Simulating Collisional Dark Matter

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Contents

Chapter 1

Objetives

1.1 General Objetive

To simulate the phase space of a collisional dark matter fluid using a Lattice-Boltzmann Method

1.2 Specific Objetives

- To implement a Lattice-Boltzmann simulation using a 4-dimensional phase space and a varying collisional term.
- To implement a Lattice-Boltzmann simulation using a 6-dimensional phase space and a varying collisional term.
- To study the dynamical behavior of a dark matter fluid using different equilibrium distributions in the collisional term.
- To compare the phase space of a collisional dark matter fluid with its collisionless version.

Chapter 2

Introduction

2.1 The Boltzmann Equation

2.2 Mesoscopic Modeling

Traditionally, fluid dynamics have been modeled using the Navier-Stokes equation, or some modification of it.

2.3 Lattice Automata and Lattice Boltzmann

2.4 BGK Approximation

Chapter 3

The Lattice Boltzmann Algorithm

3.1 The Mass Integral and the Poisson Equation

asdfasdf

3.2 Kick and Drift

asd

3.3 The Collisional Step

asd

3.4 Units and Initial Conditions

Chapter 4

Results

4.1 No Collisional

4.2 $\tau = 10$

4.3 $\tau = 100$

4.4 $\tau = 250$

4.5 $\tau = 500$

4.6 $\tau = 1000$

4.7 Different Equlibrium Distributions

Chapter 5

Conclusions

5.1 A Numerically Stable Simulation