Understanding Cosmic Rays

In a new study researchers at the Swedish Institute of Space Physics have used measurements from NASA's MMS (Magnetospheric MultiScale) satellites to reveal that there are ripples, or surface waves, moving along the surface of shocks in space. Such ripples in shocks can affect how plasma is heated and are potential sites of particle acceleration. [9]

The universe is not spinning or stretched in any particular direction, according to the most stringent test yet. [8]

A discrepancy in the measurement of how quickly the universe is expanding has been found by researchers at the John Hopkins University in Baltimore, and released online. [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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Author: George Rajna

Ripples in space key to understanding cosmic rays

In a new study researchers at the Swedish Institute of Space Physics have used measurements from NASA's MMS (Magnetospheric MultiScale) satellites to reveal that there are ripples, or surface waves, moving along the surface of shocks in space. Such ripples in shocks can affect how plasma is heated and are potential sites of particle acceleration. These results have been published in the latest issue of Physical Review Letters.

Most visible matter in the Universe consists of ionized gas known as plasma. Shock waves in plasmas form around planets, stars and supernovas. Shocks in space plasma are efficient particle accelerators. Shocks in supernova explosions are thought to be the main source of cosmic rays – very high energy charged particles from space.

The details on how particles are accelerated and how plasma is heated at shocks in space plasmas are still unclear. The shock waves are usually considered planar surfaces but numerical simulations have previously showed that ripples can form on the surface of shock waves. The elusive ripples have been hard to study in space due to their small size and high speed.

A new study, by researchers at the Swedish Institute of Space Physics (IRF) in Uppsala, shows that these ripples do in fact exist in the Earth's bow shock. The study uses the newly launched MMS mission to study the shock in unprecedented detail.

"With the new MMS spacecraft we can, for the first time, resolve the structure of the bow shock at these small scales," says Andreas Johlander, PhD student at IRF, who led the study.

The results are of importance to the broader field of astrophysics where these ripples are thought to play an important role in accelerating particles to very high energies. The structure of the shock wave also determine how plasma is deflected and heated at shocks.

"These direct observations of shock ripples in a space plasma allow us to characterize the physical properties of the ripples. This brings us one step closer to understanding how shocks can produce cosmic rays," says Andreas Johlander. [9]

Scientists confirm the universe has no direction

The universe is not spinning or stretched in any particular direction, according to the most stringent test yet.

Looking out into the night sky, we see a clumpy universe: planets orbit stars in solar systems and stars are grouped into galaxies, which in turn form enormous galaxy clusters. But cosmologists assume this effect is only local: that if we look on sufficiently large scales, the universe is actually uniform.

The vast majority of calculations made about our universe start with this assumption: that the universe is broadly the same, whatever your position and in whichever direction you look.

If, however, the universe was stretching preferentially in one direction, or spinning about an axis in a similar way to the Earth rotating, this fundamental assumption, and all the calculations that hinge on it, would be wrong.

Now, scientists from University College London and Imperial College London have put this assumption through its most stringent test yet and found only a 1 in 121,000 chance that the universe is not the same in all directions.

Oldest light in the universe

To do this, they used maps of the cosmic microwave background (CMB) radiation: the oldest light in the universe created shortly after the Big Bang. The maps were produced using measurements of the CMB taken between 2009 and 2013 by the European Space Agency's Planck satellite, providing a picture of the intensity and, for the first time, polarisation (in essence, the orientation) of the CMB across the whole sky.

Previously, scientists had looked for patterns in the CMB map that might hint at a rotating universe. The new study considered the widest possible range of universes with preferred directions or spins and determined what patterns these would create in the CMB.

A universe spinning about an axis, for example, would create spiral patterns, whereas a universe expanding at different speeds along different axes would create elongated hot and cold spots.

Dr Stephen Feeney, from the Department of Physics at Imperial, worked with a team led by Daniela Saadeh at University College London to search for these patterns in the observed CMB. The results, published today in the journal Physical Review Letters, show that none were a match, and that the universe is most likely directionless.

Cosmology is safe

Dr Feeney said: "This work is important because it tests one of the fundamental assumptions on which almost all cosmological calculations are based: that the universe is the same in every direction. If this assumption is wrong, and our universe spins or stretches in one direction more than another, we'd have to rethink our basic picture of the universe.

"We have put this assumption to its most exacting examination yet, testing for a huge variety of spinning and stretching universes that have never been considered before. When we compare these predictions to the Planck satellite's latest measurements, we find overwhelming evidence that the universe is the same in all directions."

