Neutrino Detectable Supernova Explosion

A team of researchers at North Carolina State University has found that current and future neutrino detectors placed around the world should be capable of detecting neutrinos emitted from a relatively close supernova. [8]

As a massive star dies, expelling most of its guts across the universe in a supernova explosion, its iron heart, the star's core, collapses to create the densest form of observable matter in the universe: a neutron star. [7]

NASA's Chandra X-ray Observatory has discovered the first direct evidence for a superfluid, a bizarre, friction-free state of matter, at the core of a neutron star. Superfluids created in laboratories on Earth exhibit remarkable properties, such as the ability to climb upward and escape airtight containers. The finding has important implications for understanding nuclear interactions in matter at the highest known densities. [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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Calculations show close Ia supernova should be neutrino detectable offering possibility of identifying explosion type

A team of researchers at North Carolina State University has found that current and future neutrino detectors placed around the world should be capable of detecting neutrinos emitted from a relatively close supernova. They also suggest that measuring such neutrinos would allow them to explain what goes on inside of a star during such an explosion—if the measurements match one of two models that the team has built to describe the inner workings of a supernova.

Supernovae have been classified into different types depending on what causes them to occur—one type, called a la supernova, occurs when a white dwarf pulls in enough material from a companion, eventually triggering carbon fusion, which leads to a massive explosion. Researchers here on Earth can see evidence of a supernova by the light that is emitted. But astrophysicists would really like to know more about the companion and the actual process that occurs inside the white dwarf leading up to the explosion—and they believe that might be possible by studying the neutrinos that are emitted.

In this new effort, a team led by Warren Wright calculated that neutrinos from a relatively nearby supernova should be detectable by current sensors already installed and working around the planet and by those that are in the works. Wright also headed two teams that have each written a paper describing one of two types of models that the team has built to describe the process that occurs in the white dwarf leading up to the explosion—both teams have published their work in the journal Physical Review Letters.

The first model is called the deflagration-to-detonation transition; the second, the gravitationally confined detonation. Both are based on theory regarding interactions inside of the star and differ mostly in how spherically symmetric they are. The two types would also emit different kinds and amounts of neutrinos, which is why the team is hoping that the detectors capable of measuring them will begin to do so. That would allow the teams to compare their models against real measurable data, and in so doing, perhaps finally offer some real evidence of what occurs when stars explode. [8]

Five extreme facts about neutron stars

As a massive star dies, expelling most of its guts across the universe in a supernova explosion, its iron heart, the star's core, collapses to create the densest form of observable matter in the universe: a neutron star.

A neutron star is basically a giant nucleus, says Mark Alford, a professor at Washington University.

"Imagine a little lead pellet with cotton candy around it," Alford says. "That's an atom. All the of mass is in the little lead pellet in the middle, and there's this big puffy cloud of electrons around it like cotton candy."

In neutron stars, the atoms have all collapsed. The electron clouds have all been sucked in, and the whole thing becomes a single entity with electrons running around side-by-side with protons and neutrons in a gas or fluid.

Neutron stars are pretty small, as far as stellar objects go. Although scientists are still working on pinning down their exact diameter, they estimate that they're somewhere around 12 to 17 miles across, just about the length of Manhattan. Despite that, they have about 1.5 times the mass of our sun.

If a neutron star were any denser, it would collapse into a black hole and disappear, Alford says. "It's the next to last stop on the line."

These extreme objects offer intriguing test cases that could help physicists understand the fundamental forces, general relativity and the early universe. Here are some fascinating facts to get you acquainted:

1. In just the first few seconds after a star begins its transformation into a neutron star, the energy leaving in neutrinos is equal to the total amount of light emitted by all of the stars in the observable universe.

Ordinary matter contains roughly equal numbers of protons and neutrons. But most of the protons in a neutron star convert into neutrons—neutron stars are made up of about 95 percent neutrons. When protons convert to neutrons, they release ubiquitous particles called neutrinos.

Neutron stars are made in supernova explosions which are giant neutrino factories. A supernova radiates 10 times more neutrinos than there are particles, protons, neutrons and electrons in the sun.

2. It's been speculated that if there were life on neutron stars, it would be two-dimensional.

Neutron stars have some of the strongest gravitational and magnetic fields in the universe. The gravity is strong enough to flatten almost anything on the surface. The magnetic fields of neutron stars can be a billion times to a million billion times the magnetic field on the surface of Earth.

"Everything about neutron stars is extreme," says James Lattimer, a professor at Stony Brook University. "It goes to the point of almost being ridiculous."

Because they're so dense, neutron stars provide the perfect testbed for the strong force, allowing scientists to probe the way quarks and gluons interact under these conditions. Many theories predict that the core of a neutron star compresses neutrons and protons, liberating the quarks of which they are constructed. Scientists have created a hotter version of this freed "quark matter" in the Relativistic Heavy Ion Collider and the Large Hadron Collider.

