SYNOPSIS

The thesis is divided into nine chapters.

Chapter I of the thesis is introductory in nature. In this chapter we have discussed some relevant quantum theoretic results regarding the problems we have studied subsequently. The work of other authors in the domain in which we have worked in later chapters of the thesis has been briefly reviewed here.

Original work starts from Chapter II. We have established in this chapter that the massive vector meson field (otherwise known as the Proca field) becomes non-existent when it is allowed to interact with the cylindrically symmetric gravitational field characterised by Einstein-Rosen metric.

We have tackled the general problem of interaction of gravitational and massive complex scalar field in the context of cylindrically symmetric Einstein-Rosen metric in Chapter III. It is observed that as a result of such an interaction the mass parameter and the electromagnetic field tensor of the complex scalar field vanish.

The vanishing of the mass parameter of the complex scalar field has been utilised in Chapter IV to obtain a class of exact solutions of the complex scalar field for

Einstein-Rosen metric. The solutions obtained have been studied with special reference to singular behaviour and the CPT (charge conjugation, parity and time reversal) transformations. The nature of the solutions of the complex field is also discussed.

Continuing our studies of Chapter IV, some more exact solutions have been obtained and the physics involved has been discussed in Chapter V. In course of our investigations we have brought out the periodic nature of the gravitational and the complex field representing the solutions. The singularities of the gravitational fields are indicated and the CPT theorem is utilised to single out the solutions of the complex field which are physically realistic.

A theorem for obtaining a class of exact solutions of the complex scalar field for time-dependent Einstein-Rosen metric from those of vacuum field has been developed in Chapter VI and the application is illustrated by an example.

Our work on Lyttleton-Bondi universe starts from Chapter VII. In this chapter we have obtained a class of cosmological solutions of the Lyttleton-Bondi universe for cylindrically symmetric Einstein-Rosen metric. The solutions obtained are studied with reference to their singular behaviour and the geodetic paths of a test particle in these fields are also investigated.

A class of plane symmetric solutions of the Lyttleton-Bondi universe has been obtained and studied in Chapter VIII.

The contents of Chapter IX comprise of some exact solutions of the Lyttleton-Bondi universe in the case of spherically symmetric Robertson-Walker metric for some specific situations of the equation of state of perfect fluid distribution.