Supermassive Black Holes Galaxies Merge

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A simulation of the powerful jets generated by supermassive black holes at the centers of the largest galaxies explains why some burst forth as bright beacons visible across the universe, while others fall apart and never pierce the halo of the galaxy. [15]

Astronomers from Chalmers University of Technology have used the giant telescope Alma to reveal an extremely powerful magnetic field very close to a supermassive black hole in a distant galaxy. The results appear in the 17 April 2015 issue of the journal Science. [14]

Quasars, even those that are billions of light years away, are some of the "brightest beacons" in the universe. Yet how can quasars radiate so much energy that they can be seen from Earth? One explanation is that at each quasar's center is a growing supermassive black hole (SMBH). [13]

If dark matter comes in both matter and antimatter varieties, it might accumulate inside dense stars to create black holes. [12]

For a long time, there were two main theories related to how our universe would end. These were the Big Freeze and the Big Crunch. In short, the Big Crunch claimed that the universe would eventually stop expanding and collapse in on itself. This collapse would result in…well…a big crunch (for lack of a better term). Think "the Big Bang", except just the opposite. That's essentially what the Big Crunch is. On the other hand, the Big Freeze claimed that the universe would continue expanding forever, until the cosmos becomes a frozen wasteland. This theory asserts that stars will get farther and farther apart, burn out, and (since there are no more stars bring born) the universe will grown entirely cold and eternally black. [11]

Newly published research reveals that dark matter is being swallowed up by dark energy, offering novel insight into the nature of dark matter and dark energy and what the future of our Universe might be. [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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Author: George Rajna

What role do supermassive black holes play when galaxies merge?

In roughly four billion years, the Milky Way will be no more.

Indeed, our home galaxy is on course to collide and unite with the Andromeda Galaxy, at present some two million light years away.

Of course, we don't notice that the two galaxies are drawing closer together.

"To the human perspective, our galaxy doesn't appear to be changing," says University of Iowa astrophysicist Hai Fu, "but in the history of the universe, it is changing all the time."

Galaxies have been merging for most of the universe's 13-billion-year history, and scientists have been observing these mergers for some time. What they don't fully understand is how mergers occur.

Fu, an assistant professor in physics and astronomy, aims to clarify the phenomenon by observing supermassive black holes (with a mass of about one billion suns), which are at the center of most galaxies. Astrophysicists believe large galaxies grow by devouring smaller ones. In such cases, the black holes of both are expected to orbit each other and eventually merge. Fu and his team won a three-year, $405,011 grant from the National Science Foundation to find and characterize these celestial events.

"What we're trying to see is the late stages of merging galaxies, when two galaxies are so close together they unleash tidal forces of energy, kind of like the pulsing tidal forces caused when the sun and moon line up with the Earth but much, much more intense," he says.

Fu will scan a large chunk of the night sky—imagine the moon multiplied 1,200 across the sky and you'll have a sense of the size—to find evidence of black holes' accretion, or mass-gathering.

"Pairs of galaxies with accreting black holes are rare and difficult to find," Fu says, "and that's why we need such a large area to survey."

Black holes aren't always accreting. But those that are resemble someone on an eating binge. Accreting black holes hungrily absorb material around them. Slowly, as they munch on more and more cosmic food, they pull their host galaxies closer together.

"They're no longer on a diet," Fu says.

All that eating unleashes a torrent of energy, intense bursts of light called quasars that are so bright they nearly obscure the galaxies themselves. Those quasars should be easy to observe, even at great distances, but most of the light they produce is actually extinguished by the dust brewed up in the merging activity.

Thankfully, supermassive black holes also emit radio waves, and those emissions "come to the rescue because they don't get extinguished by the dust," Fu says.

Fu and his team will examine radio-emission maps captured by the Very Large Array, one of the world's premier astronomical radio observatories, located in New Mexico and operated by the National Radio Astronomy Observatory, an NSF facility. The group will confirm its findings through optical observations at the W.M. Keck Observatory, located on Mauna Kea, a dormant volcano in Hawaii.

The NSF grant also will fund the student-led building of an "augmented reality sandbox" to demonstrate gravity's influence in the universe, such as on the orbits of planets, the accretion disk around a black hole or neutron star, and the complex orbits of stars in elliptically shaped galaxies.

Nine undergraduates have so far been involved in the project; they divided into teams to write the software programming, build the sandbox (with actual sand), and create an app for Android tablets.

The sandbox will be used in astronomy classes, physics demonstrations for K-12 students in the greater Iowa City area, and exhibitions at the UI Museum of Natural History and the UI Mobile Museum.

The sandbox is expected to be complete by the end of the spring 2017 semester.