The intense gravity of neutron stars requires scientists to use the general theory of relativity to describe the physical properties of neutron stars. In fact, measurements of neutron stars give us some of the most precise tests of general relativity that we currently have.

Despite their incredible densities and extreme gravity, neutron stars still manage to maintain a surprising amount of internal structure, housing crusts, oceans and atmospheres. "They're a weird mixture of something the mass of a star with some of the other properties of a planet," says Chuck Horowitz, a professor at Indiana University.

But while here on Earth we're used to having an atmosphere that extends hundreds of miles into the sky, because a neutron star's gravity is so extreme, its atmosphere may stretch up less than a foot.

3. The fastest known spinning neutron star rotates about 700 times each second.

Scientists believe that most neutron stars either currently are or at one point have been pulsars, stars that spit out beams of radio waves as they rapidly spin. If a pulsar is pointed toward our planet, we see these beams sweep across Earth like light from a lighthouse.

Scientists first observed neutron stars in 1967, when a graduate student named Jocelyn Bell noticed repeated radio pulses arriving from a pulsar outside our solar system. (The 1974 Nobel Prize in Physics went to her thesis advisor, Anthony Hewish, for the discovery.)

Pulsars can spin anywhere from tens to hundreds of times per second. If you were standing on the equator of the fastest known pulsar, the rotational velocity would be about 1/10 the speed of light.

The 1993 Nobel Prize in Physics went to scientists who measured the rate at which a pair of neutron stars orbiting each other were spiraling together due to the emission of gravitational radiation, a phenomenon predicted by Albert Einstein's general theory of relativity.

Scientists from the Laser Interferometer Gravitational-Wave Observatory, or LIGO, announced in 2016 that they had directly detected gravitational waves for the first time. In the future, it might be possible to use pulsars as giant, scaled-up versions of the LIGO experiment, trying to detect the small changes in the distance between the pulsars and Earth as a gravitational wave passes by.

4. The wrong kind of neutron star could wreak havoc on Earth.

Neutron stars can be dangerous because of their strong fields. If a neutron star entered our solar system, it could cause chaos, throwing off the orbits of the planets and, if it got close enough, even raising tides that would rip the planet apart.

But the closest known neutron star is about 500 light-years away. And considering Proxima Centauri, the closest star to Earth at a little over 4 light-years away, has no bearing on our planet, it's unlikely we'll feel these catastrophic effects anytime soon.

Probably even more dangerous would be radiation from a neutron star's magnetic field. Magnetars are neutron stars with magnetic fields a thousand times stronger than the extremely strong fields of "normal" pulsars. Sudden rearrangements of these fields can produce flares somewhat like solar flares but much more powerful.

On December 27, 2004, scientists observed a giant gamma-ray flare from Magnetar SGR 1806-20, estimated to be about 50,000 light years away. In 0.2 seconds the flare radiated as much energy as the sun produces in 300,000 years. The flare saturated many spacecraft detectors and produced detectable disturbances in the Earth's ionosphere.

Fortunately, we are not aware of any nearby magnetars powerful enough to cause any damage.

5. Despite the extremes of neutron stars, researchers still have ways to study them.

There are many things we don't know about neutron stars—including just how many of them are out there, Horowitz says. "We know of about 2000 neutron stars in our own galaxy, but we expect there to be billions more. So most neutron stars, even in our own galaxy, are completely unknown."

