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Possibility of harvesting of dark energy

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Abstract
Dark Energy is one of the most challenging problem in Physics. Recent research work suggest that the whole universe is expanding in an accelerated frame. Dark energy explains the cause behind. Many cosmological observations indicated that the universe is expanding. By studying supernovae type Ia (SNe Ia), it was found that the expansion of the universe is speeding up rather than slowing down, as was expected if only matter and radiation were present. The force responsible for this 'anti-gravity' is termed as 'dark energy'. Dark energy or cosmological constant or quintessence is an unknown form of energy. This is the dominant component of the physical Universe. This is supposed that the dark energy permeates all the space which accelerate the expansion of the universe. Distant galaxies appear to be moving away from us at high speed: the idea is that the universe is getting bigger and has been since the Big Bang. It has become apparent that the Earth, the planets, the stars and everything we are familiar with, make up only a tiny 4.9% of the total matter and energy in the universe. Increasingly dependable evidence from gravitational lensing, galaxy rotation curves and studies of the cosmic microwave background radiation (CMB) indicates that non-baryonic cold dark matter (CDM) makes up about 26.8% of the rest, but the remaining 68.3%, the dark energy, has not been satisfactorily explained. And other components such as neutrinos and photons contribute a very small amount. Again on a mass–energy equivalence basis, the density of dark energy (6.91×10^{-27} kg/m^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. Besides discussing the origin and nature of dark energy, this paper overviews the various models of dark energy and investigates the theoretical options for conversion of dark energy into usable energy.
Besides discussing the origin and nature of dark energy, this paper overviews the unified field theory and investigates the theoretical options for conversion of dark energy into usable energy by considering the dark energy as a property of gravity.

Keywords: Dark energy, UFT, ΛCDM universe, dynamical field, supernovae Ia etc.

Introduction
Unified field theory (UFT) is also called the Theory of Everything. UFT is the theory for trying to tying together all matter and energy under one principle. A field refers to an area in which influence of a force, such as gravity or electricity can be experienced. UFT would reconcile seemingly incompatible aspects of various field theories to create a single comprehensive set of equations. UFT could potentially unlock all the secrets of nature and make a countless of wonders possible, including an inexhaustible source of clean energy, among many others. Maxwell proposed the first field theory, for electromagnetism, in the middle of the 1800s. Early in the 20th century, Einstein's general theory of relativity which is about gravitation became the second field theory. Einstein attempted to prove that electromagnetism and gravity were different manifestations of a single fundamental field. When quantum theory entered the picture, the puzzle became more complex. Although electromagnetism and the strong and weak nuclear forces have long been explained by a single theory known as the standard model, gravitation does not fit into the equation. The current quest for a unified field theory is largely focused on superstring theory and M-theory [1, 2, 3].

Unified field theory allows the fundamental forces such as strong interaction, electromagnetic interaction, weak interaction and gravitational interaction and elementary particles to be written in terms of a single field. In1963 Sheldon Glashow proposed that the weak nuclear force, electricity and magnetism could arise from a partially unified electroweak theory. In 1967, Abdus Salam and Steven Weinberg independently revised

Glashow's theory by having the masses for the W particle and Z particle arise through spontaneous symmetry breaking with the Higgs mechanism. Gravity has yet to be successfully included in a theory of everything. Physicists have not yet formulated a widely accepted, consistent theory that combines general relativity and quantum mechanics. The incompatibility of the two theories remains an outstanding problem in the field of physics [4, 5, 6].

Dark energy is a property of gravity

Theoretical aspects

There was no information regarding dark energy and dark matter in the general theory of relativity. The dark matter phenomenon was initially discovered by Fritz Zwicky in early 1930s, Kent Ford and Vera Cooper Rubin in 1970s, and the dark energy phenomenon was discovered in 1990s by Saul Perlmutter, Brian P. Schmidt and Adam G. Riess.

The most logical and simple explanation of existence of dark energy is that it is simply the "cost of having space". Obviously this volume of space has some intrinsic, fundamental energy. This is the cosmological constant (Λ). From Einstein's mass energy relation [E = mc2] and Einstein's general theory of relativity, this energy must also have a gravitational effect. The cosmological constant is of the order of 10−29 gm/cm3. The cosmological constant has negative pressure equal to its energy density and therefore causes the accelerated expansion of the universe. The observed acceleration of the galaxies is caused by the potential energy of a dynamical field. This dynamical field is also referred as quintessence field or dark energy. Quintessence differs from the cosmological constant in that it can vary in space and time. To show that dark energy is merely a property of gravity. Tian Ma and Shouhong Wang [2] modified the Einstein gravitational field equations by considering the following facts. Symmetry dictates law of gravity.