"It is quite impressive," Fu says. "The students may not necessarily like taking exams, but they work really well in teams." [16]

Astronomers explain mystery of magnetically powered jets produced by supermassive black holes

A simulation of the powerful jets generated by supermassive black holes at the centers of the largest galaxies explains why some burst forth as bright beacons visible across the universe, while others fall apart and never pierce the halo of the galaxy.

About 10 percent of all galaxies with active nuclei - all presumed to have supermassive black holes within the central bulge - are observed to have jets of gas spurting in opposite directions from the core. The hot ionized gas is propelled by the twisting magnetic fields of the rotating black hole, which can be as large as several billion suns.

A 40-year-old puzzle was why some jets are hefty and punch out of the galaxy into intergalactic space, while others are narrow and often fizzle out before reaching the edge of the galaxy. The answer could shed light on how galaxies and their central black holes evolve, since aborted jets are thought to roil the galaxy and slow star formation, while also slowing the infall of gas that has been feeding the voracious black hole. The model could also help astronomers understand other types of jets, such as those produced by individual stars, which we see as gamma-ray bursts or pulsars.

"Whereas it was rather easy to reproduce the stable jets in simulations, it turned out to be an extreme challenge to explain what causes the jets to fall apart," said University of California, Berkeley theoretical astrophysicist Alexander Tchekhovskoy, a NASA Einstein postdoctoral fellow, who led the project. "To explain why some jets are unstable, researchers had to resort to explanations such as red giant stars in the jets' path loading the jets with too much gas and making them heavy and unstable so that the jets fall apart."

By taking into account the magnetic fields that generate these jets, Tchekhovskoy and colleague Omer Bromberg, a former Lyman Spitzer Jr. postdoctoral fellow at Princeton University, discovered that magnetic instabilities in the jet determine their fate. If the jet is not powerful enough to penetrate the surrounding gas, the jet becomes narrow or collimated, a shape prone to kinking and breaking. When this happens, the hot ionized gas funneled through the magnetic field spews into the galaxy, inflating a hot bubble of gas that generally heats up the galaxy.

Powerful jets, however, are broader and able to punch through the surrounding gas into the intergalactic medium. The determining factors are the power of the jet and how quickly the gas density drops off with distance, typically dependent on the mass and radius of the galaxy core.

The simulation, which agrees well with observations, explains what has become known as the Fanaroff-Riley morphological dichotomy of jets, first pointed out by Bernie Fanaroff of South Africa and Julia Riley of the U.K. in 1974.

"We have shown that a jet can fall apart without any external perturbation, just because of the physics of the jet," Tchekhovskoy said. He and Bromberg, who is currently at the Hebrew University of Jerusalem in Israel, will publish their simulations on June 17 in the journal Monthly Notices of the Royal Astronomical Society, a publication of Oxford University Press.

The supermassive black hole in the bulging center of these massive galaxies is like a pitted olive spinning around an axle through the hole, Tchekhovskoy said. If you thread a strand of spaghetti through the hole, representing a magnetic field, then the spinning olive will coil the spaghetti like a spring. The spinning, coiled magnetic fields act like a flexible drill trying to penetrate the surrounding gas.

The simulation, based solely on magnetic field interactions with ionized gas particles, shows that if the jet is not powerful enough to punch a hole through the surrounding gas, the magnetic drill bends and, due to the magnetic kink instability, breaks. An example of this type of jet can be seen in the galaxy M87, one of the closest such jets to Earth at a distance of about 50 million light-years, and has a central black hole equal to about 6 billion suns.

"If I were to jump on top of a jet and fly with it, I would see the jet start to wiggle around because of a kink instability in the magnetic field," Tchekhovskoy said."If this wiggling grows faster than it takes the gas to reach the tip, then the jet will fall apart. If the instability grows slower than it takes for gas to go from the base to the tip of the jet, then the jet will stay stable."

The jet in the galaxy Cygnus A, located about 600 million light-years from Earth, is an example of powerful jets punching through into intergalactic space.

