REPULSIVE GRAVITY OF LIGHT BEAMS

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Abstract. The analysis of some exact solutions of Einstein equations, describing gravitational waves produced by light, shows that there can be repulsion between light beams. This is due only to the spin-1 character of the solutions and not to the introduction of other inputs external to General Relativity. Cosmological relativistic jets give an example of a such phenomenon.

1. Introduction

In this paper we study the possibility of a repulsive behavior in gravitational interaction, in particular between two light beams, due to the spin properties of some exact solutions of Einstein equations. More precisely we observe that there are exact solutions with spin-1 which describe gravitational waves produced by light sources and give rise to a repulsive behavior. The arguments which actually attribute spin-2 to gravitational waves, relies on the assumption that the solutions be Fourier expandable and, as a consequence have no spin-1 components. However there exist [7, 23, 31, 32] (see Sections 2 and 3) physically meaningful solutions of Einstein equations which although not Fourier expandable are nonetheless finite energy solutions. An application of this result (see Section 4) is concerned with the numerical data related to cosmological relativistic jets.

Section 2 describes a family of exact solutions of Einstein equations, representing gravitational waves generated by a light beam or, more generally, by massless particles, and their physical properties.

Section 3 contains some historical remarks and with the Tolman, Ehrenfest, Podolsky [33] and Wheeler [36] results on gravitational repulsive behavior.

Section 4 deals with cosmological relativistic jets.