Nuclear Spectroscopy of ^{122}Te

W. Schauer, C. Doll, T. v. Egidy, M. Grinberg [a], J. Ott, and H.-F. Wirth
[a] Institute of Nuclear Research and Nuclear Energy, 1784 Sofia, Bulgaria

The structure of even–even Te nuclei has been the subject of intense experimental and theoretical studies (see ref. [1,2] and references therein). Interpretations were proposed in terms of an anharmonic version of U(5) symmetry in the framework of the IBA, especially for ^{122}Te [2,3] but also for other isotopes [4]. Also other models were suggested. The $E(4_1^+)/E(2_1^+)$ ratios of all even Te isotopes are very close to 2.0 which implies a vibrational behavior. But there are several problems with the behavior of the low lying states, e.g. the energy of the 0_2^+ is rapidly increasing from ^{118}Te to ^{130}Te, while the energy of the 6_1^+ is nearly constant with neutron number. Also the existence of intruder states with 4p2h configuration across the Z=50 shell closure is unclear. Only in ^{118}Te [5] and recently in other light tellurium isotopes (see e.g. [6]) high–spin deformed states were investigated. But there are no low lying intruder levels known.

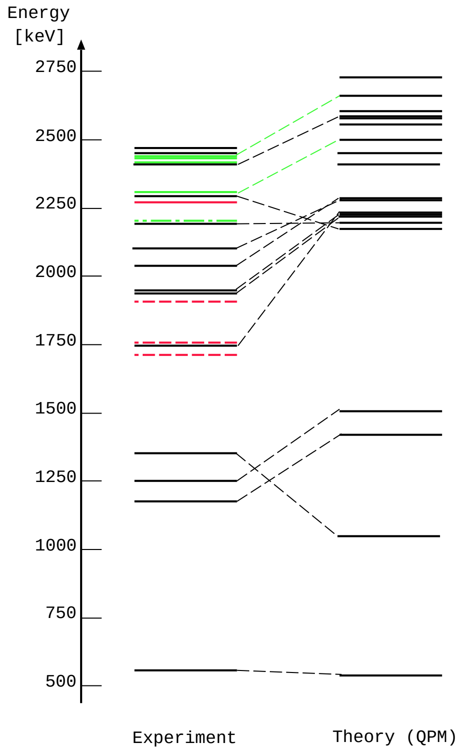

Fig. 1: Comparison between the QPM–calculation and the measurement. The experimental levels not assigned to theoretical levels are in dotted lines.

We reported recently [7] that with the assignment of the 3–phonon 3^+ to a level at 1951 keV ^{122}Te can be described very well in the U(5) symmetry group of the IBA-1. But several low lying levels not described within this model can be identified as a possible intruder band.

Additionally a QPM calculation is compared with the measurement (fig. 1). The QPM parameters associated with angular momenta and parities 2^+ and 3^- were fixed to fit the experimental energies for the 2_1^+ and the 3_1^-. The monopole pairing interaction was determined for the given basis of single particle–states by constant matrix elements for all Te isotopes. With this calculation the same result as in the U(5)-calculation occurs. The overall agreement of this calculation is good, but there are also several low lying intruder candidates between 1.7 and 2.0 MeV which are not described as they are not included in this model.

With the assignment of the 3–phonon 3^+ level at 1951 keV to the known 3^+ level in ^{126}Te it is possible to find also the 3^+ in ^{124}Te. The branching ratio of the 3^+ in ^{126}Te and ^{122}Te is very similar, because there is no admixture of other levels. The energy of the 3^+ in ^{124}Te is expected in between the energies of the 3^+ of ^{122}Te and ^{126}Te. There is one candidate at 2039 keV, elsewhere assigned as a 2_3^+ state, which fulfills these two postulations. The branching of these three levels is shown in fig. 2. The branching ratios are close to each other, so this level is a good candidate for the 3_1^+ in ^{124}Te.

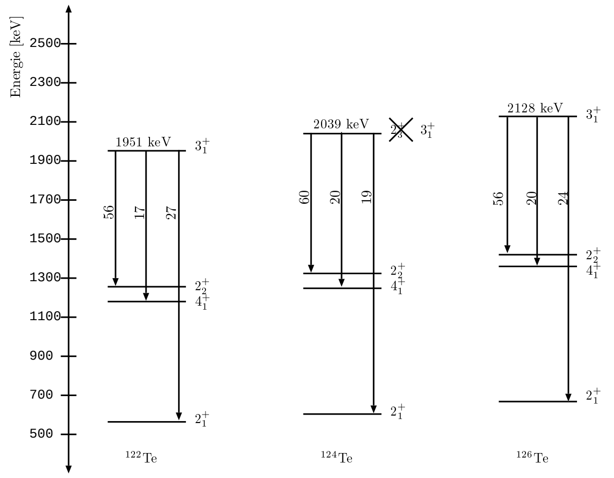

Fig. 2: Comparison between the 3_1^+ levels in ^{122}Te and ^{126}Te in comparison with the candidate in ^{124}Te.

References

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