Lead author Daniela Saadeh from University College London added: "You can never rule it out completely, but we now calculate the odds that the universe prefers one direction over another at just 1 in 121,000. We're very glad that our work vindicates what most cosmologists assume. For now, cosmology is safe." [8]

The universe is expanding eight percent faster than our current laws of physics can explain, according to a new study by US physicists.

A discrepancy in the measurement of how quickly the universe is expanding has been found by researchers at the John Hopkins University in Baltimore, and released online.

If independent tests confirm this discrepancy, the laws of physics may have to be rewritten to reflect the latest development, Nature reports.

“I think that there is something in the standard cosmological model that we don't understand,” Adam Riess, astrophysicist, Nobel laureate and study leader, said.

The universe has been gradually expanding since the Big Bang. Under current models of cosmology, the gravitational pull of 'dark matter' slows the process down, while 'dark energy' on the other hand tugs in the opposite direction, accelerating the expansion.

Astrophysicists analyze the rate of expansion by measuring the Cosmic Microwave Background, known as CMB. However, Reiss and his team have drawn on an alternative to CMB involving 'standard candles'.

A 'standard candle' is the term for stars or supernovae with known levels of brightness. By measuring the luminosity of these objects, physicists can use them as markers to track how fast the universe is expanding away from us.

Reiss and his team studied standard candles in 18 galaxies using hundreds of hours of data from the Hubble Space Telescope, and calculated the universe's speed of expansion to be eight percent faster than previously thought.

This could mean that the universe is stretching more quickly towards its demise, Mother News Network suggests. However, it could also mean that the technique deployed is not as reliable as previous methods, as one University of Chicago astronomer told Nature.

Reiss and his team are currently waiting for their results - which have been submitted for peer review - to be confirmed or disproved. [7]

The Big Bang

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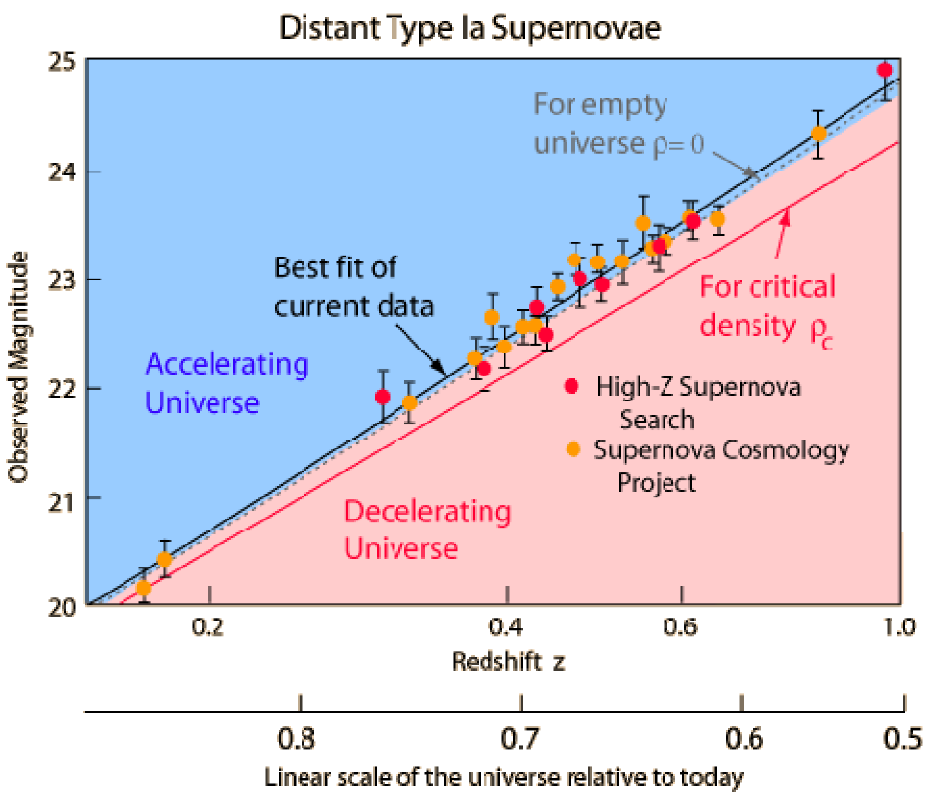
The positive and negative charged currents attracts each other or by the magnetic forces or by the much stronger electrostatic forces!?
The gravitational force attracting the matter, causing concentration of the matter in a small space and leaving much space with low matter concentration: dark matter 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: $\Lambda = 8\pi\rho_{vac}$, 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 $E = hv$ 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

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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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