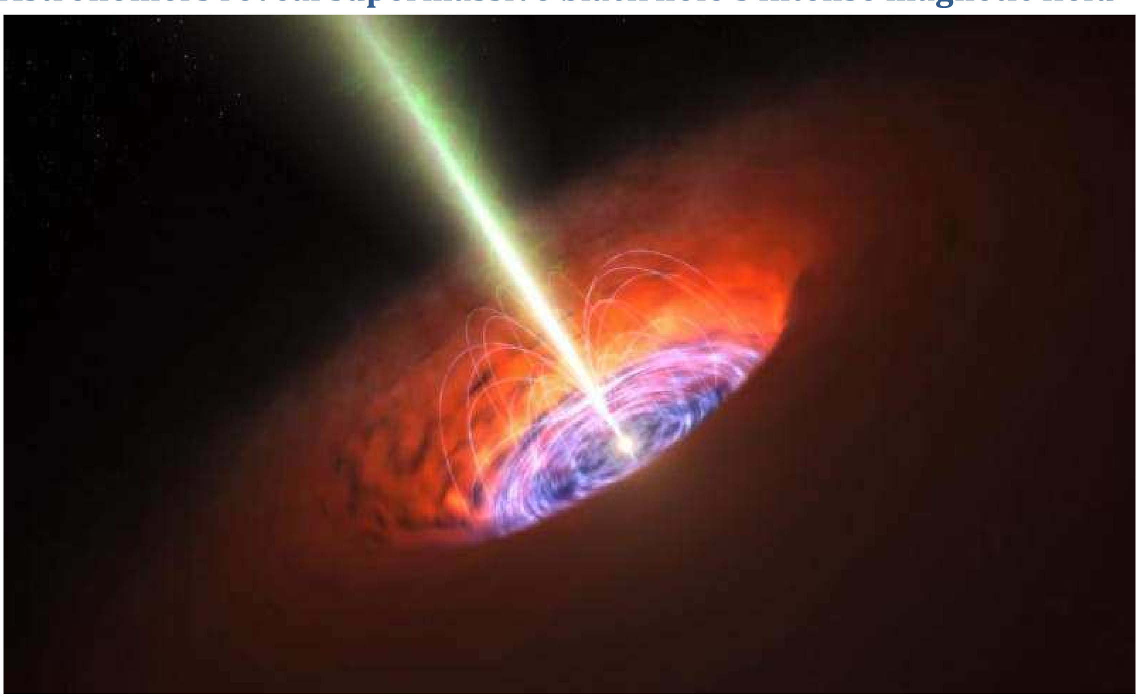
Tchekhovskoy argues that the unstable jets contribute to what is called black hole feedback, that is, a reaction from the material around the black hole that tends to slow its intake of gas and thus its growth. Unstable jets deposit a lot of energy within the galaxy that heats up the gas and prevents it from falling into the black hole. Jets and other processes effectively keep the sizes of supermassive black holes below about 10 billion solar masses, though UC Berkeley astronomers recently found black holes with masses near 21 billion solar masses.

Presumably these jets start and stop, lasting perhaps 10-100 million years, as suggested by images of some galaxies showing more than one jet, one of them old and tattered. Evidently, black holes go through binging cycles, interrupted in part by the occasional unstable jet that essentialy takes away their food.

The simulations were run on the Savio computer at UC Berkeley, Darter at the National Institute for Computational Sciences at the University of Tennesee, Knoxville, and Stampede, Maverick and Ranch computers at the Texas Advanced Computing Center at the University of Texas at Austin. The entire simulation took about 500 hours on 2,000 computer cores, the equivalent of 1 million hours on a standard laptop.

The researchers are improving their simulation to incorporate the smaller effects of gravity, buoyancy and the thermal pressure of the interstellar and intergalactic media. [15]

Astronomers reveal supermassive black hole's intense magnetic field



This artist's impression shows the surroundings of a supermassive black hole, typical of that found at the heart of many galaxies. The black hole itself is surrounded by a brilliant accretion disc of very hot, infalling material and, further out, a dusty torus. There are also often high-speed jets of material ejected at the black hole's poles that can extend huge distances into space.

A team of five astronomers from Chalmers University of Technology have revealed an extremely powerful magnetic field, beyond anything previously detected in the core of a galaxy, very close to the event horizon of a supermassive black hole. This new observation helps astronomers to understand the structure and formation of these massive inhabitants of the centers of galaxies, and the twin high-speed jets of plasma they frequently eject from their poles.

Up to now only weak magnetic fields far from black holes—several light-years away—had been probed. In this study, however, astronomers from Chalmers University of Technology and Onsala Space Observatory in Sweden have now used Alma to detect signals directly related to a strong magnetic field very close to the event horizon of the supermassive black hole in a distant galaxy named PKS 1830-211. This magnetic field is located precisely at the place where matter is suddenly boosted away from the black hole in the form of a jet.

The team measured the strength of the magnetic field by studying the way in which light was polarized, as it moved away from the black hole.

"Polarization is an important property of light and is much used in daily life, for example in sun glasses or 3D glasses at the cinema," says Ivan Marti-Vidal, lead author of this work.

"When produced naturally, polarization can be used to measure magnetic fields, since light changes its polarization when it travels through a magnetized medium.
In this case, the light that we detected with Alma had been travelling through material very close to the black hole, a place full of highly magnetized plasma."

The astronomers applied a new analysis technique that they had developed to the Alma data and found that the direction of polarization of the radiation coming from the centre of PKS 1830-211 had rotated.

Magnetic fields introduce Faraday rotation, which makes the polarization rotate in different ways at different wavelengths. The way in which this rotation depends on the wavelength tells us about the magnetic field in the region.