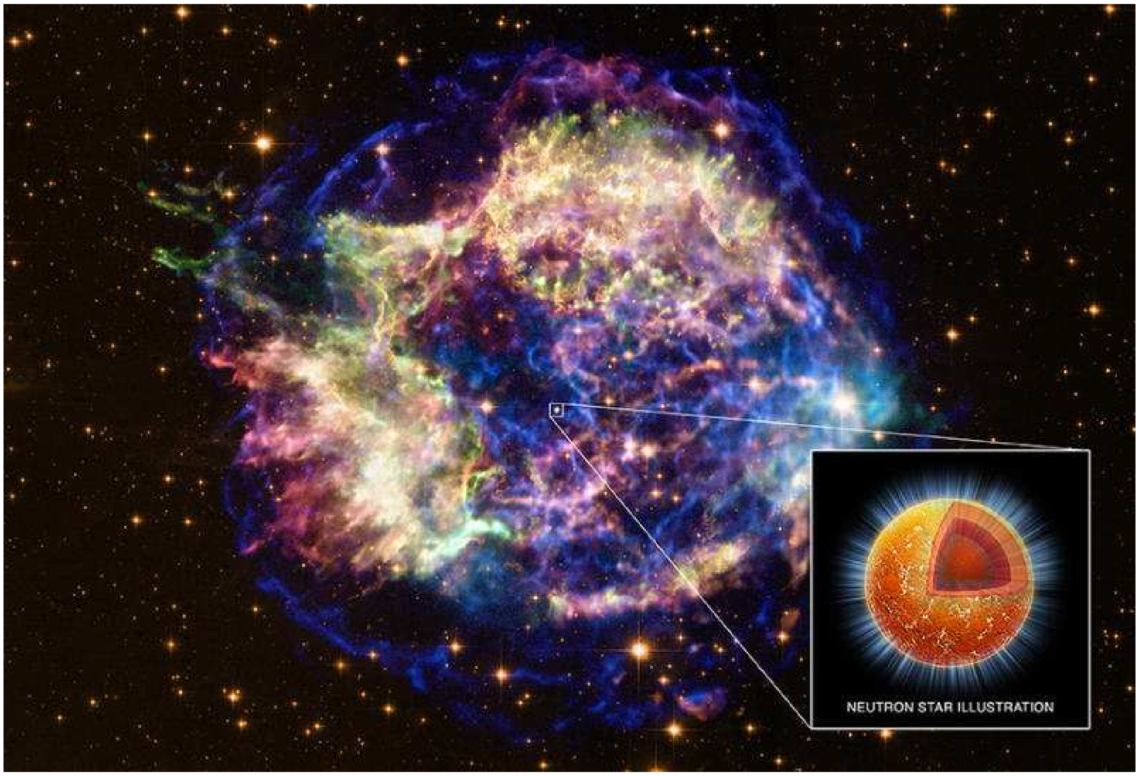
Many radio, X-ray and optical light telescopes are used to investigate the properties of neutron stars. NASA's upcoming Neutron Star Interior Composition ExploreR Mission (NICER), which is scheduled to attach to the side of the International Space Station in 2017, is one mission devoted to learning more about these extreme objects. NICER will look at X-rays coming from rotating neutron stars to try to more accurately pin down their mass and radii.

We could also study neutron stars by detecting gravitational waves. LIGO scientists hope to detect gravitational waves produced by the merger of two neutron stars. Studying those gravitational waves might clue scientists in to the properties of the extremely dense matter that neutron stars are made of.

Studying neutron stars might help us figure out the origin of the heavy chemical elements, including gold and platinum, in our universe. There's a possibility that when neutron stars collide, not everything gets swallowed up into a more massive neutron star or black hole, but instead some fraction gets flung out and forms these heavy nuclei.

"If you want to use the lab of 24th or 25th century," says Roger Romani, a professor at Stanford University, "then studying neutron stars is a way of looking at conditions that we cannot produce in labs on Earth." [7]

Bizarre friction-free 'superfluid' found in neutron star's core



This composite image shows a beautiful X-ray and optical view of Cassiopeia A (Cas A), a supernova remnant located in our Galaxy about 11,000 light years away.
These are the remains of a massive star that exploded about 330 years ago, as measured in Earth's time frame. X-rays from Chandra are shown in red, green and blue along with optical data from Hubble in gold. At the center of the image is a neutron star, an ultra-dense star created by the supernova. The inset shows an artist's impression of the neutron star at the center of Cas A. The different colored layers in the cutout region show the crust (orange), the core (red), where densities are much higher, and the part of the core where the neutrons are thought to be in a superfluid state (inner red ball). The blue rays emanating from the center of the star represent the copious numbers of neutrinos -- nearly massless, weakly interacting particles -- that are created as the core temperature falls below a critical level and a neutron superfluid is formed, a process that began about 100 years ago as observed from Earth. These neutrinos escape from the star, taking energy with them and causing the star to cool much more rapidly.

Neutron stars contain the densest known matter that is directly observable. One teaspoon of neutron star material weighs six billion tons. The pressure in the star's core is so high that most of the charged particles, electrons and protons, merge resulting in a star composed mostly of uncharged particles called neutrons.

Two independent research teams studied the supernova remnant Cassiopeia A, or Cas A for short, the remains of a massive star 11,000 light years away that would have appeared to explode about 330 years ago as observed from Earth. Chandra data found a rapid decline in the temperature of the ultra-dense neutron star that remained after the supernova, showing that it had cooled by about four percent over a 10-year period.

"This drop in temperature, although it sounds small, was really dramatic and surprising to see," said Dany Page of the National Autonomous University in Mexico, leader of a team with a paper published in the February 25, 2011 issue of the journal Physical Review Letters. "This means that something unusual is happening within this neutron star."

Superfluids containing charged particles are also superconductors, meaning they act as perfect electrical conductors and never lose energy. The new results strongly suggest that the remaining protons in the star's core are in a superfluid state and, because they carry a charge, also form a superconductor.

