Mathematical Theory and Modeling
ISSN 2224-5804 (Paper) ISSN 2225-0522 (Online)
Vol.2, No.5, 2012

Mass And Energy-A Bank General Assets And Liabilities Approach – The General Theory Of 'Mass, Energy ,Space And Time'-Part 2

[*1]Dr K N Prasanna Kumar, [2]Prof B S Kiranagi [3]Prof C S Bagewadi

1.Department of studies in Mathematics, Kuvempu University, Shimoga, Karnataka, India

*Correspondence Mail id : drknpkumar@gmail.com

2.UGC Emeritus Professor (Department of studies in Mathematics), Manasagangotri, University of Mysore, Karnataka, India

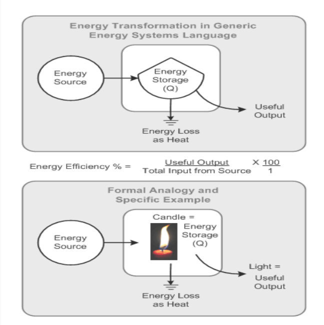
3.Chairman, Department of studies in Mathematics and Computer science, Jnanasahyadri Kuvempu university, Shankarghatta, Shimoga district, Karnataka, India

Abstract: Diurnal dynamics of mass and energy equivalence is studied. From the Einstein's classic equation $E=mc^2$,it bears ample testimony that $E-mc^2=0$ which provides an infallible observatory to the fact that matter would dissipate energy on various fronts, be it transformation of one energy to another or intergalactic cataclysms that lead to apocalyptic atrophication in the mass ,notwithstanding the fact that the radiation carries the rest mass. , and law of conservation of mass and energy are conserved. Hawking's radiation is another example in the point. Like the Bank Deposits and Credits are equal, and the credits dissipate deposits, nonetheless Profit shown up as a part of the balance sheet, we argue that such an approach shall provide a more saner explanation of the various unrelated manifestations that have taken place after GTR. One point that is to be noted is that the law of conservation of mass and law of conservation of energy is preserved in such energy transformations. In the Bank, individual debits and credits are tallied, and later on, after a complete drafting of various day's credits and debits, transfer scrolls are tallied with that of the slips and a General Ledger is written. ON the same lines a General Ledger can be written of the various energy ,mass, space, time transactions what with the debits and credits shown in each account thereof, the consolidated Credit or Debit balance is showed. This we state is itself the General Ledger Or the General Theory of Mass Energy, Space and Time, In the final series we give consolidated analysis of the equations., Concatenated and consolidated equations are given in the annexure inconsideration to the various permutations and combinations of space, energy ,mass, time. Introduction expatiates in detail about the details of these four variables and we draw from annexural equations for further papers, which call for more mathematics for understanding the comprehensive scenario and scepter of the universe.

Key Words: Cataly Zeproton Decay, Energy Transformation, Rest Mass, Relativistic Energy, Invariant Mass, Mass,

Energy, Space, Time.

Energy transformation



Energy Transformation in Energy Systems Language

Energy transformation or **energy conversion** is the process of changing one form of energy to another. In physics, the term energy describes the capacity to produce certain changes within a system, without regard to limitations in transformation imposed by entropy. Changes in total energy of systems can only be accomplished by adding or subtracting energy from them, as energy is a quantity, which is conserved, according to the first law of thermodynamics. According to special relativity, changes in the energy of systems will also coincide with changes in the system's mass, and the total amount of mass of a system is a measure of its energy.

Energy in a system may be transformed so that it resides in a different state, or different type of energy. Energy in many states may be used to do many varieties of physical work. Energy may be used in natural processes or machines, or else to provide some service to society (such as heat, light, or motion). For example, an internal combustion engine converts the potential chemical energy in gasoline and oxygen into heat, which is then transformed into the propulsive energy (kinetic energy that moves a vehicle). A solar cell converts solar radiation into electrical energy that can then be used to light a bulb or power a computer. The generic name for a device which converts energy from one form to another, is a transducer.