The Alma observations were at an effective wavelength of about 0.3 millimeters, the shortest wavelengths ever used in this kind of study. This allows the regions very close to the central black hole to be probed. Earlier investigations were at much longer radio wavelengths. Only light of millimeter wavelengths can escape from the region very close to the black hole; longer wavelength radiation is absorbed.

"We have found clear signals of polarization rotation that are hundreds of times higher than the highest ever found in the Universe," says Sebastien Muller, co-author of the paper. "Our discovery is a giant leap in terms of observing frequency, thanks to the use of Alma, and in terms of distance to the black hole where the magnetic field has been probed—of the order of only a few light-days from the event horizon. These results, and future studies, will help us understand what is really going on in the immediate vicinity of supermassive black holes." [14]

Black Holes in the Early Universe

Quasars, even those that are billions of light years away, are some of the “brightest beacons” in the universe. Yet how can quasars radiate so much energy that they can be seen from Earth? One explanation is that at each quasar’s center is a growing supermassive black hole (SMBH).

An artist’s rendition of accretion lines from a black hole’s accretion disk, courtesy of WikiCommons

Black holes feed from accretion disks: disks of matter formed by particles that collect around the singularity. But what observable evidence do we have for this?
“During the process of falling in, [particulate matter] is heated to temperatures of 107 to 108 Kelvin,” says Priyamvada Natarajan, Professor of Astronomy and Physics at Yale. “Some fraction of the rest mass energy of [this matter] gets converted into radiation.” This hyper-efficient energy transformation is empirically understood in Einstein’s famous equation: E=mc2. This radiation is observed as electromagnetic waves between visible light and X-rays, and it allows scientists to infer the presence of SMBHs as highly luminous quasars.

Using the quasar’s luminosity, astrophysicists can accurately determine a black hole’s mass. Some quasars are so bright that they indicate that their powering black holes are almost a billion times larger than the sun. But, despite their intimidating masses, black holes actually have a limit on their growth. Black holes reach a “sweet spot”—an intricate balance between the pull of gravity on particles and the push of the disk’s radiation. This limit, known as the Eddington limit, places an upper bound on how big black holes can get in a certain period of time. But within five hundred million years (a relatively short time) of the big bang, SMBHs have been observed with masses surpassing this limit.

Tal Alexander, an astrophysicist at the Weizmann Institute of Science in Rehovot, Israel, and Priyamvada Natarajan recently published research in Science to provide a different mechanism for black hole growth—one that accounts for super-Eddington accretion, therefore explaining the existence of SMBHs. One of the Eddington limit’s constraints is that only the black hole’s gravity is significant. In the early universe, the first structures to form were likely extremely gas-rich star clusters. In such an environment, light black hole 'seeds' (one to ten solar masses) can zigzag through dense cold gas, pulled by the more massive stars' gravity. As they random walk through the gas rich star, cluster black hole 'seeds' subsonically sweep up gas preventing the formation of an accretion disk. In this new configuration, the black hole takes in matter akin to a wind—accreting more mass faster than by having an accretion disk. After their calculations, Alexander and Natarajan found that the accretion rate for this geometry is super-Eddington.

This mechanism explains how the first quasars were formed. Not only does it offer a new black hole accretion model, but it also challenges previous accretion models. Most importantly, however, the mechanism provides an explanation for the SMBHs seen in the early universe. [13]

Dark Matter Black Holes Could Be Destroying Stars at the Milky Way's Center

If dark matter comes in both matter and antimatter varieties, it might accumulate inside dense stars to create black holes Dark matter may have turned spinning stars into black holes near the center of our galaxy, researchers say. There, scientists expected to see plenty of the dense, rotating stars called pulsars, which are fairly common throughout the Milky Way. Despite numerous searches, however, only one has been found, giving rise to the so-called "missing pulsar problem." A possible explanation, according to a new study, is that dark matter has built up inside these stars, causing the pulsars to collapse into black holes. (These black holes would be smaller than the supermassive black hole that is thought to lurk at the very heart of the galaxy.)

The universe appears to be teeming with invisible dark matter, which can neither be seen nor touched, but nonetheless exerts a gravitational pull on regular matter.
Scientists have several ideas for what dark matter might be made of, but none have been proved. A leading option suggests that dark matter is composed of particles called weakly interacting massive particles (WIMPs), which are traditionally thought to be both matter and antimatter in one. The nature of antimatter is important for the story. When matter and antimatter meet they destroy one another in powerful explosions—so when two regular WIMPs collide, they would annihilate one another.

But it is also possible that dark matter comes in two varieties—matter and antimatter versions, just like regular matter. If this idea—called asymmetric dark matter—is true, then two dark matter particles would not destroy one another nor would two dark antimatter particles, but if one of each type met, the two would explode. In this scenario both types of dark matter should have been created in abundance during the big bang (just as both regular matter and regular antimatter are thought to have been created) but most of these particles would have destroyed one another, and those that that remain now would be just the small excess of one type that managed to avoid being annihilated.

