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Mathematical Physics

A Lorentzian Quantum Geometry

Felix Finster, Andreas Grotz

(Submitted on 11 Jul 2011 (v1), last revised 26 Jan 2012 (this version, v2))

We propose a formulation of a Lorentzian quantum geometry based on the framework of causal fermion systems. After giving the general definition of causal fermion systems, we deduce space-time as a topological space with an underlying causal structure. Restricting attention to systems of spin dimension two, we derive the objects of our quantum geometry: the spin space, the tangent space endowed with a Lorentzian metric, connection and curvature. In order to get the correspondence to differential geometry, we construct examples of causal fermion systems by regularizing Dirac sea configurations in Minkowski space and on a globally hyperbolic Lorentzian manifold. When removing the regularization, the objects of our quantum geometry, up to higher order curvature corrections.

Comments: 65 pages, LaTeX, 4 figures, minor improvements Subjects: Mathematical Physics (math-ph); General Relativity and Quantum Cosmology (gr-qc); Differential Geometry (math.DG) Cite as: arXiv:1107.2026 [math-ph] (or arXiv:1107.2026v2 [math-ph] for this version)

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