Black hole simulator

# Introduction

Black holes are a very well known and fascinating physical phenomenon. Space time around the singularity is warped to the point that beyond the event horizon, light cannot escape. As complicates as these objects are, the equations for light around them are not terribly difficult. Using a series of simple differential equations, the motion of light around a black hole can be solved, using a simplified raytracing algorithm it is possible for us to visualize this phenomenon rather than just understand it mathematically

# Abstract

It is a provable fact that, for a diagonal metric, geodesic path through a space can be solved by the Lagrangian method:

In the case of light around a black hole, the Lagrangian takes the form:

By solving these equations we can trace the path of light around the black hole. Using raytracing algorithms, some borrowed from projects provided by github it is possible to use these equations to show what a black hole would look like in different situations.

# Objectives

Using the Verlet method for integrating the differential equations involved, as they are based on conservation of energy at some level, we can use a simplified ray-tracing algorithm to make the image of a black hole.

A user interface is probably beyond our abilities for this project, but the code to be used by other coders will be possible. Along with this, pictures of the black hole in different scenarios to demonstrate different lensing effects, such as:

* Show a black hole on color sample background
* Show a black hole with accretion disk
* Attempt to loop light around the black hole to show objects behind the “camera”

As a stretch-goal we may attempt to show the red-shifting of light as it travels further away from the center of gravity.