CONCLUSION

We conclude by saying that in this thesis we have investigated some of the important properties of quantum liquids using field theoretic techniques. The quantum liquids, that have been chosen for our investigation are superfluid $^4$He, degenerate electron gas system and superconductors. As regards superfluid $^4$He is concerned, we have succeeded in identifying the new branch of elementary excitations observed in this system with the one arising due to two-phonon excitations. An important consequence of $\mathbf{k}^2$ dependence of the static as well as dynamic structure factor corresponding to two-phonon excitations has been analysed with respect to $f$-sum rule. This is a new kind of result which is borne out of our investigation. Although the results of several other investigations in this field do not support our finding we do not see any reason why this is to be ruled out.

It is interesting to see that quantum liquid of the Fermion class, the system of degenerate electron gas behaves similar to that of superfluid $^4$He which is a Bose system. This is realised from the similarity in the spectrum of $\mathcal{S}(\mathbf{k},\omega)$ for both these systems. For both the system the double peak structure is being explained on the basis of two-phonon/pair excitations. The last chapter of the thesis is devoted to the study of phase transitions using positron annihilation technique. In this chapter it is shown that positron annihilation technique is not a sensitive probe for studying phase transition as encountered in a superconductor.