Chameleon Dark Matter and Energy

Is dark energy a cosmic chameleon that can fade into its surroundings? A recent test brings the mysterious anti-gravitational force down to earth. [10]

The gravitational force attracting the matter, causing concentration of the matter in a small space and leaving much space with low matter concentration: dark matter and energy.

There is an asymmetry between the mass of the electric charges, for example proton and electron, can understood by the asymmetrical Planck Distribution Law. This temperature dependent energy distribution is asymmetric around the maximum intensity, where the annihilation of matter and antimatter is a high probability event. The asymmetric sides are creating different frequencies of electromagnetic radiations being in the same intensity level and compensating each other. One of these compensating ratios is the electron – proton mass ratio. The lower energy side has no compensating intensity level, it is the dark energy and the corresponding matter is the dark matter.

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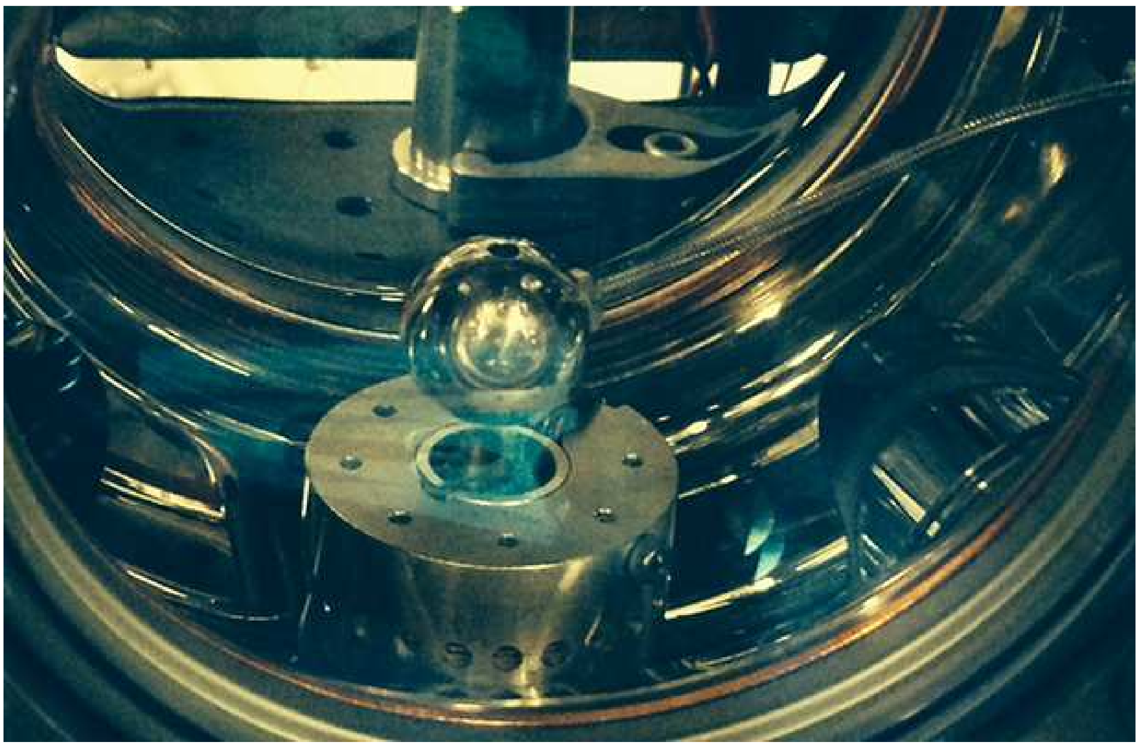
Dark Energy Tested on a Tabletop



A vacuum chamber with a marble-size sphere at its center was used to test the nature of dark energy.

Dark energy has topped cosmologists' "most wanted" list since 1998, when astronomers noticed that the expansion of the universe is speeding up rather than slowing down. The entity responsible — whatever it is — must be incredibly powerful, constituting nearly 70 percent of the universe. Figuring out the identity of this dark energy is "arguably the most important problem in physics," said Clare Burrage of the University of Nottingham in the United Kingdom.

