Due to advanced gamma-ray detection facilities and highly sophisticated analysis

procedures, we now have significant experimental data on the three-quasiparticle (3qp)

states. The extraction of various features exhibited by the 3qp rotational bands and their

explanation in terms of theoretical and semi-empirical approaches are the main objectives of

the present thesis. In order to achieve these goals, we have done a systematic study of the

3qp intrinsic excitations and the rotational bands based on them within the framework of

Three-Quasiparticle Plus Axially Symmetric Rotor Model (TQPRM).

The main findings of the research work are given below:

1. We have presented the complete, confirmed and updated experimental information of 171 3qp rotational bands observed in 58 nuclei in the mass region153 *A* 187 . We have pointed out the various high-spin features such as signature splitting, signature inversion, tilted rotation, band-termination, high-K isomers, back-bending/band-crossing etc. The various theoretical and semiempirical approaches existing in the literature for explanation of these features

have been discussed in brief.

2. An empirical rule which is an extension of the rule for the 2qp bands is devised

to check the favored signature in the 3qp rotational bands. Its applications for

confirmation of the spin/parity, configuration assignment and prediction of

signature inversion in the unobserved part of the given band are discussed. We

have also presented a statistical study of the one-quasiparticle (1qp) and 3qp

excitations in the framework of Random Matrix Theory and pointed out that

196 there appears to be no loss of integrability while going from the 1qp excitations

to the 3qp excitations.

3. We have completed the existing model for the calculation of band-head energies

by including the rotor-particle coupling, particle-particle coupling and

irrotational contributions. On the basis of the revised model for the band-head

energy calculations, we have also focused on the problem of fixing the ordering

of all the members of a given quadruplet for *nnn/ppp* and *npp/nnp* configurations.

New rules have been devised, which are further generalizations of the rules

proposed earlier, to predict the ordering of the members of a quadruplet.

4. The main part of the present thesis is the development of the TQPRM. Its

complete theoretical formulation along with its applications for explanation of

various features such as signature splitting and signature inversion has been

discussed. We have noted that rotor-particle (Coriolis) terms are playing the

major role in the observed signature effects. The variation of phase change with

members of a 3qp quadruplet and the explanation of signature effects within the

framework of the TQPRM has been presented by us for the first time.

5. Several computer codes in Fortran 77 has been written and tested in the course of

these calculations.