In general, most types of energy, save for thermal energy, may be converted efficiently to any other kind of energy. Sometimes this occurs with an efficiency of essentially 100%, such as when potential energy is converted to kinetic energy as an object falls in vacuum, or when it orbits nearer or farther from another object, in space. Conversion of other types of energies to heat may also occurs with nearly perfect efficiency (many types of friction do this).Exceptions for perfect conversion efficiency (even for isolated systems) occur when energy has already been partly distributed among many available quantum states for a collection of particles, which are freely allowed to explore any state of momentum and position (phase space). In such circumstances, a measure called entropy, or evening-out of energy distribution in such states, dictates that future states of the system must be of at least equal evenness in energy distribution. (There is no way, taking the universe as a whole, to collect energy into fewer states, once it has spread to them).

A consequence of this requirement is that there are limitations to the efficiency with which thermal energy can be converted to other kinds of energy, since thermal energy in equilibrium at a given temperature already represents the maximal evening-out of energy between all possible states. Such energy is sometimes considered "degraded energy," because it is not entirely usable. The second law of thermodynamics is a way of stating that, for this reason, thermal energy in a system may be converted to other kinds of energy with efficiencies approaching 100%, only if the entropy (even-ness or disorder) of the universe is increased by other means, to compensate for the decrease in entropy associated with the disappearance of the thermal energy and its entropy content. Otherwise, only a part of thermal energy may be converted to other kinds of energy (and thus, useful work), since the remainder of the heat must be reserved to be transferred to a thermal reservoir at a lower temperature, in such a way that the increase in entropy for this process more than compensates for the entropy decrease associated with transformation of the rest of the heat into other types of energy.

Energy transformations in the universe over time are (generally) characterized by various kinds of energy which has been available since the Big Bang, later being "released" (that is, transformed to more active types of energy such as kinetic or radiant energy), when a triggering mechanism is available to do it. A direct transformation of energy occurs when hydrogen produced in the big bang collects into structures such as planets, in a process during which gravitational potential may be converted directly into heat. In Jupiter, Saturn, Uranus, and Neptune, for example, such heat from continued collapse of the planets' large gas atmospheres continues to drive most of the planets' weather systems, with atmospheric bands, winds, and powerful storms which are only partly powered by sunlight.

Familiar examples of other such processes transforming energy from the big bang include nuclear decay, in which energy is released which was originally "stored" in heavy isotopes, such as uranium and thorium. This energy was stored at the time of these elements' nucleosynthesis, a process which ultimately uses the gravitational potential energy released from the gravitational collapse of supernovae, to store energy in the creation of these heavy elements before they were incorporated into the solar system and the Earth. This energy in uranium is triggered for sudden-release in nuclear fission bombs, and similar stored energies in atomic nuclei are released spontaneously, during most types of radioactive decay. In this process, heat from decay of these atoms in the core of the Earth is transformed immediately to heat. This heat in turn may lift mountains, via plate tectonics and orogenesis. This slow lifting of terrain thus represents a kind of gravitational potential energy storage of the heat energy. The stored potential energy may be released to active kinetic energy in landslides, after a triggering event. Earthquakes also release stored elastic potential energy in rocks, a kind of mechanical potential energy which has been produced ultimately from the same radioactive heat sources. Thus, according to present understanding, familiar events such as landslides and earthquakes release energy which has been stored as potential energy in the Earth's gravitational field, or elastic strain (mechanical potential energy) in rocks. Prior to this, the energy represented by these events had been stored in heavy atoms, ever since the time that gravitational potentials transforming energy in the collapse of long-destroyed stars created these atoms, and in doing so, stored the energy within them.