Now a team of physicists has directly tested one option for dark energy using not powerful telescopes or satellites, but a vacuum chamber fashioned on a tabletop.

The most straightforward explanation for dark energy is that it is the energy inherent in the vacuum of space itself. In this model, every teaspoonful of space brims with the same amount of dark energy, a value known as the cosmological constant. But there’s a major flaw in this simple solution. Physicists’ best calculation of this energy, which is thought to be due to the constant appearance and disappearance of “virtual” quantum particles, overshoots the actual observed value by a factor of 10120.

So perhaps instead of — or in addition to — the cosmological constant, there may be extra quantum fields, called scalar fields, that have a given strength at each point in space, just as a measurable temperature exists everywhere.

“We know there’s no explanation for the cosmological-constant problem within general relativity and the Standard Model of particle physics,” said Burrage. “Pretty much anytime you want to go beyond that, the new physics you try and introduce gives you new scalar fields.”

Scalar fields could produce dark energy in the fields’ lowest-energy, or vacuum, state, just as the cosmological constant would. But many proposed scalar fields interact with matter, which raises its own problem. If a scalar field interacts with ordinary matter — like the stuff that makes up Earth and the sun — its presence should already have been observed in our own solar system as an extra, unexplained force, and none has been seen. “If your theory of dark energy tells you these extra scalar fields are around, you have to explain why we haven’t seen them,” Burrage said.

One solution is that, like a chameleon, the field changes depending on the surrounding environment. Such a field would produce a negligible effect near high-density matter, like Earth, slipping by unnoticed in the presence of the stronger, familiar force of gravity.
But in the emptiness of space between galaxies, it would produce a long-range pull. (Unfortunately, this pull would still be imperceptible to astronomers, since it would disappear around large objects whose movements they could track.)

Dark energy has the same value everywhere in a “cosmological constant” model. If dark energy is described by a “chameleon” field instead, it would have only minor effects around large objects such as Earth.

Chameleon models are not especially well motivated from the standpoint of fundamental physics, admits Burrage, who began studying them in graduate school, but since dark energy presents such a profound mystery, physicists are willing to consider just about anything.

Last August, Burrage and her colleagues posted a paper on the scientific preprint site arxiv.org suggesting a way to lay a trap for these cagey cosmic chameleons. They envisioned a vacuum chamber about the size of a bowling ball with a marble-size sphere at its center. The chameleon field, assuming it was there, would be minimized near the walls of the chamber and immediately around the central sphere. It would have a higher value in the empty space between them. That means that an atom — whose own mass is too small to kill off the chameleon field — placed inside the vacuum chamber would feel a different force from the field depending on its position in the chamber.

Pulses of laser light could be used to track the atom’s movement in the chamber at three different times. If the tracking revealed an unexplained acceleration, it could be due to the force of a chameleon field. “You use the light beam as a ruler, and you just watch the atoms moving across the ruler,” said Ed Hinds, the head of the Center for Cold Matter at Imperial College London and the lead experimentalist on the team proposing the test.

After devising the chameleon trap, Hinds and his team set out to build it; he expects to get the first results in a few months. But other physicists led by Holger Müller at the University of California, Berkeley, already had a similar setup in their lab, so they got a head start on the tests and reported their first results in a paper posted to arxiv.org on Feb. 13 and submitted to a prominent peer-reviewed journal. (Müller declined to comment for this article, as the journal’s policies forbid him from speaking directly to the media until shortly before the paper is published.)

Using cesium atoms as the test particles, Müller’s team found that the atoms’ movement did not change depending on their distance from the sphere. That ruled out most chameleon models that could account for dark energy, Müller reported at a talk at Harvard University on Feb. 23.

The result came out “exactly as I predicted, so it’s a little bit galling that it wasn’t in my lab,” Hinds said. “But I must say they’ve done a very fine job.” Hinds believes that the test can be made 1,000 times more sensitive, allowing him to probe energies close to the scale where quantum mechanics becomes important for gravity. But he is closemouthed about how he plans to get there. “I need to have some way to come back at the Berkeley people,” he joked.

