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HOLONOMICAL QUANTUM FIELD THEORY

CENAP OZEL, HADEEL ALBELADI and PATRICK LINKER

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We formulate an alternative formalism of quantum field theory called holonomical quantum field theory. This approach treats elementary particles and force carriers as extended objects instead of point-like entities. Using the fact that holonomies are generally gauge-invariant and can be generalized around closed hypersurfaces, we derive a mathematically rich version of traditional theory. We propose a novel way to consider particles exclusively as closed and compact manifolds. This framework utilizes generalized holonomies and simplicial homology to describe interactions. Finally we compare this model with string theory and loop quantum gravity.

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1. Introduction

Despite the great success of the standard model of particle physics and its experimental verification, unifying all forces of nature, including gravity, remains a challenging issue. On one hand, it is unclear how physics operates at energy scales much higher than the regime in which the standard model, with its Higgs mechanism and unification of the electromagnetic and weak forces, is experimentally validated. Currently, we lack the experimental equipment to probe these concepts at such scales. On the other hand, constructing theories that go beyond the standard model is inherently difficult. A notable example is the unification of gravity with other forces, which is hindered by the fact that naively quantizing the gravitational field i.e., the metric tensor of general relativity leads to non-renormalizable ultraviolet (UV) divergences [13].

Several models have been proposed to address these challenges. One prominent approach is string theory, which posits that all elementary particles are extended objects called strings [4]. These strings may also interact with other extended objects known as branes. String theory aims to unify all known forces of nature