In other similar chain of transformations beginning at the dawn of the universe, nuclear fusion of hydrogen in the Sun releases another store of potential energy which was created at the time of the Big Bang. At that time, according to theory, space expanded and the universe cooled too rapidly for hydrogen to completely fuse into heavier elements. This meant that hydrogen represents a store of potential energy which can be released by nuclear fusion. Such a fusion process is triggered by heat and pressure generated from gravitational collapse of hydrogen clouds when they produce stars, and some of the fusion energy is then transformed into sunlight. Such sunlight may again be stored as gravitational potential energy after it strikes the Earth, as (for example) snow-avalanches, or when water evaporates from oceans and is deposited high above sea level (where, after being released at a hydroelectric dam, it can be used to drive turbine/generators to produce electricity). Sunlight also drives many weather phenomena on Earth. An example of a solar-mediated weather event is a hurricane, which occurs when large unstable areas of warm ocean, heated over months, give up some of their thermal energy suddenly to power a few days of violent air movement. Sunlight is also captured by plants as chemical potential energy, when carbon dioxide and water are converted into a combustible combination of carbohydrates, lipids, and oxygen. Release of this energy as heat and light may be triggered suddenly by a spark, in a forest fire; or it may be available more slowly for animal or human metabolism, when these molecules are ingested, and catabolism is triggered by enzyme action. Through all of these transformation chains, potential energy stored at the time of the Big Bang is later released by intermediate events, sometimes being stored in a number of ways over time between releases, as more active energy. In all these events, one kind of energy is converted to other types of energy, including heat.

Examples of sets of energy conversions in machines

ISSN 2224-5804 (Paper) ISSN 2225-0522 (Online)
Vol.2, No.5, 2012

For instance, a coal-fired power plant makes lots of energy and involves these energy transformations:

1. Chemical energy in the coal converted to thermal energy
2. Thermal energy converted to kinetic energy in steam
3. Kinetic energy converted to mechanical energy in the turbine
4. Mechanical energy of the turbine converted to electrical energy, which is the ultimate output

In such a system, the last step is almost perfectly efficient, the first and second steps are fairly efficient, but the third step is relatively inefficient. The most efficient gas-fired electrical power stations can achieve 50% conversion efficiency. Oil- and coal-fired stations achieve less.

1. In a conventional automobile, these energy transformations are involved:
2. Potential energy in the fuel converted to kinetic energy of expanding gas via combustion
3. Kinetic energy of expanding gas converted to linear piston movement
4. Linear piston movement converted to rotary crankshaft movement
5. Rotary crankshaft movement passed into transmission assembly
6. Rotary movement passed out of transmission assembly
7. Rotary movement passed through differential
8. Rotary movement passed out of differential to drive wheels
9. Rotary movement of drive wheels converted to linear motion of the vehicle

Other energy conversions

There are many different machines and transducers that convert one energy form into another. A short list of examples follows:

1. Thermoelectric (Heat → Electric energy)
2. Geothermal power (Heat→ Electric energy)
3. Heat engines, such as the internal combustion engine used in cars, or the steam engine (Heat → Mechanical energy)
4. Ocean thermal power (Heat → Electric energy)
5. Hydroelectric dams (Gravitational potential energy → Electric energy)
6. Electric generator (Kinetic energy or Mechanical work → Electric energy)

7. Fuel cells (Chemical energy → Electric energy)
8. Battery (electricity) (Chemical energy → Electric energy)
9. Fire (Chemical energy → Heat and Light)
10. Electric lamp (Electric energy → Heat and Light)
11. Microphone (Sound → Electric energy)
12. Wave power (Mechanical energy → Electric energy)

Energy can be converted from one form to another. though Mechanical energy, such as the kinetic energy of motion, can be converted to heat energy, for example in the heating of a car's brakes when it slows down. Chemical energy in the gasoline of the car can be converted into both heat energy in the exhaust and heating the engine, and into mechanical energy to move the car. Potential energy, such as the gravitational potential energy stored in an object which is on a high shelf, can be converted into kinetic energy as the object falls down. Electrical energy can be converted to heat or mechanical energy or sound energy in a variety of useful ways around the house using common appliances.

One very interesting feature of energy is that other forms can be converted into rest mass and back again (particle physicists do this every day in their accelerators). Einstein's $E=mc^2$ gives the relationship between the rest mass of a particle (measured in standard mass units) and the amount of energy that corresponds to (measured in standard energy units). It even applies to other systems where particles are neither created nor destroyed. If a box contains some air at a temperature, and then is warmed up, it will become ever so slightly more massive because of the extra energy given to it. You can call that rest mass of the whole box or the mass equivalent of the kinetic energy of the particles in it- nature doesn't care what names you give it

SPACE AND MATTER:

If **space expands**, then logically our most fundamental measure of it, the **speed of light** should increase proportionally. Note that a point is made about the fundamental measure of the space. Otherwise it isn't expanding space, it's increasing distance of space. That's what **Doppler effect** is. The train moving away isn't stretching space, it's moving away in stable space.