Gravity is one of the four fundamental forces of Nature. The following equations are based on the principle of general relativity and the principle of interaction dynamics (PID [8]

$$R_{\mu\nu} - \frac{1}{2} g_{\mu\nu} R = -\frac{8\pi G}{C^4} T_{\mu\nu} - \nabla_\mu \phi_\nu \qquad (1)$$

The above equation is supplemented by the following equation of the energy-momentum conservation-

$$\nabla^\mu \left[\frac{8\pi G}{C^4} T_{\mu\nu} + \nabla_\mu \phi_\nu \right] = 0 \qquad (2)$$

Here

- ϕ_ν is a vector field defined on the 4D space-time manifold M, and needs to be solved together with the Riemannian metric
- $g_{\mu\nu}$, representing the gravitational potential. Also ∇^μ is the gradient operator on M,
- $R_{\mu\nu}$ and R are the Ricci and scalar curvatures,
- $R_{\mu\nu}$ and $T_{\mu\nu}$ is the energy-momentum of the baryonic matter in the universe.

The field equations (1) are derived solely based on the two first principles. The principle of general relativity, together with the simplicity of laws of Nature, uniquely determines the Lagrangian action for gravity as the Einstein-Hilbert functional-

$$L_{EH(\{g_{\mu\nu}\})} = \int_M \left(R + \frac{8\pi G}{C^4} \right) \sqrt{-g}\, dx \qquad (3)$$

This can be shown that the presence of dark matter and dark energy implies that the variation of the Einstein-Hilbert functional must be taken under energy-momentum conservation constraint, leading precisely to the gravitational field equations (1).

This is the exact form of principle of interaction dynamics (PID when applied to gravity, and is the original motivation of PID [9].

2. Duality

The field equations (1) establish a natural duality between the gravitational field $g_{\mu\nu}$ and its dual vector field ϕ_ν.

There are two aspects of this duality. The first is the duality of the two fields:

$g_{\mu\nu}$, representing massless spin-2 graviton,

And ϕ_ν, representing massless spin-1 dual vector graviton:

Spin 2 graviton$\leftrightarrow$ Spin 1 graviton (4)

The second aspect of the duality is the duality of the gravitational force. Namely, gravitational interaction generates both attractive and repulsive forces:

This is a well known fact that the Schwarzschild solution of classical Einstein equations gives rise to the classical Newton's gravitational force formula. Using the field equations (1), however, one can deduce a revised gravitational force formula. In fact, consider a central matter field with total mass and with spherical symmetry. We can derive an approximate gravitational force formula. Here the first term represents the Newton gravitation, the attracting second term stands for dark matter and the repelling third term is the dark energy. In summary, we have shown that it is the duality between the attracting gravitational field $\{g_{\mu\nu}\}$ and the repulsive dual vector field $\{\phi_\nu\}$, together with the nonlinear interaction of these two fields through the field equations (1) and (2), that give rise to gravity, and in particular the gravitational effect of dark energy and dark matter.

3. Law of Gravity, Dark Matter and Dark Energy

Here we summarize the law of gravity as we understand now.

- (Principle of Equivalence) The space-time is a 4D Riemannian manifold M, with the metric $\{g_{\mu\nu}\}$ being the gravitational potential. ϕ_ν
- The gravitational potential $\{g_{\mu\nu}\}$ and its dual vector field satisfy the law of gravity, the gravitational field equations (1) and (2), which are completely determined by the principle of general relativity and PID.
- Gravitational effect is achieved through that the space-time curvature dictated by the gravitational potential $\{g_{\mu\nu}\}$.
- Gravity can display both attractive and repulsive effect, caused by the duality between the attracting gravitational field $\{g_{\mu\nu}\}$ and the repulsive dual vector field $\{\phi_\nu\}$, together with their nonlinear interactions governed by the field equations (1) and (2).

This can be also be shown that the energy-momentum conservation constraint variation is simply the direct and unique consequence of the presence of dark energy and dark matter.