If dark matter is asymmetric, it would behave differently from the vanilla version of WIMPs. For example, the dense centers of stars should gravitationally attract nearby dark matter. If dark matter is made of regular WIMPS, when two WIMPs meet at the center of a star they would destroy one another, because they are their own antimatter counterparts. But in the asymmetric dark matter picture, all the existing dark matter left today is made of just one of its two types—either matter or antimatter. If two of these like particles met, they would not annihilate, so dark matter would simply build up over time inside the star. Eventually, the star's core would become too heavy to support itself, thereby collapsing into a black hole. This is what may have happened to the pulsars at the Milky Way's center, according to a study published November 3 in Physical Review Letters.

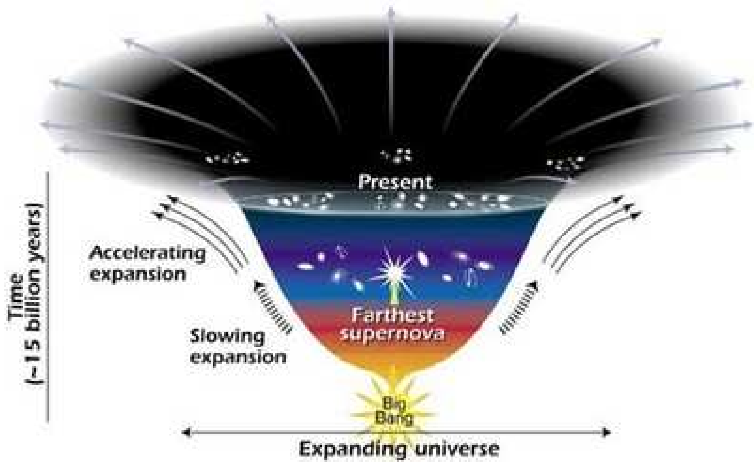
The scenario is plausible, says Raymond Volkas, a physicist at the University of Melbourne who was not involved in the study, but the missing pulsar problem might easily turn out to have a mundane explanation through known stellar effects. "It would, of course, be exciting to have dramatic direct astrophysical evidence for asymmetric dark matter," Volkas says. "Before believing an asymmetric dark matter explanation, I would want to be convinced that no standard explanation is actually viable."

The authors of the study, Joseph Bramante of the University of Notre Dame and Tim Linden of the Kavli Institute for Cosmological Physics at the University of Chicago, agree that it is too early to jump to a dark matter conclusion. For example, Linden says, maybe radio observations of the galactic center are not as thorough as scientists have assumed and the missing pulsars will show up with better searches. It is also possible some quirk of star formation has limited the number of pulsars that formed at the galactic center.

The reason nearby pulsars would not be as affected by asymmetric dark matter is that dark matter, of any kind, should be densest at the cores of galaxies, where it should congregate under the force of its own gravity. And even there it should take dark matter a very long time to accumulate enough to destroy a pulsar because most dark particles pass right through stars without interacting. Only on the rare occasions when one flies extremely close to a regular particle can it collide, and then it will be caught there. In normal stars the regular particles at the cores are not dense enough to catch many dark matter ones. But in superdense pulsars they might accumulate enough to do damage. "Dark matter can't collect as densely or as quickly at the center of regular stars," Bramante says, "but in pulsars the dark matter would collect into about a two-meter ball. Then that ball collapses into a black hole and it sucks up the pulsar."

If this scenario is right, one consequence would be that pulsars should live longer the farther away they are from the dark matter–dense galactic center. At the far reaches of the Milky Way, for example, pulsars might live to ripe old ages; near the core, however, pulsars would be created and then quickly destroyed before they could age. "Nothing astrophysical predicts a very strong relation between the age of a pulsar and its distance from the center of a galaxy," Linden says. "You would really see a stunning effect if this scenario held." It is also possible, although perhaps not probable, that astronomers could observe a pulsar collapse into a black hole, verifying the theory. But once the black hole is created, it would be near impossible to detect: As dark matter and black holes are each unobservable, black holes made of dark matter would be doubly invisible. [12]

Everything You Need to Know About Dark Energy



For a long time, there were two main theories related to how our universe would end. These were the Big Freeze and the Big Crunch. In short, the Big Crunch claimed that the universe would eventually stop expanding and collapse in on itself. This collapse would result in…well…a big crunch (for lack of a better term). Think "the Big Bang", except just the opposite. That's essentially what the Big Crunch is. On the other hand, the Big Freeze claimed that the universe would continue expanding forever, until the cosmos becomes a frozen wasteland. This theory asserts that stars will get farther and farther apart, burn out, and (since there are no more stars bring born) the universe will grown entirely cold and eternally black.

