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ENERGY-DEPENDENT METRIC FOR GRAVITATION FROM CLOCK-RATE EXPERIMENTS

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We carry out a detailed analysis of the data on the comparison of clock rates between a flying clock and a clock at ground, performed by Alley and co-workers at the end of 1970's. The fit to such data is in favor of an energy-dependent metric for gravitation, whose time coefficient is at variance with the standard Einsteinian one in the weak-field approximation. By exploiting the formalism of a deformed Minkowski space–time, with metric coefficients dependent on the energy, we show that a possible lower limit on the propagation speed of gravitational effects is about 10^{10}c, in agreement with a recent analysis by Van Flandern based on the acceleration of binary systems.

1. Introduction

The geometrical structure of the physical world — both at a large and a small scale — has been debated since a long time ago. After Einstein, the generally accepted view considers the arena of physical phenomena as a four-dimensional space–time, endowed with a *global*, curved, Riemannian structure and a *local*, *flat*, Minkowskian geometry.

However, a recent analysis of some experimental data concerning physical phenomena ruled by different fundamental interactions seems to provide evidence for a local departure from Minkowski metric:[1–6] among them, the lifetime of the (weakly decaying) K_s^0 meson,[7] the Bose–Einstein correlation in (strong) pion production[8] and the superluminal propagation of electromagnetic waves in waveguides.[9] These phenomena seemingly show a (local) breakdown of Lorentz invariance, together with a plausible inadequacy of the Minkowski metric; on the other hand, they can be

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