Emergent Dimensions in Background Independent Quantum Gravity

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ABSTRACT

Abstract goes here.

I. INTRODUCTION

Background-independent models of spacetime geometry are increasingly common in the search for a quantum theory of gravity. If General Relativity is only an effective theory,

Introduction [1], [2], [3].

II. SECTION 1

A. Evolution of the Model

Given an undirected, loopless graph G with vertices $V(G) = \{1...N\}$ and edges $E(G)$, a Hamiltonian H can be defined on the graph as follows:

$$H = J \sum_{i,j \in V(G), i \neq j} (d_i - d_j)^2 + K \sum_{v \in V(G)} d_v \tag{1}$$

Where J and K are weighting constants, and d_i simply represents the degree (number of connected edges) of a given node. The first of the sum forces the graph to be regular in the low-temperature limit, while the second sum pushes the graph to be more or less connected depending on the value of K. As K goes to infinity, the expectation value of the average node degree drops to zero. Conversely, as K tends towards negative infinity, the expectation value of the average node degree should go to $N - 1$. A set of seed graphs are evolved according to this Hamiltonian using a Monte-Carlo simulation with a Metropolis algorithm.

III. GEOMETRICAL PROPERTIES OF GRAPHS

Geometrical properties of the graphs considered are defined as in [5]. This definition of dimensionality is computationally problematic, not due to the complexity of the algorithm but rather due to its fundamentally recursive nature. Calculating the dimensionality of a complete graph K_N on N nodes requires $N!$ recursive calls, which quickly becomes computationally intractable as N increases. Of course, K_N is just an N-1-dimensional simplex, but no such simplification exists for highly dense graphs close to K_N.

IV. CONCLUSION

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[2] S. Chen and S. S. Plotkin, Phys. Rev. D **87**, no. 8, 084011 (2013) doi:10.1103/PhysRevD.87.084011 [arXiv:1210.3372 [gr-qc]].

[3] T. Konopka, Phys. Rev. D **78**, 044032 (2008) doi:10.1103/PhysRevD.78.044032 [arXiv:0805.2283 [hep-th]].

[4] F. Conrady, J. Statist. Phys. **142**, 898 (2011) doi:10.1007/s10955-011-0135-9 [arXiv:1009.3195 [gr-qc]].

[5] O. Knill [arXiv:1112.5749 [math.PR]]