Abstract. The construction of effective Hamiltonians arising from Loop Quantum Gravity and incorporating Planck scale corrections to the dynamics of photons and spin 1/2 particles is summarized. The imposition of strict bounds upon some parameters of the model using already existing experimental data is also reviewed.

Loop Quantum Gravity Induced Modifications to Particle Dynamics

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I INTRODUCTION

The possibility of bringing quantum gravity induced effects to the observational realm has sparked a lot of attention recently. It is expected that the observation of high energy cosmological particles, such as photons [1] and neutrinos [2] arising from gamma ray bursts, will provide the appropriate arena to test such predictions. Also, very precise experiments already performed in atomic and nuclear physics to search for minute Lorentz covariance violations have been used to place strict bounds upon such effects [3].

One of the leading theories providing a consistent description of quantum gravity is Loop Quantum Gravity (LQG) [4]. This theory predicts the quantization of space in units of $\ell_P^3$, with $\ell_P$ being the Planck length [5]. An intuitive way of thinking about this is to imagine space being described by discrete cells at very small distances $d \sim \ell_P$, with the standard continuous description being recovered for large distances $d \geq \ell_P$. From the point of view of a particle immersed in such a space, this granular structure will act as an effective medium modifying the particle propagation properties with respect to those usually assumed in the standard vacuum. Such granularity will induce also minute violations of Lorentz covariance, which have been the subject of very precise experimental investigations [6], as well as theoretical descriptions leading to a standard model extension which can account for the diversity of observations that have been made [7]. Modifications arising from LQG constitute a specific realization of such general scheme, providing a physical interpretation of the parameters involved.

To obtain such modifications starting from the full LQG requires a semiclassical approximation where the particles (photons and spin 1/2 particles, for example) are treated as classical fields, while an appropriate integration is performed upon the gravitational degrees of freedom. In this sense, we are interested in the regime where the matter fields are slowly varying while the gravitational variables are rapidly varying. The full Hamiltonian is known in LQG,