Simulated Expansion of the Universe

Physicists at the University of Geneva (UNIGE), Switzerland, have developed a new code of numerical simulations that offers a glimpse of the complex process of the formation of structures in the Universe. Based on Einstein's equations, they were able to integrate the rotation of space-time into their calculations and calculate the amplitude of gravitational waves, whose existence was confirmed for the first time on February 12, 2016. [7]

Dark matter and dark energy are two of the greatest mysteries of the universe, still perplexing scientists worldwide. Solving these scientific conundrums may require a comprehensive approach in which theories, computations and ground-based observations are complemented by a fleet of spacecraft studying the dark universe. One of the space missions that could be essential to our understanding of these mysteries is European Space Agency's (ESA) Euclid probe, designed to unveil the secrets of dark energy and dark matter by accurately measuring the acceleration of the universe. [6]

This paper explains the Accelerating Universe, the Special and General Relativity from the observed effects of the accelerating electrons, causing naturally the experienced changes of the electric field potential along the moving electric charges. The accelerating electrons explain not only the Maxwell Equations and the Special Relativity, but the Heisenberg Uncertainty Relation, the wave particle duality and the electron's spin also, building the bridge between the Classical and Relativistic Quantum Theories.

The Big Bang caused acceleration created the radial currents of the matter and since the matter 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. 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.

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Team simulates the expansion of the Universe

The Universe is constantly expanding. It changes, creating new structures that merge. But how does our Universe evolve? Physicists at the University of Geneva (UNIGE), Switzerland, have developed a new code of numerical simulations that offers a glimpse of the complex process of the formation of structures in the Universe. Based on Einstein's equations, they were able to integrate the rotation of space-time into their calculations and calculate the amplitude of gravitational waves, whose existence was confirmed for the first time on February 12, 2016. The study is published in the journal Nature Physics.

Until now, scientists studied the formation of large-scale cosmological structures based numerical simulations of Newtonian gravitation. These codes postulate that space itself does not change, it is said to be static, while time goes on. The simulations that it allows are very precise if the matter in the Universe moves slowly (i.e., about 300 km per second). However, when the matter particles move at high speed, this code only allows approximate calculations. Furthermore, it does not describe the fluctuations of dark energy. Constituting 70% of the total energy of the Universe (the remaining 30% is made of dark matter and ordinary matter), it is responsible for the accelerated

expansion of the Universe. Therefore, it was necessary to find a new way to simulate the formation of cosmological structures and allow the study of these two phenomena.

The theory of general relativity applied

Ruth Durrer's team from the Department of Theoretical Physics in the Faculty of Science at UNIGE, has thus created a code, named gevolution, based on Einstein's Theory of general relativity. Indeed, general relativity considers space-time as being dynamical, that is to say that space and time are constantly changing, unlike the static space of Newtonian theory. The goal was to predict the amplitude and the impact of gravitational waves and frame-dragging (the rotation of space-time) induced by the formation of cosmological structures.

Self-regulating calculations

To do so, the physicists from UNIGE analysed a cubic portion in space, consisting of 60 billion zones with each containing a particle (that is to say, a portion of a galaxy), in order to study the way they move with respect to their neighbors. Thanks to the LATfield2 library (developed by David Daverio from UNIGE), which solves nonlinear partial differential equations, and the Supercomputer from the Swiss Supercomputer Center in Lugano, the researchers were able to study the motion of particles and calculate the metric (the measure of distances and time between two galaxies in the Universe) using Einstein's equations. The resulting spectra of these calculations allow to quantify the difference between the results obtained by gevolution and those coming from Newtonian codes. This allows to measure the effect of frame-dragging and gravitational waves introduced by the formation of structure in the Universe.

Gravitational waves and frame-dragging predicted by gevolution

Indeed, frame-dragging and gravitational waves have never been included in simulations until the creation of the gevolution code. This opens the way for the comparison of simulation results of the evolution of the Universe with observations. With their new code, the physicists at UNIGE will be able to test the theory of general relativity on much larger scales than at present. In order to open research to a maximum in this field, Professor Ruth Durrer and her team will make their gevolution code public. Perhaps soon light will be shed on the mysteries of dark energy. [7]