Lam Hui, a theoretical astrophysicist at Columbia University, said such experiments are interesting, but not for their ability to shed light on dark energy. That is because cosmic acceleration, according to chameleon models, would be caused not by any camouflaging behavior on the part of the field but simply by the value of its lowest-energy state. Instead, the experiments are “testing the chameleon mechanism,” he said — the general idea that the universe could harbor undetected scalar fields that interact with matter.

Mikhail Lukin, a physicist at Harvard who attended Müller’s talk there, said the method holds a lot of promise. Such high-precision instruments should “really push the frontier of our understanding of the universe,” he said, but he added that “the big thing would be to really observe something” rather than rule models out.

To date, cosmological observations have had an edge in this regard, said Ronald Walsworth, another Harvard physicist at the talk.
“They’ve actually seen effects that we can’t explain,” he said, referring to the observations that revealed dark energy.

Still, some of those who trade in cosmic observations are impressed with the new study. “That was a very neat idea,” said Valeria Pettorino of the University of Heidelberg in Germany. “It’s quite different from other kinds of tests we are used to for dark energy.”
She led a team that recently compared the predictions of various models of dark energy with observations from the Planck satellite and other telescopes. The combined data from all sources revealed the faintest hint of a deviation from the simplest dark-energy model based on the cosmological constant.

If chameleon models are one day ruled out completely, “then that is great,” said Amanda Weltman of the University of Cape Town in South Africa, who co-developed the first such models more than a decade ago. "It is exciting to be able to propose a theory that can be tested and ruled out in a reasonable time frame." [10]

The Big Bang

The Big Bang caused acceleration created radial currents of the matter, and since the matter is composed of negative and positive charges, these currents are creating magnetic field and attracting forces between the parallel moving electric currents. This is the gravitational force experienced by the matter, and also the mass is result of the electromagnetic forces between the charged particles. The positive and negative charged currents attracts each other or by the magnetic forces or by the much stronger electrostatic forces!?

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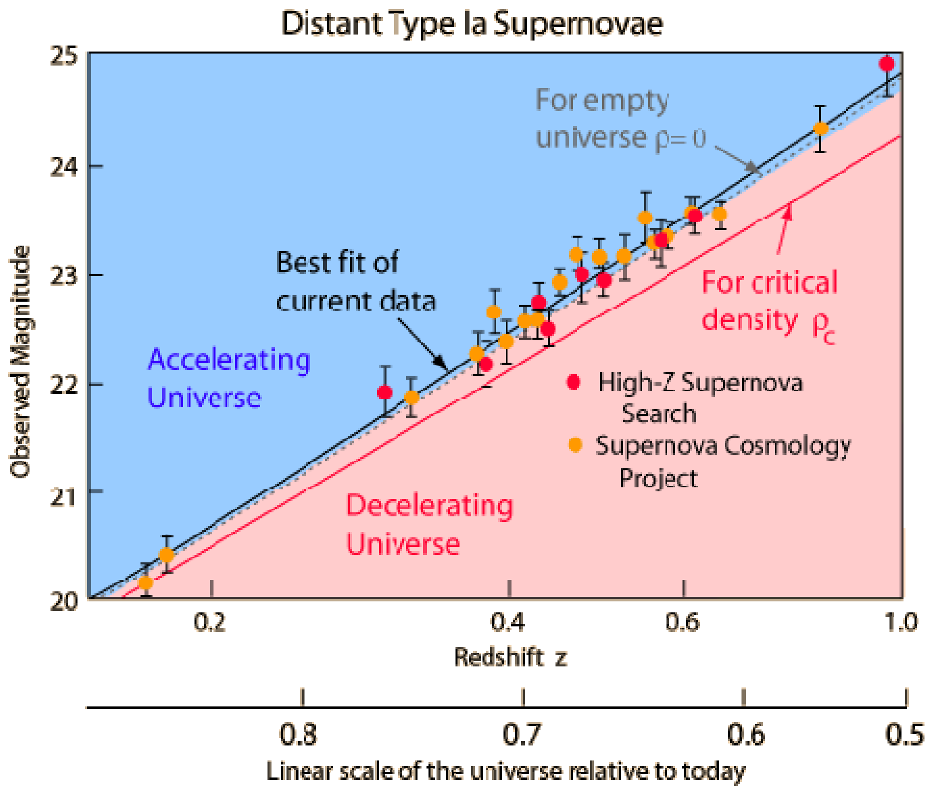
Evidence for an accelerating universe

