P R E F A C E

The dissertation entitled 'STUDY OF THE STRAIN VARIATION EQUATION IN CONTINUUM MECHANICS' consists of four chapters. The main mathematical tool for the dissertation is the Newman Penrose formalism.

An exposition of this null tetrad approach is to be found in Chapter O. The advantage of this formalism over the rest are cited.

The derivation of the strain variation equation is accomplished in Chapter I. The scope of relativistic continuum mechanics is expressed in terms of three types of orders of magnitude in the Sec.1. The characterization of the strain tensor field is contained in Sec.2, [illegible] exposes the confusion in the nomenclature of the strain tensor in the literature. The next Section 3 is devoted to the application of this concept to cosmology. Sec.4 contains the derivation of the Lie derivative of material tensor field to be exploited as a computational aid for following sections. Details of the kinematical form and the dynamical form of the strain variation equation are described in the Sections 5 and 6 respectively. The chapter ends with Newtonian and special relativistic approximation for the equation in question. These two chapters do not contain original results, except for exposition.

The following two chapters contain some investigations believed to be new. The novelty of such results is indicated by underlining.

Chapter II is captioned Disordered Distribution of Radiation, (DR). At the outset some historical account of the DR is attempted. Sec.2 deals with properties of DR. We define the '<u>complexion vector</u>' of a continuum in Sec.3 and prove that <u>it coincides with the vorticity vector in the case of the special distribution under consideration.</u> In Sec.4 entitled null ray formalism for DR <u>it is found that energy balance</u> equation are equivalent to $\delta p = 0$ and $Dp = \frac{2}{3}(\mu + \bar{\mu} - \rho - \bar{\rho})$, where p is the hydrostatic pressure of DR. All 18 NP equations and 11 Bianchi identities are recast for DR and it is observed that <u>pressure gradient depends only on the expansion of the flow.</u> Exploration of the strain-free field for certain null fields is the aim of Sec.5. It is <u>established that when l^a, n^a are strain-free then the free-gravitational field of DR is necessarily of Petrov type D. It is also shown that, if l^a, n^a are strain free, then u^a is also strain free but the converse is not true.</u> Kinematical parameters in tensor version and NP version are listed in Sec.6. In the same Section eight types of flow are discussed and it is found that DR does not admit the pure boost or boost flow. <u>However DR admits a hypersurface orthogonal flow.</u>

Sec.7 deals with the relative velocity and the relative acceleration of separation vector between two neighbouring geodesic curves for DR. One finds that the relative acceleration is never zero and it is always negative.

The application of the strain variation equation developed in Chapter I to the special distribution studied in Chap. II is the aim of Chap. III. Here certain types of strain variation in the early universe are investigated. Primary attention is on the physically (or materially) constant strain variation.

By utilizing the kinematical and dynamical relations derived in Chap. I for DR, it is established that irrotational flow of DR with Petrov type D Weyl tensor and physically constant strain is incompatible when $m\bar{m}$ is a geodesic surface. The necessary and sufficient condition for $\pounds_{u}\Theta_{ab}=0$ (physically constant strain) is obtained in Sec.5 . It is claimed that the pressure of DR is inversely proportional to the square of affine parameter along l^{a} in asymptotically flat spaces when the real null congruences are strain free. Later the magnetic type gravitational fields attract our attention. In Sec.6 When the Jaumann derivative of a tensor field with respect to flow vanishes we say that the said field is stationary. It is shown that there do not exist physically constant strain as well as stationary strain when the DR admits only purely magnetic type gravitational fields.

Further an irrotational flow of DR with Petrov type D Weyl tensor and stationary strain is just found to be incompatible, when $m\bar{m}$ is a geodesic surface. Finally in Sec 7 generalised Raychaudhury's equation for DR is constructed and it is inferred that rotation and pressure induce expansion of DR while shear induces contraction. In DR the non-existence of uniform strain with l^a, n^a ~~as~~ gradient fields is delegated to an appendix.