Phenomenological description of interactions by energy-dependent metrics

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ABSTRACT. We review the foundations and the basic laws of "deformed special relativity" (DSR). DSR is a generalization of the special theory of relativity, based on a "deformation" of the Minkowski metric, with parameters dependent on the energy of the physical system considered. Such a deformed metric realizes, for any interaction, the "solidarity principle" between interactions and spacetime geometry (usually assumed for gravitation), according to which the peculiar features of every interaction determine - locally - its own spacetime structure.The DSR formalism permits to approach the problem of the breakdown of the local Lorentz symmetry in a quite general way. In particular, it allowed us to derive, for all four fundamental interactions, the explicit forms of the related deformed metrics as functions of the energy,which provide an effective dynamical description of the interactions (at least in the energy range considered). DSR admits also of an interpretation in terms of a Kaluza-Klein-like scheme, with energy as fifth dimension.

1 Introduction

The main aim of this paper is to review the formalism of *Deformed Special Relativity (DSR),* together with its main implications.

DSR was introduced quite recently[(1−7)] essentially to dealing in a phenomenological way with a possible breakdown of local Lorentz invariance (LLI) in some physical processes. They are: the anomalous behaviour of the lifetime of the (weakly decaying) K_s^0 meson[(8)]; the Bose-Einstein correlation in (strong) pion production[(9)]; the superluminal photon tunneling[(10)] . All such phenomena seemingly show a (local) breakdown of Lorentz invariance and, therefore, an inadequacy of the Minkowski metric in describing them, *at different energy scales and for*