

SJCHS23

San Juan College High School

Physics and Astronomy

Concept of Negative Mass

Problem Definition:

The mystery of the four fundamental forces still perplex humanity to this day. Gravity, the weakest of the four, is defined differently on Isaac Newton's classical mechanics, Albert Einstein's general relativity, and quantum mechanics. Gravity acts differently depending on masses. It asks many questions such as black holes, worm holes, and time travel. However, the purpose of this project is not to answer those questions, it is supposed to ask another question; what would happen if there were to be something called a negative mass? The basics of negative mass is that if we were to use Newton's law of universal gravitation, how would gravity act if we were to allow negative numbers to be placed in the mass variable? This also gives light to more questions, where can we find negative mass, what can we use it for, does it have a role on the big bang, can it be used to unify gravity with the electromagnetic force? All of those questions are answerable, but not in the present. In this present, the project is only focusing on answering the basic question.

Problem solution:

This project is not the hardest, however, it is also not the easiest. Net Logo is utilized to solve this project. The project, a simple action upon two objects and how they react based on Newton's Law of Universal Gravity. Thankfully, there was already a sample model that does half of these actions. This sample model can be found in sample models> chemistry and physics> mechanics>

(unverified)> N-Bodies, Copyright 1998 Uri Wilensky. The computation is only half the battle, the other half is to get it to work with the mathematics. Manipulation of the module was done to allow the possibility of a negative mass; however, the hard part was inertial force. It has been decided to use absolute value on inertial force but not on gravitational force and after two long months of struggling with the mathematics, a mathematical proof has been written.

Progress:

The project is complete, somewhat. The project does show the action from a distance between two objects and it does allow the interaction between mass and negative mass. It works great with interaction between similar masses, it doesn't work great however, in interaction between many objects with mixed masses. So far, if one were to want to see how objects interact, with positive or negative mass, the project is finished, but if one were to want to make the interaction more accurate, the project is incomplete. The problem however, is close to be fixed, and hopefully no further assistance is needed.

Expected Results:

So far, the simulation is working great. Until the problem with the mass addition can be solved, the project will be incomplete. In the finished product, the expected result will be similar to the real world. As we know from Edwin Hubble's observation that caused Einstein to create the Cosmological Constant, the universe is not static, the universe is indeed, expanding. Astronomers and physicists have concluded that something is causing the universe to expand and they call whatever it is, dark energy. Just as dark energy is causing the expansion of the universe, negative mass can possibly be related to dark energy, "repelling" mass. Dark energy may be objects with

negative mass, and the expected result for the project will be something similar to the behavior of the cosmos.

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Newton, I., Cohen, I., & Whitman, A. (1999). *The principia : Mathematical principles of natural philosophy*. Berkeley: University of California Press.

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<https://www.youtube.com/watch?v=ApUFtLCrU90&list=PL47F408D36D4CF129>

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