

An introduction to Lattice Quantum Chromodynamics

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Abstract

1 Introduction

The aim of this paper is to give a hand-on introduction to the how one can go from a rudimentary understanding of quantum mechanics and quantum field theory, to simulating quantum chromodynamics on the lattice. In order to kick this is of, let us begin by discussing our end-goal, Quantum Chromodynamics(QCD).

QCD is the theory for interacting quarks and gluons.

2 Refreshing quantum mechanics

3 The path integral formalism

Wick rotation.

4 The Metropolis algorithm

5 Statistical analyses

What is autocorrelation? Autocorrelation versus correlation?

- 5.1 Bootstrapping
- 5.2 Jackknife method
- 5.3 Blocking
- 6 Quantum Field Theory and its fundamentals
 - 6.1 Observables
 - 6.2 Action
- 7 Lattice Quantum Chromodynamics
 - 7.1 Making a theory gauge invariant
 - 7.2 The Plaquette
 - 7.3 The Wilson gauge action
 - 7.4 Notes on a Lattice QCD simulation
 - 7.4.1 Updating matrices
 - 7.4.2 Generating random $SU(3)$ matrices
 - 7.4.3 Generating random $SU(2)$ matrices