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Asymptotic Behaviour of Neutrino Fields in Curved Space-time*

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Abstract. It is shown that, if a solution of the Weyl equation in some Riemann space is asymptotically smooth and describes a neutrino field with causal behaviour, than the order of the radiation term in the corresponding energy-momentum tensor predominates asymptotically the orders of the other terms.

1. Introduction

Usually, in General Relativity matter is described phenomenologically or by singularities. In contrast to this, a rigorous microphysical field-theory of matter must be based on a generalization of relativistic quantum mechanics, which first establishes *matter in curved space-time* on the same theoretical level as electrodynamics. In doing so, direct analogies to the well known electrodynamic fields are to be expected in case of the quantum mechanical zero rest-mass field of neutrinos described by the generally covariant Weyl theory (Section 2). Recently some topics of this theory of the gravitational interaction of neutrinos were discussed by Griffiths and Newing [1–3], Wainwright [4], Trim [5], Audretsch and Graf [6]. The direct physical significance of the theory results from the important role which neutrinos play, interacting with strong gravitational fields in some processes of stellar evolution and cosmology.

Continuing the investigations cited above, our main purpose in this paper is to study the asymptotic behaviour of the neutrino energy-momentum tensor $T^{\alpha\beta}$ in curved space-time with the sole aid of generally covariant assumptions about the nature of the Weyl field. In particular, we want to show that these Weyl fields (in analogy to certain gravitational and electromagnetic fields) behave asymptotically like *neutrino radiation.*

For gravitational fields, *radiation* is defined by the Petrov type N of the conformal tensor $C_{\alpha\beta\gamma\delta}$ (comp. [7]), whereas for the remaining physical fields, radiation is characterised by the Plebanski type $[4N]_2$ (comp. [8]) of the energy-momentum tensor $T^{\alpha\beta}$. Especially in the case

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