Originally it was proposed that **red shift** was due to **normal recessional velocity**,(normal recessional velocity produced red shift) but since other galaxies are red shifted so that they appear to be moving **directly away** from us, this would mean we would have to be at the center of the universe. So it was switched to say that space itself is expanding, but this is based on the red shift of the light spectrum, yet it is assumed that the speed of light is stable

and that if the universe were to expand to twice its current size, a galaxy x light-years away would be 2x light years away, but this means we need an otherwise stable speed of light to measure it! So **how can light speed be stable if space itself is expanding**? Expansion of the Universe is due to **momentum**, let alone the seeming **acceleration** of it. If the actual structure of the Universe is physically swelling then anything moving at a "constant" speed would appear from a fixed point to be accelerating.

Imagine an endless train speeding away from Earth at a constant speed but the train itself were expanding, wouldn't the engine car appear to be moving ever faster and faster? Depending on the **rate of its expansion** it could appear to be much **further away** than it actually is… If the actual structure of the Universe is physically swelling then anything moving at a "constant" speed would appear from a fixed point to be accelerating.

According to theory and observation (Mapp, cobe), **gravitational collapse** is generally proportional to **universal expansion,** resulting in flat space. If expansion is neutralized by gravity, how can the universe as a whole expand ? Think of it this way: **Space is defined by the matter and energy occupying it**. Gravity causes matter to collapse, thus the space defined by gravity is collapsing. Thus, the space is defined by the gravity. Now in between these gravity wells is lots of empty space, but energy is radiating back out across it from these wells, from light to the charged particles shooting out the poles of galaxies and with all the other anomalies in physics maybe what falls into black holes emerges as vacuum fluctuation**. Black holes have energy and mass and this is reduced by Hawking radiation.**". So this empty space is actually **absorbing** lots of energy, therefore our measure of it expands. But this energy than eventually **condenses** back out as matter and the cycle goes round. Since the only way to measure it is by the light crossing it, it doesn't make sense to say that it expands linearly from a point, if we use a stable measure of light speed to judge it. So all we can really say is the spectrum is red shifted by crossing space and the more space it crosses, the more the effect is multiplied. We can only measure what does cross the space and not all that was pulled into gravity wells, even what falls into our telescopes. **So both expansion and crunching are happening at the same time.**

Time and space and gravitation have no separate existence from matter. ... Physical objects are not in space, but these objects are spatially extended. In this way the concept 'empty space' loses its meaning. ... Since the theory of general relatively implies the representation of physical reality by a continuous field, the concept of particles or material points cannot play a fundamental part, ... and can only appear as a limited region in space where the field strength / energy density are particularly high. (Albert Einstein, 1950)

Law of conservation of mass (or matter), the mass in a system that is closed will be constant. This holds despite what occurs inside the system. If a candle is burned, the mass of the candle disappears. But the mass is still around in the form of combustion byproducts. For a long time, this idea was presented in the form "**matter can neither be created nor destroyed**" but only changed (rearranged). In the contemporary age now that relativity and quantum mechanics have taken center stage and shouldered aside the ideas of classical physics, we have to modify the law to allow for the **conversion of mass to energy**. But classical mechanics still finds broad application in chemistry, and also in the areas of mechanics and fluid dynamics

The current Law of Physics is the Conservation of Mass and Energy, where mass and energy can be changed in form but not created of destroyed. According to Linus Paulings 'Chemistry' book an atomic bomb converts mass to energy according to the formula $E=MC^2$. In fact, he says, the measured amount of energy **produced** in test reactions is about 1.6% of this amount. Each type of nuclear bomb with different materials seems to have a **different conversion rate**. The Laws of Physics prior to this combined law were the two laws the 'Conservation of Energy' and the 'Conservation of Mass' where each were considered immutable at that time. None of these Laws provide for the creation of matter or energy outside of this convervatism. Neither do they provide for the ultimate destruction of matter and energy.

