CHAPTER VII

CONCLUSIONS

In the previous chapters we described the usefulness of the statistical approach to nuclear spectroscopy as in the applications of the spectral distribution methods for the study of the properties of sd and fp shell nuclei. The formalism of spectral distributions showed many new and interesting features which need to be studied further. In this chapter we briefly describe some of the future work that can be carried out.

The sum rule strengths for Gamow−Teller and isovector M1 excitations have been studied here in detail for all nuclei. Similar studies for other electromagnetic operators including the isoscalar ones will be useful. For operators like E2 one clearly has to do the calculations over several major shells and the newly developed strength density formalism may be particularly suited for that. A configuration−isospin averaged sum rule strength density may improve upon the scalar−isospin results even for the GT and isovector M1 sum rules.

The strength distribution using the strength density formalism in SDM is able to reproduce the strength in the right energy domain for GT and isovector M1 excitations. But this is just a beginning of the studies − one needs to calculate the centroid and the width of the strength distribution more accurately and extend the calculations to nuclei with non−zero ground state isospin. One also needs to study the strength distribution spread over several major shells and understand the role of the tensor force in spreading the strength to higher energies giving rise to quenched experimentally observed strengths. For this the work of French and Kota on level density using decomposition of large spaces into unitary orbits needs to be extended for treating strengths. The spectral distribution theory is able to predict strengths from excited states as well. For beta decay this is useful in beta-delayed particle emission processes. For the electromagnetic transitions the subject of giant resonances built on excited states is a rich field.

Finally for the presupernova evolution problem one needs for the nuclei with $A > 60$ the electron capture rates as well particularly for the proton-rich ones. These rates are useful for the supernova problem also. A calculation of the gravitational collapse with the dynamical input of the capture rates of a number of nuclei having different neutron and proton numbers simultaneously is not yet done. When the total neutron number of the nuclei in the supernova goes beyond 40, the allowed capture rates get blocked and the rates decrease by an order of magnitude. Electron captures through forbidden transitions become important then and spectral distribution ideas can be used to estimate these capture rates also.

Thus the application of spectral distribution theory is by no means complete and has many interesting possibilities.