Now, we know that the expansion of the universe is not slowing. In fact, expansion is increasing. Edwin Hubble discovered that the farther an object was away from us the faster it was receding from us. In simplest terms, this means that the universe is indeed expanding, and this (in turn) means that the universe will likely end as a frozen, static wasteland. However, this can all change there is a reversal of dark energy's current expansion effect. Sound confusing? To clear things up, let's take a closer look at what dark energy is.

How We Discovered That The Universe Is Expanding:

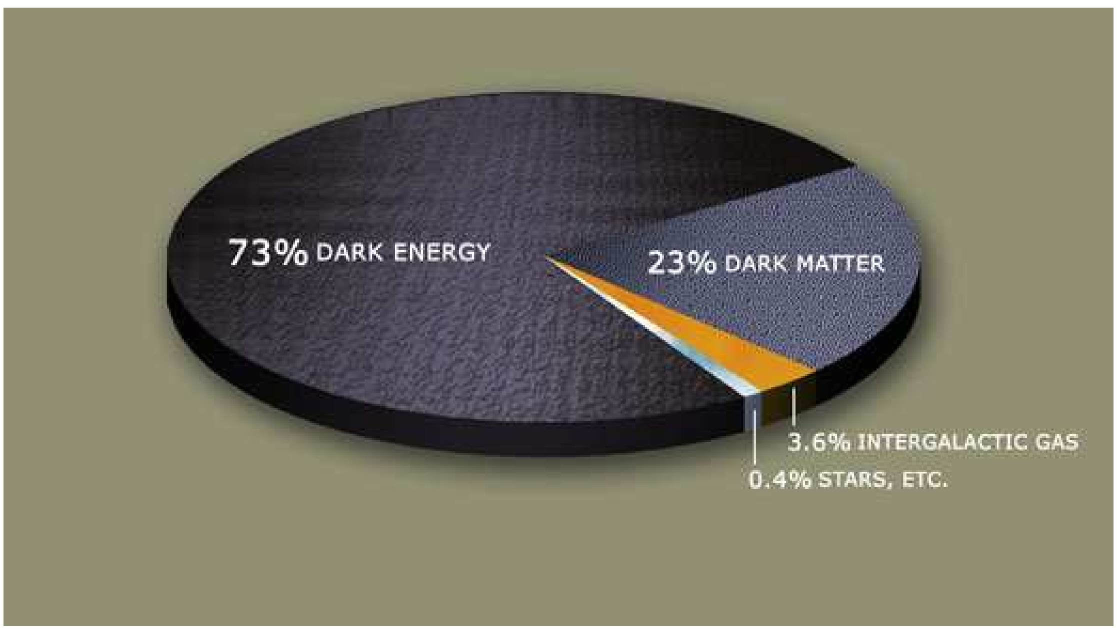
The accelerating expansion of the universe was discovered when astronomers were doing research on type 1a supernova events. These stellar explosions play a pivotal role in discerning the distance between two celestial objects because all type 1a supernova explosions are remarkably similar in brightness. So if we know how bright a star should be, we can compare the apparent luminosity with the intrinsic luminosity, and we get a reliable figure for how far any given object is from us. To get a better idea of how these work, think about headlights. For the most part, car headlights all have the same luminosity. So if one car's headlights are only 1/4 as bright as another car's, then one car is twice as far away as the other.

Incidentally, along with helping us make these key determinations about the locations of objects in the universe, these supernova explosions also gave us a sneak preview of one of the strangest observations ever made about the universe. To measure the approximate distance of an object, like a star, and how that distance has changed, astronomers analyze the spectrum of light emitted. Scientists were able to tell that the universe is increasing in expansion because, as the light waves make the incredibly long journey to Earth—billions of light-years away—the universe continues to expand. And as it expands, it stretches the light waves through a process called "redshifting" (the "red" is because the longest wavelength for light is in the red portion of the electromagnetic spectrum). The more redshifted this light is, the faster the expansion is going. Many years of painstaking observations (made by many different astronomers) have confirmed that this expansion is still ongoing and increasing because (as previously mentioned) the farther away an object is, the more redshifted it is, and (thus) the faster it is moving away from us.

How Do We Know That Dark Energy Is Real?

The existence of dark energy is required, in some form or another, to reconcile the measured geometry of space with the total amount of matter in the universe. This is because of the largely successful Planck satellite and Wilkenson Microwave Anisotropy Probe (WMAP) observations. The satellite's observations of the cosmic microwave background radiation (CMB) indicate that the universe is geometrically flat, or pretty close to it.

All of the matter that we believe exists (based on scientific data and inferences) combines to make up just about 30% of the total critical density of the observed universe. If it were geometrically flat, like the distribution suggests from the CMB, critical density of energy and matter should equal 100%. WMAP's seven year sky survey, and the more sophisticated Planck Satellite 2 year survey, both are very strong evidence of a flat universe. Current measurements from Planck put baryonic matter (atoms) at about 4%, dark matter at 23%, and dark energy making up the remainder at 73%.