"The rapid cooling in Cas A's neutron star, seen with Chandra, is the first direct evidence that the cores of these neutron stars are, in fact, made of superfluid and superconducting material," said Peter Shternin of the Ioffe Institute in St Petersburg, Russia, leader of a team with a paper accepted in the journal Monthly Notices of the Royal Astronomical Society.

Both teams show that this rapid cooling is explained by the formation of a neutron superfluid in the core of the neutron star within about the last 100 years as seen from Earth. The rapid cooling is expected to continue for a few decades and then it should slow down.

"It turns out that Cas A may be a gift from the Universe because we would have to catch a very young neutron star at just the right point in time," said Page's co-author Madappa Prakash, from Ohio University. "Sometimes a little good fortune can go a long way in science."

The onset of superfluidity in materials on Earth occurs at extremely low temperatures near absolute zero, but in neutron stars, it can occur at temperatures near a billion degrees Celsius. Until now there was a very large uncertainty in estimates of this critical temperature. This new research constrains the critical temperature to between one half a billion to just under a billion degrees.

Cas A will allow researchers to test models of how the strong nuclear force, which binds subatomic particles, behaves in ultradense matter. These results are also important for understanding a range of behavior in neutron stars, including "glitches," neutron star precession and pulsation, magnetar outbursts and the evolution of neutron star magnetic fields.

Small sudden changes in the spin rate of rotating neutron stars, called glitches, have previously given evidence for superfluid neutrons in the crust of a neutron star, where densities are much lower than seen in the core of the star. This latest news from Cas A unveils new information about the ultra-dense inner region of the neutron star. [6]

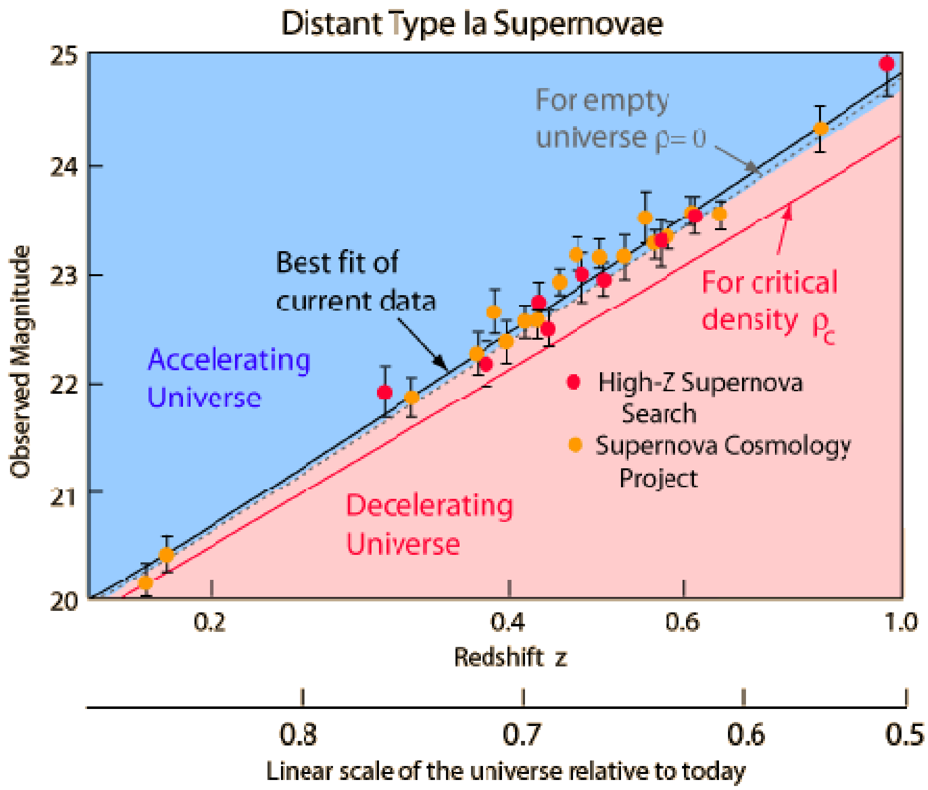
The Big Bang

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.

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 $\boldsymbol{E = h\nu}$ and $\boldsymbol{E = mc^2}$, $\boldsymbol{m = h\nu / c^2}$ that is the $\boldsymbol{m}$ depends only on the $\boldsymbol{\nu}$ 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 $\boldsymbol{m_o}$ 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

"Previously we had no idea how extended superconductivity of protons was in a neutron star," said Shternin's co-author Dmitry Yakovlev, also from the Ioffe Institute. The cooling in the Cas A neutron star was first discovered by co-author Craig Heinke, from the University of Alberta, Canada, and Wynn Ho from the University of Southampton, UK, in 2010. It was the first time that astronomers have measured the rate of cooling of a young neutron star. [6]

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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