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An Exact Solution for Uniformly Accelerated Particles in General Relativity

III. Singular Expanding (Contracting) Null Surface

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Abstract. Recently an exact solution of Einstein's empty-space equations referring to four uniformly accelerated particles was given. The relation of this to static axially symmetric metrics of the Weyl and Einstein-Rosen classes is investigated in the present paper. A physical interpretation of the singularity along half of the axis of symmetry of the uniformly accelerated metric in Weyl's form is given.

An exact solution corresponding to an expanding (contracting) singular null surface is obtained by a limiting process from that for uniformly accelerated particles.

§ 1. Introduction

In a recent paper prepared with Professor W. B. BONNOR [1, 2], I gave an exact solution of Einstein's field equations

$$R_{ik} = 0\,, \tag{1.1}$$

referring to a number of uniformly accelerated particles. In this paper I investigate the relation of this metric to the metrics of Weyl and Einstein-Rosen.

An exact solution of (1.1) corresponding to a singular null surface moving with speed of light is obtained by a limiting process from a solution for two uniformly accelerated particles. The singularities of (1.1) are expected to represent mass or stresses. Hence the physical interpretation becomes difficult in the case of a singular null surface.

The plan of the paper is as follows. In § 2 I consider some transformations of flat space-time, and give a physical interpretation of the singularity along half the axis of symmetry of a uniformly accelerated metric in the Weyl form. In § 3 the derivations of the metric from Weyl and Einstein-Rosen metrics are given. The solution corresponding to a singular null surface is obtained in § 4 and the paper ends with a summary of the results.