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Evolution and Definition of Dark Energy (Gravitons)

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Abstract

Dark energy is the name given for an unknown force behind an expanding universe. It fills all the space with low density. Graviton particles are a type of boson in dark energy. There are possibilities of various different types of gravitons, with and without mass. The availability of gravitons increased during Populations I and II due to increase in star formations, novas, supernovas, etc. This, in turn, caused the universe to expand at an exponential rate. Any confirmation of its existence has yet to be provided yet this author believes graviton particles were found using the large Hadron Collider. Dark energy (gravitons) will eventually be described as a force or a warp in space-time. Any confirmation of its existence has yet to be provided. But, in December 2015, CERN scientists reported that proton smashing in both of the large Hadron Collider's principal detector systems, called ATLAS and CMS, had discovered an anomaly in the signals measured at energies higher than those needed to make the Higgs boson. This possible particle is 12 times heavier than Higgs boson that decays into two gamma rays and has a mass of 1400 GeV. This is an exciting possibility that this could be the graviton particle. All the other fundamental forces have associated particles and so the graviton is extremely anticipated. This could change the Standard Model and a possibility of whole new physics. Currently, all statistical effects have not been taken into consideration, therefore, five-sigma, considered the gold standard for discovery, is nowhere close.

Keywords

Dark Energy, Graviton Particles, CERN, Density, Cosmological Constant

1. Introduction

Dark energy is not dark, black, nor bright. It is simply a name for the force behind an expanding universe. It expands like a gas cloud, as more mass is added to the cloud but the individual particles in the cloud have attractive gravity. Dark energy accounts for 68.3% of the universe. It uniformly fills all of space with a density of 10^{-29} grams per cubic centimeter. Based on the standard model of cosmology, the best current measurements indicate that dark energy contributes 68.3% of the total energy in the present-day observable universe. The mass-energy of dark matter and ordinary (baryonic) matter contribute 26.8% and 4.9%, respectively, and other components such as neutrinos and photons contribute a very small amount (**Figure 1**). Again, on a mass-energy equivalence basis, the density of dark energy ($\sim 7 \times 10^{-30}$ g/cm^3) is very low, much less than the density of ordinary matter or dark matter within galaxies. However, it comes to dominate the mass-energy of the universe because it is uniform across space Energy (E) is interchangeable with matter (mass, m) by Einstein's equation of relativity $E = mc^2$, where c is the speed of light [1]. Dark energy is accelerating the expansion of the universe. In 2003, the first Wilkinson Microwave Anisotropy Probe (WMAP) results came out indicating that the universe was flat and that the dark matter made up only 24% (since changed) of the density required to produce a flat universe. If 71.4% (since changed) of the energy density in the universe is in the form of dark energy, which has a gravitationally repulsive effect, it is just the right amount to explain both the flatness of the universe and the observed accelerated expansion [2]. Thus dark energy explains many cosmological observations at once. However, it comes to dominate the mass-energy of the universe because it is uniform across space. The best model we currently have for dark energy is the cosmological constant. This is a *constant* energy density (hence the name) that is added to Einstein's equation of general relativity. This model provides by far the best match to cosmological observations, including the recent (February 2015) analysis of observations by the Planck satellite, which are the most accurate cosmological measurements we have so far.

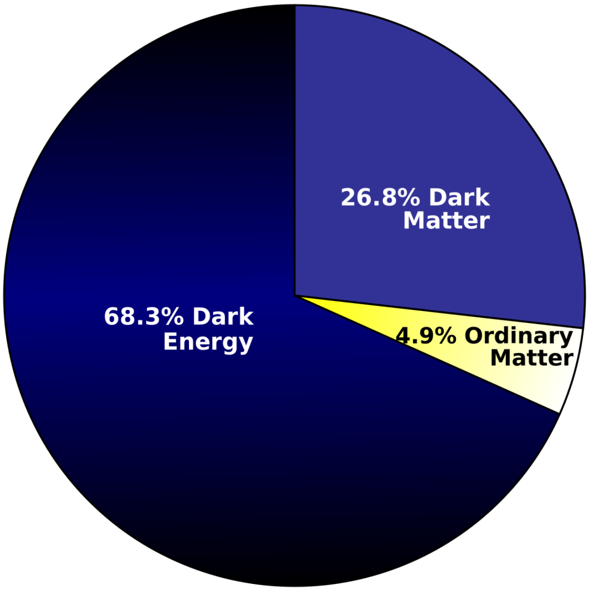

Figure 1. This diagram demonstrates the enormous amount in which dark energy fills our Universe. Credit: *WMAP*, NASA, 2015.

2. Description

The designation of dark energy is easier to explain than evolution and content. Cosmologists' standard model predicts that within the first 10^{-32} of a second after the Big Bang, the universe doubled in size 60 times in a growth spurt known as inflation. Dark energy does not interact with the electromagnetic force, thus making it transparent and hard to detect. It has existed for the past 9.8 billion years.

There is potential mass, aka inertial mass, or gravitational rest mass. Then there is kinetic mass aka relativistic mass. Energy coming from kinetic mass is the dark energy. In the universe, the number for potential mass is equal to the kinetic mass and the number is very large (10^{83}, if the electron is mass = 1). The potential mass starts to group together but a small distance separates them, this is the Planck length. Kinetic mass dispersed giving the effect of universal expansion.

The kinetic mass grouping together forms bosons with integral spin. These bosons were called graviton particles. Graviton particles have zero rest mass and zero charge [3]. One cannot avoid discussing density when discussing mass. Density is a property of continuity and mass is a property of subtlety.

$$\text{Density} = \frac{\text{mass}}{\text{volume}}$$

So when mass is constant, density is entirely continuous if the volume is infinitely large but the density also approaches zero. But when the volume is very small, for constant mass, the density is very large. The density of dark energy is low; $\sim 7 \times 10^{-30}$ g/cm^3. This means the graviton is located most everywhere in the universe. Therefore, low density and high volume produce graviton particles that cause the expansion.