What's more, an experiment called Wiggle Z galaxy sky survey in 2011 further supported the dark energy hypothesis by its observations of large scale structures of the universe (such as galaxies, quasars, galaxy clusters, etc). After observing more than 200,000 galaxies (by looking at their redshift and measuring the baryonic acoustic oscillations), the survey quantitatively put the age of when the universe started increasing its acceleration at a timeline of 7 billion years. After this time in the universe, the expansion started to speed up.

How Does Dark Energy Work?

According to Occam's razor (which proposes that the hypothesis with the fewest amount of assumptions is the correct one), the scientific community has favored Einstein's cosmological constant. Or in other words, the vacuum energy density of empty space, imbued with the same negative pressure value everywhere, eventually adds up with itself to speed up and suffuse the universe with more empty space, accelerating the entire process. This would kind of be similar to the energy pressure when talking about the "Casimir effect," which is caused by virtual particles in so-called "empty space", which is actually full of virtual particles coming in and out of existence.

The Problem With Dark Energy:

Called "the worst prediction in all of physics," cosmologists predict that this value for the cosmological constant should be 10^ -120 Planck units. According to dark energy equation, the parameter value for w (for pressure and density) must equal -1. But according to the latest findings from Pan-STARRS (short for Panoramic Survey Telescope and Rapid Response System), this value is in fact -1.186. Pan-STARRS derived this value from combining the data it obtained with the observational data from Planck satellite (which measured these very specific type 1a supernovas, 150 of them between 2009 and 2011, to be exact).

"If w has this value, it means that the simplest model to explain dark energy is not true," says Armin Rest of the Space Telescope Science Institute (STScI) in Baltimore. Armin Rest is the lead author of the Pan-STARRS team reporting these results to the astrophysics Web site arXiv (actual link to the paper) on October 22, 2013.

The Significance:

What exactly does the discrepancy in the value in the cosmological constant mean for our understanding of dark energy? At first glace, the community can dismiss these results as experimental uncertainty errors. It is a well accepted idea that telescope calibration, supernova physics, and galactic properties are large sources of uncertainties. This can throw off the cosmological constant value. Several astronomers have immediately spoken up, denying the validity of the results. Julien Guy of University Pierre and Marie Curie in Paris say the Pan-STARRS researchers may have underestimated their systematic error by ignoring a source of uncertainty from supernova light-curve models. They have been in contact with the team, who are looking into that very issue, and others are combing over the meticulous work on the Pan-STARRS team to see if they can find any holes in the study.

Despite this, these results were very thorough and made by an experienced team, and work is already on its way to rule out any uncertainties. Not only that, but this is third sky survey to now produce experimental results that have dependencies for the pressure and density value of w being equal to 1, and it is starting to draw attention from cosmologists everywhere. In the next year or two, this result will be definitive, or it will be ruled out and disappear, with the cosmological constant continue being supported.

Well, if the cosmological constant model is wrong, we have to look at alternatives. That is the beauty of science, it does not care what we wish to be true: if something disagrees with observations, it's wrong. Plain and simple. [11]

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.

Study Reveals Indications That Dark Matter is Being Erased by Dark Energy

Researchers in Portsmouth and Rome have found hints that dark matter, the cosmic scaffolding on which our Universe is built, is being slowly erased, swallowed up by dark energy.

The findings appear in the journal Physical Review Letters, published by the American Physical Society. In the journal cosmologists at the Universities of Portsmouth and Rome, argue that the latest astronomical data favors a dark energy that grows as it interacts with dark matter, and this appears to be slowing the growth of structure in the cosmos.

