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Five-dimensional Relativity with Energy as Extra Dimension

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A Kaluza–Klein-like framework is developed in five-dimensional spaces in which the extra dimension is assumed to be the energy of physical processes and the four-dimensional spacetime is endowed with an energy-dependent metric. The detailed analysis of some classes of solutions of the (vacuum) Einstein equations shows that the $E = \text{const.}$ slices possess energy-dependent four-dimensional metrics which intriguingly reproduce the phenomenological "deformed" metrics derived from the experimental data on some physical phenomena ruled by the four fundamental interactions (electromagnetic, weak, strong and gravitational). This extends previous results concerning the slowing down of clock rates in a gravitational field. Incidentally it is also shown that a special solution of the five-dimensional geodesics equation allows to derive a sort of quantum-mechanical time-energy uncertainty relation.

KEY WORDS : Kaluza–Klein theories ; broken Lorentz invariance ; deformed Minkowski space

1. INTRODUCTION

The ultimate geometrical structure of the physical world — both at a large and at a small scale — is a long-debated problem and after Einstein

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