DOUG: The Decentralized Organization Upgrade Guy

Dennis McKinnon
dennis.r.mckinnon@gmail.com

Thursday, April 25, 2014

Abstract

In this work, we numerically generate measurements of a free massive scalar field at all points in space for both flat Minkowski spacetime and inflationary Friedmann-Lemaitres-Robertson-Walker spacetimes. We first quantize the field in the Heisenberg picture and then calculate fluctuations of the field amplitude in the Schrodinger picture. We attain strong numerical support for the analytic calculations of [**?**] and [**?**] in Minkowski space and weak numerical support for their analytic calculations in an inflationary de Sitter-like spacetime.

1 Introduction

At this point anyone who has been soaked in crypto-systems be it Bitcoin, an Alt-coin or Ethereum has heard of DAOs/DACs. For those few who haven't heard about DAOs yet, DAO stands for Decentralized Autonomous Organization. Though agreement on what qualifies as a DAO differs from person to person, almost everyone agrees that DAOs are the end goal of decentralized crypto-systems. For me a the two most important letters of DAO are AO. At this point with a platform like Ethereum, the D is pretty well taken care of (though many interesting particular problems still exist eg. Proof of custody). A successful DAO must then focus on being an organization of people who interact in a system which is self ruling. In other words this organization must not require any particularly special third party in order to operate or more importantly change how it operates.

Despite the amount of attention DAOs are getting, there has been limited progress towards actual implementations of them. Though I should note at this point that according to my definition above, society its self is a DAO going all the way up to governments. There is no outside party which is explicitly running things (Though most probably agree that this DAO is not particularly well set up in terms of evenish distribution of power).

This brings me to DOUG. To best understand DOUG let me make it clear, DOUG is not a DAO. DOUG might be best described as a design philosophy on how to construct DAOs. I go into more details of the functioning of a DOUG below but the basic idea is that DOUG serves the purpose of making a DAO adaptable in a manner which does not require any specific third party to be responsible for the changes.

2 Quantum Field Theory on Minkowski Space

2.1 Motivation

As a first step to studying a quantum field on a curved spacetime, we attempt to study a simple case: a quantum field in flat spacetime trapped in a box. We could think of this as a toy model of a photon trapped in a three-dimensional cubic mirrored cavity. We begin by analytically studying the Klein-Gordon equation for a massive scalar field in the hope that we will eventually reach a point where we can move our calculations to a computer.

2.2 Theory

The following treatment follows [?] but draws a little bit from [?]. While [?] and [?] treat a more difficult problem where there are no Dirichlet boundary conditions, we still use them as a guide for our study. In Minkowski space, the Klein-Gordon equation for a scalar field ϕ takes the form

$$\left(\partial_t^2 - \Delta + m^2\right)\phi(\mathbf{x}, t) = 0, \tag{1}$$

where $\Delta = \partial_i \partial^i \; \forall \; i \in \{1, 2, 3\}$ is the Laplace operator in space and m is the mass [?, ?]. To avoid an infrared divergence and to make computation easier, we impose that our field live in a three-dimensional cube with length scale L

$$\Omega = [0, L] \times [0, L] \times [0, L] \tag{2}$$

and Dirichlet boundary conditions [?]:

$$\phi(\mathbf{x}, t)\Big|_{\partial\Omega} = 0. \tag{3}$$

If we insist that L be very large, the boundary conditions we impose should have no effect on the dynamics in the bulk [?, ?].