4. Dark energy and dark matter phenomena are simply a property of gravity

The dark matter phenomenon was initially discovered by Fritz Zwicky in early 1930s, Kent Ford and Vera Cooper Rubin in 1970s, and the dark energy phenomenon was discovered in 1990s by Saul Perlmutter, Brian P. Schmidt and Adam G. Riess. As the information in connection with dark energy and dark matter were missing in the general theory of relativity. To solve the mystery of dark energy and dark matter, numerous attempts were made to alter the Einstein gravitational field equations to get the required results. Tian Ma and Shouhong Wang [2] observed that the presence of dark matter and dark energy induces variation of the Einstein-Hilbert action under energy-momentum conservation constrains, leading to the postulation of PID for all four fundamental interactions. The new term $\nabla_\mu \phi_\nu$ in the new field equations (1) is the natural and unique consequence of PID. Second, it is then clear that the term $\nabla_\mu \phi_\nu$ does not correspond to any Lagrangian action density, and is the direct consequence of PID. If one intends to derive this new term by adding into the Einstein-Hilbert action density something like-

$g_{\mu\nu}\nabla_\mu \phi_\nu$ then two problems arise. First, field equation would contain not only $\nabla_\mu \phi_\nu$, but also additional terms;

$g^{\mu\nu}\delta(\nabla_\mu \phi_\nu)$ as the covariant derivative ∇_μ is metric dependent. The second problem is that Stokes formula would imply that the added density is nil:

$$\int_M g^{\mu\nu}\, \nabla_\mu \phi_\nu = 0$$

Third, if we take the cosmic microwave background radiation into consideration, the field equations are in a more general form with the vector field ϕ_ν; where the term $\frac{e}{hc}\nabla_\mu \phi_\nu$ represents the coupling between the gravitation and the microwave background radiation.

Hypothetical experimental picture for using dark energy as a power source

The purpose of this hypothetical experiment' is to show that the Unified Field Theory is correct with respect to the conversion of dark energy into useful energy which is the manifestation of gravitational field. It is a characteristic of an energy field to seek the lowest possible energy configuration owing to which energy field becomes even and the stable state is attained. When a discontinuity or unevenness is present in the field, then a force is generated, according to the well known equation of classical mechanics which is $\vec{F} = -\vec{\nabla}U$. The purpose of such forces is to reduce the potential energy and recreate the stable state. If we make the assumption, consistent with the Unified Field Theory, that the warped space' of the three dimensional universe' is just one more manifestation of this energy field, then it follows from this that it must be possible to translate energy in the form of this three dimensional space' which is space energy or dark energy into usable electrical energy.

Now let us consider the following hypothetical experimental situations

1. Let two charged bodies at different potential are connected then current flows from the body at higher potential to the body at lower potential then in response to the force which is generated due to discontinuity or the unevenness of the electric field, until finally the potential difference no longer exists. When potential difference becomes same then the force disappears because this state represents the lower possible energy configuration.
   From the above idea in mind, it seems logical to assume that want to translate the dark energy into electrical current, then we will have to create discontinuity in space.
2. Let two bar magnets are placed at small distance such that their similar poles are opposite to each other. This generates as the consequence of discontinuity in the magnetic field in three dimensional space. Now as two similar poles of a bar magnet, due to repulsive nature of force pushes the poles of the bar magnet apart. This force is so powerful that it is next to impossible to push together the two similar poles of a bar magnet.
3. If the experimental situation mentioned in the point No. (2) is repeated by using heavy weights and the force of gravity to pull the two magnetic poles together so as to generate the mechanical force required to stress the piezoelectric circuit so as to generate the electricity required to light a bulb connected in piezoelectric circuit.

Result

As a mass accelerated to a high velocity must be treated as a powerful gravitational source due to the effective increase in mass and therefore mass accelerated to a high velocity must be surrounded by a pocket of extremely warped space and the gravitational field manifests itself in this form of warped three dimensional space. Now since the gravitational field, according to the Unified Field Theory, is the momentum field of the universe, therefore The momentum' of an object must therefore be stored in the form of the warped space around the object, and we would assume that the transfer of momentum to an object is also the transfer of three dimensional space energy or dark energy. The dark energy of the universe' would therefore be the momentum of the universe, and when we convert this gravitational energy to any other form of energy it must be true that as the dark energy is a property of gravity, we are translating this dark energy into another form of energy. For using this dark energy' as a new power source, this would involve reducing the momentum of the earth in space, resulting in a shift of the earth's orbit, and possibly a new form of global warming would be the result. However this would take millions of years to manifest itself.

Conclusions

This has been hypothetically shown that gravitational energy is equivalent to electrical energy and is also equivalent to the energy in the form of electromagnetic radiation. Therefore it follows that gravitational energy is part of the universal energy cycle, and if we can convert gravitational energy into other forms then it must also be true that these other forms can also be converted into

gravitational energy and as according to more general Unified Field Theory, the dark energy could be a property of gravity, therefore this could be possible to use the dark energy as a power source. One of the consequences of the Unified Field Theory could be the development of cheap and abundant power sources with a minimal environmental impact.

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