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# Test of special relativity from K physics

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**Abstract**

A breakdown of the Local Lorentz Invariance and hence the special theory of relativity in the Kaon system can, in principle, induce oscillations between $K^0$ and $\overline{K}^0$. We construct a general formulation in which simultaneous pairwise diagonalization of mass, velocity or weak eigenstates is not assumed and the maximum attainable velocities of $K^0$ and $\overline{K^0}$ are different. This mechanism permits Local Lorentz Invariance violation in a manner that need not violate CPT conservation. We show that such a CPT-conserved violation of special relativity could be clearly tested experimentally through the energy dependence of the $K_L - K_S$ mass difference and discuss constraints imposed by present experiments. © 1998 Published by Elsevier Science B.V.

The special theory of relativity has been tested to a high degree of precision from various types of experiments [1]. These experiments probe for any dependence of the (non-gravitational) laws of physics on a laboratory's position, orientation or velocity relative to some preferred frame of reference, such as the frame in which the cosmic microwave background is isotropic. Such a dependence would constitute a direct violation of (respectively) Local Position Invariance and Local Lorentz Invariance (LLI), and hence of the Equivalence Principle [2]. Since there is no logically necessary reason why special relativity must be valid in all sectors of the standard model of elementary particle physics, its validity must be empirically checked for each sector separately [3].

A characteristic feature of LLI-violation is that every species of matter has its own maximum attainable speed. This yields several novel effects in various sectors of the standard model [3], including vacuum Cerenkov radiation [4], photon decay [5] and neutrino oscillations [6,7]. Here we extend these arguments and point out that violations of special relativity will in general induce an energy dependent $K_L - K_S$ mass difference; an empirical search for such effects can therefore be used to obtain bounds on the violation of LLI in the Kaon sector of the standard model. We present here the bound that present experiments on $K$-physics can impose on the amount of LLI violation. Although this bound is comparable in magnitude to earlier ones obtained in

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