Planck showed that **light energy must be emitted and absorbed in discrete 'quanta' to explain blackbody radiation**. Then in 1905 Einstein showed that the energy of light is determined by its frequency, where E=hf. Finally, in the late 1920s, de Broglie and Schrodinger introduced the concept of Standing Waves to explain these discrete frequency and energy states of light and matter (standing waves only exist at discrete frequencies and thus energy states).So it is clear that Waves are central to Quantum Physics and our understanding of the structure and **discrete energy states of Matter** (which explains why Quantum Theory is also called Quantum Wave Mechanics). Matter exists in Space as a Spherical Standing Wave and interacts with other Matter in the Space around it. From this foundation we can then **deduce t**he solutions to many problems currently found in Quantum Theory caused by this ancient concept that matter exists as **'particles'.**For example, the obvious solution to the paradox of the particle / wave duality of matter is to realise that the Wave-Center of the Spherical Standing Wave **causes the observed 'particle' effects of Matter** . Likewise, the discrete 'particle' properties of Light (quanta / photons) are caused by Standing Wave interactions which only occur at discrete frequencies and thus energy states.Because Schrodinger believed in real waves, he was never happy with Max Born's statistical / probability interpretation of the waves that became commonly accepted (and was actively promoted by Heisenberg and Bohr) in Quantum Theory / Mechanics.)Secondly, David Bohm provides a clear account of how this incorrect 'particle' conception of matter not only causes harm to the Sciences, but also to the way we think and live, and thus to our very society and its future evolution.

The notion that all these fragments is separately existent is evidently an illusion, and this illusion cannot do other than lead to endless conflict and confusion. Indeed, the attempt to live according to the notion that the fragments are really separate is, in essence, what has led to the growing series of extremely urgent crises that is confronting us today. Thus, as is now well known, this way of life has brought about pollution, destruction of the balance of nature, over-population, world-wide economic and political disorder and the creation of an overall environment that is neither physically nor mentally healthy for most of the people who live in it. Individually there has developed a widespread feeling of helplessness and despair, in the face of what seems to be an overwhelming mass of disparate social forces, going beyond the control and even the comprehension of the human beings who are caught up in it.(**David Bohm**, Wholeness and the Implicate Order, 1980)Or where the geometry of space time reaches critical limit- e.g. loops, or twists, or makes a vortex etc. - it is not energy as such that matters, but reaching of critical geometry. And all the rest of matter and other things which **are not matter** is then established relative to such absolute scale defined by critical geometrical process. So instead of Big Bang the critical process is **the appearance of certain space time structure in a connected way**, like phase transition. After that, certain limitations on what can happen next appear. Before that, everything looks quite chaotic, but actually it is pre organizing state of Universe and is by no means chaotic as its chaos is guided by certain harmonic laws or potential. Once the critical geometry of Universe is reached, we can say that what was before , was smaller than that in at least 1 dimension, smaller than approx 10-58 m. Before reaching critical geometry meter as measure had no sense since there was nothing to be measured against.

Similar process can be seen in Super fluid helium energy spectrum when **phonons** (pre organizing wavy structures, sound) reach enough energy **to form** rotons (rotational structures utilize the energy levels reached) - than there is an energy minimum as part of unorganized excess energy goes into internal energy of rotons (energy is added) and stable new phase appears, part remains unorganized

TIME DILATION:

In the theory of relativity, **time dilation** is an actual difference of elapsed time between two events as measured by observers either moving relative to each other or differently situated from gravitational masses. An accurate clock at rest with respect to one observer may be measured to tick at a different rate when compared to a second observer's own equally accurate clocks. This effect **arises** neither from technical aspects of the clocks nor from the fact that signals need time to propagate, but from the **nature of space-time itself**. **Time dilation therefore is the attribute of the space and time itself. Gravity is the nature of Space and Time itself.**

RELATIVE VELOCITY TIME DILATION

When two observers are in relative uniform motion and uninfluenced by any gravitational mass, the point of view of each will be that the other's (moving) clock is ticking at a slower rate than the local clock. **The faster the relative velocity, the greater the magnitude of time dilation**. Thus, faster relative velocity is proportional to greater magnitude of time dilation. **In other words, more the relative velocity shall be slowing of the time. Greater relative velocity thus dissipates greater movement of the time. This** case is sometimes called special relativistic time dilation. It is often interpreted as time "**slowing down"** for the other (moving) clock. But that is only true from the physical point of view of the local observer, and of others at relative rest (i.e. in the local observer's frame of reference). The point of view of the other observer will be that again the local clock (this time the other clock) is correct and it is the distant moving one that is slow. From a local perspective, time registered by clocks that are at rest with respect to the local frame of reference (and far from any gravitational mass) always appears to pass at the same rate.