If the universe expands to twice its current radius, then it will require 10^{60} m^3 of space to be created per second, and so $10^{60} \times 10^{-27}$ kg of graviton = 10^{33} kg of graviton particles per second. This means that the mass of 1000 suns must be created every second in the universe. Over 10^{51} kg would be needed. The only possible source for this amount of mass is from normal energy producing systems [4].

3. Evolution

The graviton particles (dark energy) are produced by mainly fusion reaction in stars, and occasionally by novae and supernovae. Graviton particles were initially formed in the dark era or dark epoch. The amount of gravitons in the universe was fairly small. The only source of production of gravitons were quasars and early stars which were short-lived supermassive stars triggering nuclear fusion reactions. This dark epoch initiated approximately 9.8 billion years ago (**Figure 2**).

Eventually Population II and then Population I stars form. This increases the production of gravitons subsequently increasing the density and gravity of the universe. At this moment, gravitons (dark energy) are the predominant matter in the universe due to their solar sources being plentiful.

Gravitons as dark energy answer many questions but raise other concerns. But, the evolution and history of gravitons (dark energy) cannot be denied. During the dark

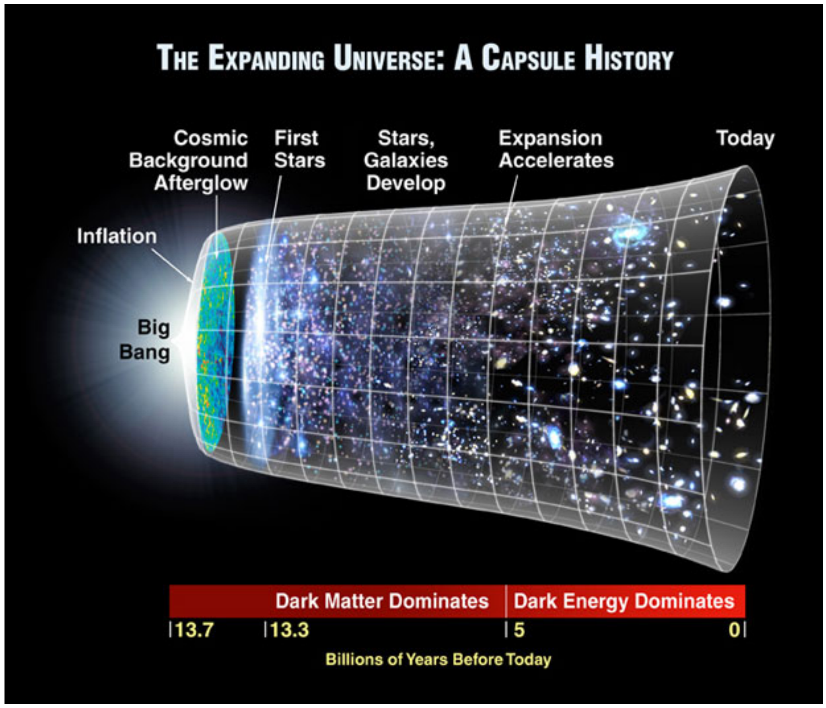

Figure 2. This diagram reveals changes in the rate of expansion of the Universe, since past 15 billion years ago. The more shallow the curve, the faster the rate of expansion. Expansion accelerates 7.5 billion years ago. Illustrations Tim Jones, Layne LundstrÃ¶m.

epoch, approximately 10 billion years ago, the universe was 1/65th its current size. But later, as the source of gravitons increased, the size of the universe increased. There are trillions of stars in the universe, producing increasing amounts of gravitons with the universe expanding at an ever-increasing rate.

4. Discussion

The basics of gravitons are: The elementary quantum particle carriers of gravity are gravitons—similar to that of photons carrying the electromagnetic force (light). Scientists are currently working to detect graviton particles. The problem with gravitons is that gravity is not actually a force according to general relativity—it is a warp in space-time. The essential properties of gravitons are massless particles, carrying a lot of energy and have the integer spin of two—which is an extremely unique property among particles. The fact that the graviton property implies the possible existence of extra dimensions opens up the probability that there is a warp in space-time [5] [6].

Last December, CERN physicists reported that proton-smashing in both of the LHC's principal detector systems, called ATLAS and CMS, had discovered an anomaly in the signals measured at energies higher than those needed to make the Higgs boson. The implication is that this is the signature of some extremely massive particle—six times heavier than the ponderous Higgs boson—that decays into two gamma rays. This could be the particle generally assumed to be the "carrier" of the gravitational force, called the graviton. All the other fundamental forces have associated particles, and so the graviton is generally anticipated. But if the graviton has non-zero mass, the implications could be huge: an explanation for so-called dark energy, perhaps, or evidence for extra dimensions of space.

5. Conclusions

Ahmed Farag Ali and Saurya Das added quantum mechanical corrections (using Bohm trajectories) to general relativistic geo discs. If gravitons are given sufficient but non-zero mass, it may explain the cosmological constant and solve the smallness problem. Most theories of gravitons as dark energy run into the problem because of the necessity of extending the Standard Model or other quantum field theories [7] [8].

Quantum mechanics states that every particle is also a vibrating wave, and recently hypothesized that graviton particles could vibrate in extra dimension, no matter how small. There are possibilities that more than one type of graviton can exist, theoretically. These are called Kaluza-Klein gravitons. They proposed certain gravitons with more vibrations can have mass. The possibilities of dark energy being graviton particles with mass and multi-dimensional capabilities would put the Standard Model upside down and force change in quantum physics.

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