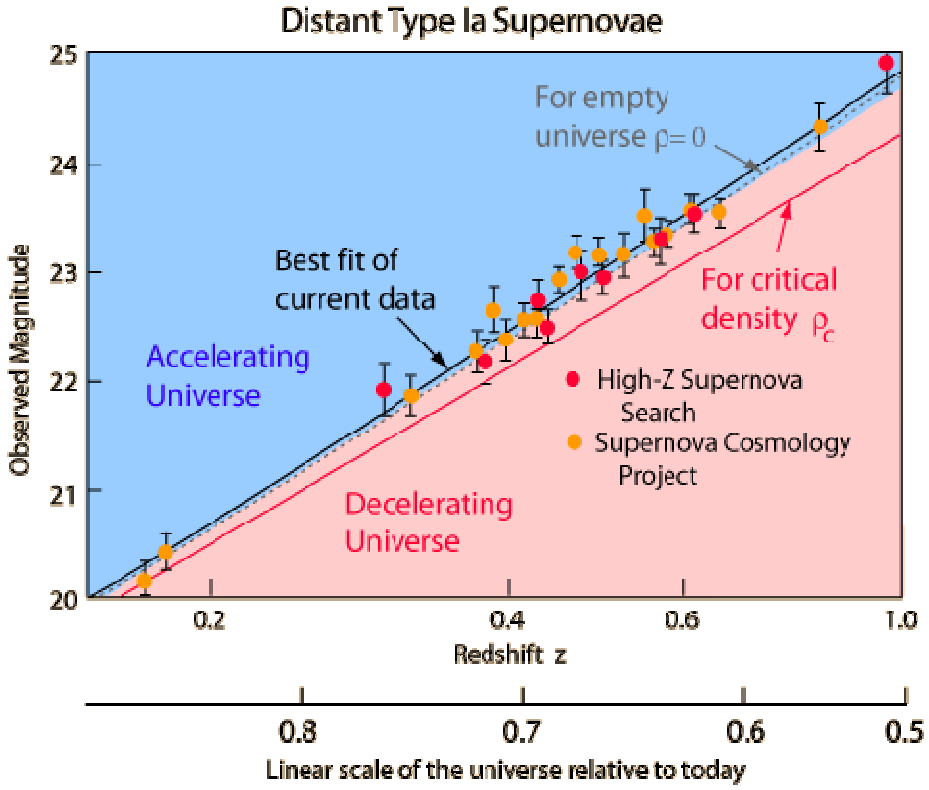
The Big Bang

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!?
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.

Evidence for an accelerating universe

One of the observational foundations for the big bang model of cosmology was the observed expansion of the universe. [4] 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: $\Lambda = 8\pi\rho_{\text{vac}}$, 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.

Measuring the acceleration of the universe with the Euclid spacecraft

Dark matter and dark energy are two of the greatest mysteries of the universe, still perplexing scientists worldwide. Solving these scientific conundrums may require a comprehensive approach in which theories, computations and ground-based observations are complemented by a fleet of spacecraft studying the dark universe.

One of the space missions that could be essential to our understanding of these mysteries is European Space Agency's (ESA) Euclid probe, designed to unveil the secrets of dark energy and dark matter by accurately measuring the acceleration of the universe.

"Euclid is designed primarily to help us understand the properties of dark energy. However, in doing so, it will utilize the exquisite precision only available to a space-based instrument to make measurements of dark matter over an unprecedented area of the sky. Thus, it will be a real

breakthrough in our understanding of both dark matter and dark energy," Ulf Israelsson, NASA Euclid project manager, told Astrowatch.net.

The spacecraft is currently in the construction phase after successfully passing its Preliminary Design Review in the Fall of 2015. It will be launched in 2020 on a Soyuz rocket from Europe's Spaceport in Kourou, French Guiana. After liftoff it will be sent into orbit around the sun-Earth L2 point located approximately 1.5 million km from our planet.

In order to help us understand dark matter and dark energy, Euclid will employ two primary scientific methods.

"The first is weak gravitational lensing, whereby the apparent shapes of background galaxies are distorted by foreground dark matter. The second is galaxy clustering, looking at the three-dimensional distribution of galaxies," Jason Rhodes, NASA Euclid Deputy Project Scientist and the U.S. Science Lead for Euclid, told SpaceFlight Insider.

The spacecraft will map the shapes, positions and movements of two billion galaxies, delivering astronomers a vast set of important data for further studies. It is expected to produce numerous deep images and spectra over at least half of the entire sky.

To achieve its ambitious scientific goals, Euclid will be equipped with two main instruments: the Visible Imaging Instrument (VIS) and the Near Infrared Spectrometer and Photometer (NISP). These large format cameras will be used to characterize the morphometric, photometric and spectroscopic properties of galaxies.

"Euclid will have two instruments. The first is the visible imaging instrument. It will use a single, very wide filter to perform photometry of visible light over a 15,000 square degree area on the sky. The second is the Near Infrared Spectrometer and Photometer. This instrument will use NASA-provided near infrared detectors to perform 3-band photometry in near infrared light over the same 15,000 square degrees as well as providing grism spectroscopy in the near infrared over the same area," Israelsson explained.

The mission, which will last six years, will survey the sky in 'step-and-stare' mode. In this mode the telescope points to a position on the sky and imaging and spectroscopic measurements are performed on an area of about 0.5 square degrees around this position. The wide survey will cover 15,000 square degrees of extragalactic sky and the deep survey is expected to cover approximately 40 square degrees, consisting of patches of at least 10 square degrees which are about two magnitudes deeper than the wide-survey.

NASA made important contributions to this mission including infrared detectors for one instrument and science and data analysis.

"NASA is providing near infrared detectors and associated electronics for the NISP instrument. NASA is also developing the Euclid NASA Science Center at IPAC [Infrared Processing and Analysis Center], a node in Euclid's distributed Science Ground Segment that will process the Euclid data. The third contribution is in support of about 70 US scientists who are part of the 1,300 member Euclid Consortium," Rhodes said. [6]

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 $E = h\nu$ and $E = mc^2$, $m = h\nu / c^2$ that is the m depends only on the ν 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 accelerating Universe fits into the accelerating charges of the electric currents, because the Bing Bang caused radial moving of the matter.

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.
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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