High-spin structures of $^{124-133}_{52}$Te isotopes in 50-82 shell model space

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The Z value of the Te nuclei is close to the magic number 50 (i.e., close to subshell closure), thus they are expected to exhibit single-particle characteristics. Thus we can study these isotopes with the help of shell model calculation. In the recent experiment the high-spin level schemes of $^{124-131}$Te nuclei have been produced by two different fusion reactions induced by heavy ions $^{12}C+^{238}$U and $^{18}O+^{208}$Pb at respectively 90 and 85 MeV bombarding energy, studied and experimental results are given in [1]. Our aim of the present work is to explain the experimental data for these isotopes nuclei. The results of (^{132,133}Te) isotopes reported here with the help of shell model calculation with $0g_{7/2}$,$1d_{5/2}$,$1d_{3/2}$,$2s_{1/2}$ and $0h_{11/2}$ orbitals for both protons and neutrons and using SN100PN effective interaction. The core is ^{100}Sn (N=Z=50). Due to huge dimensions of matrices it is only possible to performed shell model calculations without any truncation for $^{128-133}$Te isotopes. For $^{124-127}$Te we have employed truncation. Although we have performed calculation for $^{124-133}$Te. Here we are only reporting shell model results for ^{132,133}Te isotopes without truncation.

In the present calculation we have performed calculation in 50-82 model space [$0g_{7/2}$,$1d_{5/2}$,$1d_{3/2}$,$2s_{1/2}$ and $0h_{11/2}$] orbitals for both protons and neutrons with the SN100PN effective interaction which is proposed in [2, 3]. The single-particle energies for the neutrons are -10.610, -10.290, -8.717, -8.695 and -8.815 MeV for the $0g_{7/2}$,$1d_{5/2}$,$1d_{3/2}$,$2s_{1/2}$ and $0h_{11/2}$ orbitals respectively, and those for the protons are 0.807, 1.562, 3.316, 3.224 and 3.603 MeV. The total Hamiltonian is the sum of four parts, proton-proton (pp), neutron-neutron (nn), proton-neutron (pn) interaction and coulomb repulsion between the protons. The SN100PN interaction is derived from the free nucleon-nucleon CD-Bonn potential.

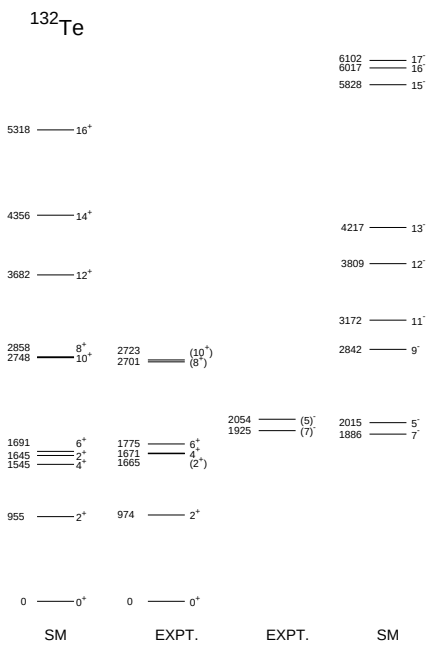

FIG. 1: Comparison of experimental and shell model calculated excitation spectra of ^{132}Te .

The results of $^{132}_{52}$Te and $^{133}_{52}$Te shown in Fig. 1 and Fig. 2, respectively. Shell model (SM) predicts 0^+ as a ground state of $^{132}_{52}$Te which is good agreement with the experiment, 2^+_1 level is only 19 keV lower than experiment. The calculated 2^+_2 and 4^+_1 levels are interchange with each other than experiment

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and level 6_1^+ is 84 keV lower in the calculation. The 8_1^+ and 10_1^+ are interchanged with each other and are at 157 keV, and 25 keV higher than experiment. Shell model predicts the higher energy levels 12_1^+, 14_1^+, and 16_1^+ at 3682, 4356, and 5316 keV respectively. In case of negative parity the order of first two calculated energy levels 7_1^- and 5_1^- are good agreement with the experimental result, while both are 39 keV lower than experiment. Another higher negative parity levels predicted by shell model are 9_1^-, 11_1^-, 12_1^-, 13_1^-, 15_1^-, 16_1^- and 17_1^- at 2842, 3172, 3809, 4214, 5828, 6017, and 6102 keV respectively.

In the case of ^{132}Te the SN100PN effective interaction predicts $\pi(0g_{7/2}^2)\otimes\nu(0g_{7/2}^8 1d_{5/2}^6 1d_{3/2}^4 2s_{1/2}^2 0h_{11/2}^{10})(\sim 28\%)$ configuration for 0^+ (g.s) where as it is $\pi(0g_{7/2}^2) \otimes \nu\ (0g_{7/2}^8 1d_{5/2}^6\ 1d_{3/2}^3 2s_{1/2}^2 0h_{11/2}^{11})$ $(\sim 76\%)$ configuration for (7^-) state.

In ^{133}Te nuclei the SM predicts $3/2^+$ as ground state, as in the experiment, the level $1/2^+$ is good agreement with experiment. The predicted $11/2_1^+$, $13/2_1^+$, $15/2_1^+$, $17/2_1^+$, and $19/2_1^+$ energy levels at 1375, 1415, 1721, 3585, and 3850 keV. The $21/2_1^+$ level is good agreement with the experiment, $27/2_1^+$ level is lower in SM then experiment. In negative parity, calculated $11/2_1^-$, $15/2_1^-$, and $19/2_1^-$ are good agreement with the experimental result. The predicted $17/2^-$ level not found in experiment, The energy levels ($21/2_1^-$, $23/2_1^-$ and $23/2_2^-$) are at higher value than experiment. The higher spins are predicted lower in SM than experiment.

In ^{133}Te the SN100PN effective interaction predicts $\pi(0g_{7/2}^2)\otimes\nu(0g_{7/2}^8 1d_{5/2}^6 1d_{3/2}^3 2s_{1/2}^2 0h_{11/2}^{12})(\sim 81\%)$ configuration for $3/2^+$ (g.s) where as it is $\pi\ (0g_{7/2}^2) \otimes \nu\ (0g_{7/2}^8 1d_{5/2}^6\ 1d_{3/2}^4 2s_{1/2}^2 0h_{11/2}^{11})$ $(\sim 77\%)$ configuration for $(11/2^-)$ state.

In conclusion, we have performed shell model calculation for $^{124-133}$Te isotopes. The results for ^{132}Te and ^{133}Te isotopes are reported here, the calculated results are in good agreement with the experimental data.

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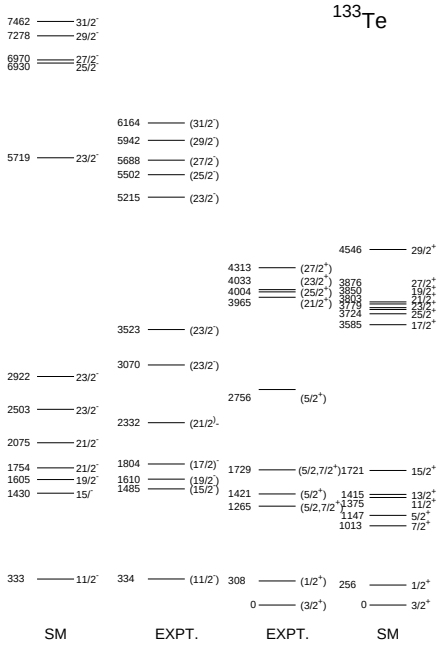

FIG. 2: Comparison of experimental and shell model calculated excitation spectra of ^{133}Te .

References

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