, Kolkata 700098, India); BHATTACHARJEE, T (Variable Energy Cyclotron Centre, 1/AF Bidhannagar, Kolkata 700064, India); SAPKOTA, Y (2Department of Physics, Dudhnoi College, Dudhnoi, Goalpara, Assam 783124, India)

Presenter: BISOI, ABHIJIT (Indian Institute of Engineering Science and Technology Shibpur)

Session Classification: Parallel Session

Track Classification: Nuclear Structure