One of the observational foundations for the big bang model of cosmology was the observed expansion of the universe. [9] Measurement of the expansion rate is a critical part of the study, and it has been found that the expansion rate is very nearly "flat". That is, the universe is very close to the critical density, above which it would slow down and collapse inward toward a future "big crunch". One of the great challenges of astronomy and astrophysics is distance measurement over the vast distances of the universe. Since the 1990s it has become apparent that type Ia supernovae offer a unique opportunity for the consistent measurement of distance out to perhaps 1000 Mpc. Measurement at these great distances provided the first data to suggest that the expansion rate of the universe is actually accelerating. That acceleration implies an energy density that acts in opposition to gravity which would cause the expansion to accelerate. This is an energy density which we have not directly detected observationally and it has been given the name "dark energy".

The type Ia supernova evidence for an accelerated universe has been discussed by Perlmutter and the diagram below follows his illustration in Physics Today.



The data summarized in the illustration above involve the measurement of the redshifts of the distant supernovae. The observed magnitudes are plotted against the redshift parameter z. Note that there are a number of Type 1a supernovae around z=.6, which with a Hubble constant of 71 km/s/mpc is a distance of about 5 billion light years.

Equation

The cosmological constant Λ appears in Einstein's field equation [5] in the form of

$$R_{\mu\nu} - \frac{1}{2}R\,g_{\mu\nu} + \Lambda\,g_{\mu\nu} = \frac{8\pi G}{c^4}T_{\mu\nu},$$

where *R* and *g* describe the structure of spacetime, *T* pertains to matter and energy affecting that structure, and *G* and *c* are conversion factors that arise from using traditional units of measurement. When Λ is zero, this reduces to the original field equation of general relativity. When *T* is zero, the field equation describes empty space (the vacuum).

The cosmological constant has the same effect as an intrinsic energy density of the vacuum, ρ_{vac} (and an associated pressure). In this context it is commonly moved onto the right-hand side of the equation, and defined with a proportionality factor of 8π: $\Lambda = 8\pi\rho_{vac}$, where unit conventions of general relativity are used (otherwise factors of *G* and *c* would also appear). It is common to quote values of energy density directly, though still using the name "cosmological constant".

A positive vacuum energy density resulting from a cosmological constant implies a negative pressure, and vice versa. If the energy density is positive, the associated negative pressure will drive an accelerated expansion of the universe, as observed. (See dark energy and cosmic inflation for details.)

Explanatory models

Models attempting to explain accelerating expansion include some form of dark energy, dark fluid or phantom energy. The most important property of dark energy is that it has negative pressure which is distributed relatively homogeneously in space. The simplest explanation for dark energy is that it is a cosmological constant or vacuum energy; this leads to the Lambda-CDM model, which is generally known as the Standard Model of Cosmology as of 2003-2013, since it is the simplest model in good agreement with a variety of recent observations.

Dark Matter and Energy

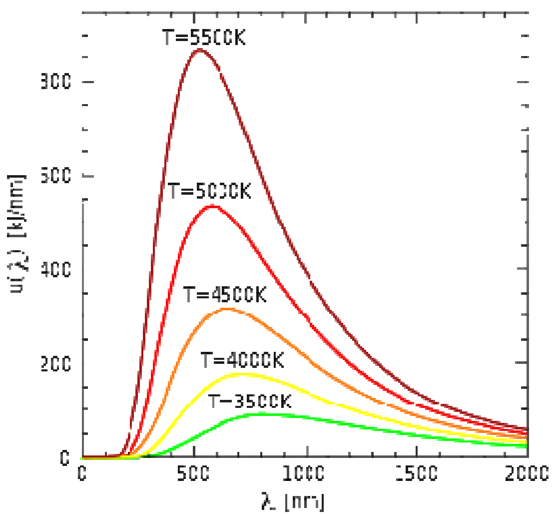
Dark matter is a type of matter hypothesized in astronomy and cosmology to account for a large part of the mass that appears to be missing from the universe. Dark matter cannot be seen directly with telescopes; evidently it neither emits nor absorbs light or other electromagnetic radiation at any significant level. It is otherwise hypothesized to simply be matter that is not reactant to light. Instead, the existence and properties of dark matter are inferred from its gravitational effects on visible matter, radiation, and the large-scale structure of the universe. According to the Planck mission team, and based on the standard model of cosmology, the total mass–energy of the known universe contains 4.9% ordinary matter, 26.8% dark matter and 68.3% dark energy. Thus, dark matter is estimated to constitute 84.5% of the total matter in the universe, while dark energy plus dark matter constitute 95.1% of the total content of the universe. [6]