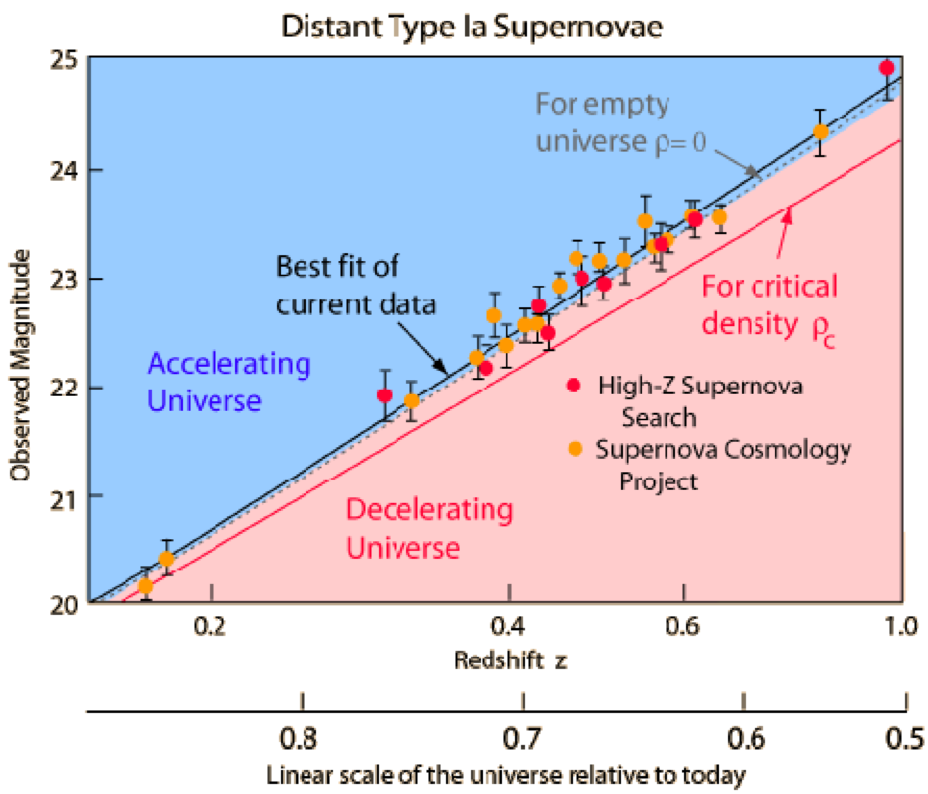
“Dark matter provides a framework for structures to grow in the Universe. The galaxies we see are built on that scaffolding and what we are seeing here, in these findings, suggests that dark matter is evaporating, slowing that growth of structure.”

Cosmology underwent a paradigm shift in 1998 when researchers announced that the rate at which the Universe was expanding was accelerating. The idea of a constant dark energy throughout space-time (the “cosmological constant”) became the standard model of cosmology, but now the Portsmouth and Rome researchers believe they have found a better description, including energy transfer between dark energy and dark matter. [10]

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

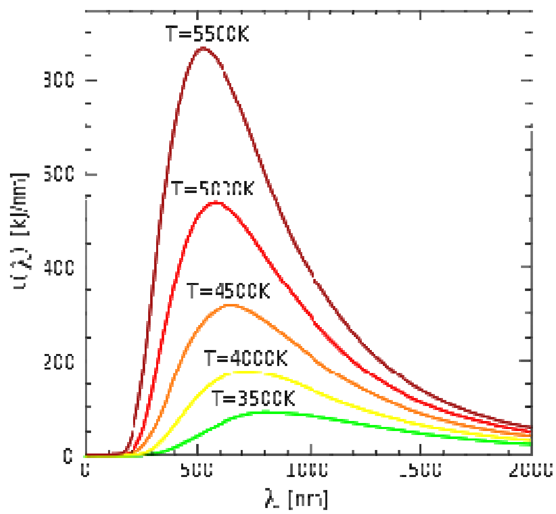
Dark matter is a type of matter hypothesized in astronomy and cosmology to account for a large part of the mass that appears to be missing from the universe. Dark matter cannot be seen directly with telescopes; evidently it neither emits nor absorbs light or other electromagnetic radiation at any significant 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 $E = h\nu$ 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

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. [1]

Relativistic change of mass

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The frequency dependence of mass

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.

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]

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.

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.

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 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

These results, and future studies, will help us understand what is really going on in the immediate vicinity of supermassive black holes." [14]
This mechanism explains how the first quasars were formed. Not only does it offer a new black hole accretion model, but it also challenges previous accretion models. Most importantly, however, the mechanism provides an explanation for the SMBHs seen in the early universe. [13]

If dark matter comes in both matter and antimatter varieties, it might accumulate inside dense stars to create black holes. It is also possible, although perhaps not probable, that astronomers could observe a pulsar collapse into a black hole, verifying the theory. But once the black hole is created, it would be near impossible to detect: As dark matter and black holes are each unobservable, black holes made of dark matter would be doubly invisible. [12]

For a long time, there were two main theories related to how our universe would end. These were the Big Freeze and the Big Crunch. In short, the Big Crunch claimed that the universe would eventually stop expanding and collapse in on itself. This collapse would result in…well…a big crunch (for lack of a better term). Think “the Big Bang”, except just the opposite. That’s essentially what the Big Crunch is. On the other hand, the Big Freeze claimed that the universe would continue expanding forever, until the cosmos becomes a frozen wasteland. This theory asserts that stars will get farther and farther apart, burn out, and (since there are no more stars bring born) the universe will grown entirely cold and eternally black. [11]

Newly published research reveals that dark matter is being swallowed up by dark energy, offering novel insight into the nature of dark matter and dark energy and what the future of our Universe might be. [10]

The changing temperature of the Universe will change the proportionality of the dark energy and the corresponding dark matter by the Planck Distribution Law, giving the base of this newly published research.

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.

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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