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Energy-dependent metric for gravitation and the breakdown of local Lorentz invariance

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ABSTRACT. We analyze the data on the comparison of clock rates between a flying clock and a clock at ground, carried out by Alley and coworkers at the end of '70's .The fit to such data is in favour of an energy-dependent metric for gravitation. We discuss also the results of a recently proposed electromagnetic test of breakdown of local Lorentz invariance - based on the detection of a voltage induced by a stationary magnetic field - and show that the obtained positive evidence for such an effect seems to support the derived form of the energy-dependent gravitational metric.

1 Introduction

The geometrical structure of the physical world - both at a large and a small scale -has been debated since a long. 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 interpreted in terms of a deformed Minkowski