Cosmic microwave background

The cosmic microwave background (CMB) is the thermal radiation assumed to be left over from the "Big Bang" of cosmology. When the universe cooled enough, protons and electrons combined to form neutral atoms. These atoms could no longer absorb the thermal radiation, and so the universe became transparent instead of being an opaque fog. [7]

Thermal radiation

Thermal radiation is electromagnetic radiation generated by the thermal motion of charged particles in matter. All matter with a temperature greater than absolute zero emits thermal radiation. When the temperature of the body is greater than absolute zero, interatomic collisions cause the kinetic energy of the atoms or molecules to change. This results in charge-acceleration and/or dipole oscillation which produces electromagnetic radiation, and the wide spectrum of radiation reflects the wide spectrum of energies and accelerations that occur even at a single temperature. [8]



Electromagnetic Field and Quantum Theory

Needless to say that the accelerating electrons of the steady stationary current are a simple demystification of the magnetic field, by creating a decreasing charge distribution along the wire, maintaining the decreasing U potential and creating the **A** vector potential experienced by the electrons moving by **v** velocity relative to the wire. This way it is easier to understand also the time dependent changes of the electric current and the electromagnetic waves as the resulting fields moving by c velocity.

It could be possible something very important law of the nature behind the self maintaining **E** accelerating force by the accelerated electrons. The accelerated electrons created electromagnetic fields are so natural that they occur as electromagnetic waves traveling with velocity c. It shows that the electric charges are the result of the electromagnetic waves diffraction.

One of the most important conclusions is that the electric charges are moving in an accelerated way and even if their velocity is constant, they have an intrinsic acceleration anyway, the so called spin, since they need at least an intrinsic acceleration to make possible they movement .

The bridge between the classical and quantum theory is based on this intrinsic acceleration of the spin, explaining also the Heisenberg Uncertainty Principle. The particle – wave duality of the electric charges and the photon makes certain that they are both sides of the same thing. Basing the gravitational force on the accelerating Universe caused magnetic force and the Planck Distribution Law of the electromagnetic waves caused diffraction gives us the basis to build a Unified Theory of the physical interactions. [4]

Lorentz transformation of the Special Relativity

In the referential frame of the accelerating electrons the charge density lowering linearly because of the linearly growing way they takes every next time period. From the referential frame of the wire there is a parabolic charge density lowering.

The difference between these two referential frames, namely the referential frame of the wire and the referential frame of the moving electrons gives the relativistic effect. Important to say that the moving electrons presenting the time coordinate, since the electrons are taking linearly increasing way every next time period, and the wire presenting the geometric coordinate. The Lorentz transformations are based on moving light sources of the Michelson - Morley experiment giving a practical method to transform time and geometric coordinates without explaining the source of this mystery.

The real mystery is that the accelerating charges are maintaining the accelerating force with their charge distribution locally. The resolution of this mystery that the charges are simply the results of the diffraction patterns, that is the charges and the electric field are two sides of the same thing. Otherwise the charges could exceed the velocity of the electromagnetic field.

The increasing mass of the electric charges the result of the increasing inductive electric force acting against the accelerating force. The decreasing mass of the decreasing acceleration is the result of the inductive electric force acting against the decreasing force. This is the relativistic mass change explanation, especially importantly explaining the mass reduction in case of velocity decrease.

The Classical Relativistic effect

The moving charges are self maintain the electromagnetic field locally, causing their movement and this is the result of their acceleration under the force of this field.
In the classical physics the charges will distributed along the electric current so that the electric potential lowering along the current, by linearly increasing the way they take every next time period because this accelerated motion.

Electromagnetic inertia and Gravitational attraction

Since the magnetic induction creates a negative electric field as a result of the changing acceleration, it works as an electromagnetic inertia, causing an electromagnetic mass.

It looks clear that the growing acceleration results the relativistic growing mass - limited also with the velocity of the electromagnetic wave.

Since $E = hv$ and $E = mc^2$, $m = hv / c^2$ that is the ***m*** depends only on the ***v*** frequency. It means that the mass of the proton and electron are electromagnetic and the result of the electromagnetic induction, caused by the changing acceleration of the spinning and moving charge! It could be that the m_o inertial mass is the result of the spin, since this is the only accelerating motion of the electric charge. Since the accelerating motion has different frequency for the electron in the atom and the proton, they masses are different, also as the wavelengths on both sides of the diffraction pattern, giving equal intensity of radiation.

If the mass is electromagnetic, then the gravitation is also electromagnetic effect caused by the accelerating Universe! The same charges would attract each other if they are moving parallel by the magnetic effect.

The Planck distribution law explains the different frequencies of the proton and electron, giving equal intensity to different lambda wavelengths! Also since the particles are diffraction patterns they have some closeness to each other – can be seen as a gravitational force.

Electromagnetic inertia and mass

Electromagnetic Induction

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Relativistic change of mass

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The frequency dependence of mass

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Electron – Proton mass rate

The Planck distribution law explains the different frequencies of the proton and electron, giving equal intensity to different lambda wavelengths! Also since the particles are diffraction patterns they have some closeness to each other – can be seen as a gravitational force. [1]

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Gravity from the point of view of quantum physics

The Gravitational force

The gravitational attractive force is basically a magnetic force.

The same electric charges can attract one another by the magnetic force if they are moving parallel in the same direction. Since the electrically neutral matter is composed of negative and positive charges they need 2 photons to mediate this attractive force, one per charges. The Bing Bang caused parallel moving of the matter gives this magnetic force, experienced as gravitational force.

Since graviton is a tensor field, it has spin = 2, could be 2 photons with spin = 1 together.

You can think about photons as virtual electron – positron pairs, obtaining the necessary virtual mass for gravity.

The mass as seen before a result of the diffraction, for example the proton – electron mass rate Mp=1840 Me. In order to move one of these diffraction maximum (electron or proton) we need to intervene into the diffraction pattern with a force appropriate to the intensity of this diffraction maximum, means its intensity or mass.

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The Graviton

In physics, the graviton is a hypothetical elementary particle that mediates the force of gravitation in the framework of quantum field theory. If it exists, the graviton is expected to be massless (because the gravitational force appears to have unlimited range) and must be a spin-2 boson. The spin follows from the fact that the source of gravitation is the stress-energy tensor, a second-rank tensor (compared to electromagnetism's spin-1 photon, the source of which is the four-current, a first-rank tensor). Additionally, it can be shown that any massless spin-2 field would give rise to a force indistinguishable from gravitation, because a massless spin-2 field must couple to (interact with) the stress-energy tensor in the same way that the gravitational field does. This result suggests that, if a massless spin-2 particle is discovered, it must be the graviton, so that the only experimental verification needed for the graviton may simply be the discovery of a massless spin-2 particle. [2]

Conclusions

The gravitational force attracting the matter, causing concentration of the matter in a small space and leaving much space with low matter concentration: dark matter and energy.
There is an asymmetry between the mass of the electric charges, for example proton and electron, can understood by the asymmetrical Planck Distribution Law. This temperature dependent energy distribution is asymmetric around the maximum intensity, where the annihilation of matter and antimatter is a high probability event. The asymmetric sides are creating different frequencies of electromagnetic radiations being in the same intensity level and compensating each other. One of these compensating ratios is the electron – proton mass ratio. The lower energy side has no compensating intensity level, it is the dark energy and the corresponding matter is the dark matter. Since the Planck Distribution Law is temperature dependent, the dark energy participation is depend on the temperature, giving a chameleon like occurrence.
The electric currents causing self maintaining electric potential is the source of the special and general relativistic effects. The Higgs Field is the result of the electromagnetic induction. The Graviton is two photons together. [3]

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