GRAVITATIONAL TIME DILATION:

Another case of time dilation, where both observers are differently situated in their distance from a significant gravitational mass, such as (for terrestrial observers) the Earth or the Sun. One may suppose for simplicity that the observers are at relative rest (which is not the case of two observers both rotating with the Earth—an extra factor described below). In the simplified case, the general theory of relativity describes how, for both observers, the clock that is closer to the gravitational mass, i.e. deeper in its "g**ravity well**", appears to **go slower** than the clock that is more distant from the mass (or higher in altitude away from the center of the gravitational mass ,i .e .not in the gravitational well). That does not mean that the two observers fully agree: each still makes the local clock to be correct; the observer more distant from the mass (higher in altitude) measures the other clock (closer to the mass, lower in altitude) to be **slower** than the local correct rate, and the observer situated closer to the mass (lower in altitude) measures the other clock (farther from the mass, higher in altitude) to **be faster** than the local correct rate. In special relativity (or, hypothetically far from all gravitational mass), clocks that are moving with respect to an inertial system of observation are measured to be running slower. This effect is described precisely by the transformation. In general relativity, clocks at lower potentials in a gravitational field—such as in closer proximity to a planet—are found to be running slower. **Gravitational time dilation and gravitational red shift** thus have an integrative function and are related to each other.

Special and general relativistic effects can combine, for example in some time-scale applications mentioned below:.In special relativity, the time dilation effect is reciprocal: as observed from the point of view of either of two clocks which are in motion with respect to each other, it will be the other clock that is time dilated. (This presumes that the relative motion of both parties is uniform; that is, they do not accelerate with respect to one another during the course of the observations.) This raises questions of perception and reality and the necessity of addition or subtraction of a few variables towards the end of obtention of truth in' measurements'. One thing stands out clearly: **Perception is not reality**

In contrast, gravitational time dilation (as treated in general relativity) is not reciprocal: an observer at the top of a tower will observe that clocks at ground level tick **slower** and observers on the ground will agree about the direction and the ratio of the difference. There is not full agreement, as all the observers make their own local clocks out to be correct, but the direction and ratio of gravitational time dilation is agreed by all observers, independent of their altitude. Time dilation can be inferred from the observed fact of the constancy of the speed of light in all reference frames. This constancy of the speed of light means, counter to intuition, that **speeds of material objects and light are not additive**. It is not possible to make the speed of light **appear faster** by approaching at speed towards the material source that is emitting light. It is not possible to make the speed of light **appear slower** by receding from the source at speed. From one point of view, it is the implications of this unexpected constancy that take away from constancies expected elsewhere.

Consider a simple clock consisting of two mirrors A and B, between which a light pulse is bouncing. The separation of the mirrors is **L** and the clock ticks once each time it hits a given mirror.

In the frame where the clock is at rest (diagram at right), the light pulse traces out a path of length 2**L**and the period of the clock is 2**L** divided by the speed of light:

$$\Delta t = \frac{2L}{c}.$$

From the frame of reference of a moving observer traveling at the speed v (diagram at lower right), the light pulse traces out a longer, angled path. The second postulate of **special relativity** states that the speed of light is constant in all frames, **which implies** a lengthening of the period of this clock from the moving observer's perspective. That is to say, in a frame moving relative to the clock, the clock appears to be running more slowly. Straightforward application of the Pythagorean theorem leads to the well-known prediction of special relativity:

Mass–energy equivalence

Mass–energy equivalence is the concept that the mass of a body is a measure of its energy content. In this concept, mass is a property of all energy and energy is a property of all mass, and the two properties are connected by a constant. This means (for example) that the total internal energy E of a body at rest is equal to the product of its rest mass m and a suitable conversion factor to transform from units of mass to units of energy. **Mass–energy equivalence does not imply that mass may be "converted" to energy, but it allows for matter to be converted to energy**. Through all such conversions, mass remains conserved, since it is a property of matter and any type of energy. In physics, mass must be differentiated from matter. Matter, when seen as certain types of particles, can be created and destroyed (as in particle annihilation or creation), but the system of precursors and products of such reactions, as a whole, retain both the original mass and energy, with each of these system properties remaining unchanged (conserved) throughout the process. Simplified, this means that the total amount of energy (E) before the experiment is equal to the amount of energy after the experiment. **Letting the m in $E = mc^2$ stand for a quantity of "matter" (rather than mass) may lead to incorrect results, depending on which of several varying definitions of "matter" are chosen. A parallel to this phenomenon can be drawn to "Hawking radiation" which depletes mass and energy of the black hole.**

When energy is removed from a system (for example in binding energy, or the energy given off by an atomic bomb) then mass is always removed along with the energy. In other words when energy is produced, mass gormandizes and gobbles up that energy. **This energy retains (e) the missing mass, which will in turn be added to any other system which absorbs (e) it. In this situation $E = mc^2$ can be used to calculate how much mass goes along with the removed energy. It also tells how much mass will be added to any system which later absorbs this energy. And the maintenance of the conservation of mass and energy calls for absorption of mass by energy formed and absorption of energy by the mass so produced. It is against the backdrop of this concept that the extant model is constructed. Clearly $E=mc^2$ allows this in that, the equation implies $E-mc^2=0$. In the mathematical sense, mc^2 depletes the Energy. This means that the radiation,kinetic energy, heat energy, or any other form of energy produced., dissipates the Total energy in question, mc^2 means that matter absorbs the energy generated .The minus sign simply implies that some amount of energy produced would be absorbed by mass .And there is a time lag in such an absorption, not all mass gobbles up energy at the same time. Lest there would have been an apocalypse like in Nagasaki or a nemesis as is predicated in 2012. Only these in which cases energy is produced, has this relation holding true.**

To give a practical example, it is like adding water to milk. Not all water that would be added to milk would be added immediately and simultaneously. Only that part of matter which has been converted to energy would have dissipated concomitant part of the energy from the Total Energy in the Universe. And the total energy in the universe is constant. That only leaves us with the fact that there is continuous creation and destruction of matter or mass (although we have said both have to clearly differentiated) in the universe, like a Bank's Debit and Credit. Individual debits and credits are tallied at the end by sorting out the different categories of Debits and Credits. General Ledger which describes in detail of Debits and Credits of various accounts such as Savings Bank Account, Cash Credit Account, Current Account, Bills liabilities, Term Deposits, etc., In essence what we are trying to say is that the continuous conversion of matter to energy is taking place under various categories and the production of matter is also taking place under various categories. All these can be classified on lines of a Bank and a 'General Ledger' can be prepared, which accounts for all types of matter (say Assets) and various types of energy to which it is converted (like say liabilities). In the Assets and Liabilities Statement, the Assets would be equal to Liabilities, for individual debits and credits are 'balances'. With the individual

'Debits 'and 'Credits' of Mass and 'Energy" balanced ,the total 'Energy' and 'Mass' would be balanced so that the conservation of mass and Energy would hold good. Similarly energy could be categorized based on the age of the matter that has been responsible for the creation of energy, and a 'General Ledger' could be built for Quantum mechanics with accounts of 'mass' and 'energy' shown in the General Theory showing a double entry system of amount of mass that is getting poured in and the Amount of mass that is being converted to energy. This forms in our opinion The 'General Theory' Of Quantum Mechanics' in particular and 'Physics' in general.

$E = mc^2$ has sometimes been used as an explanation for the origin of energy in nuclear processes, but mass–energy equivalence does not explain the origin of such energies. Instead, this relationship merely indicates that the large amounts of energy released in such reactions may exhibit enough mass that the **mass-loss may be measured, when the released energy (and its mass) have been removed from the system. For example, the** loss of mass to atoms and neutrons as a result of the capture of a neutron, and loss of a gamma ray, has been used to test mass-energy equivalence to high precision, as the energy of the gamma ray may be compared with the mass defect after capture. In 2005, these were found to agree to 0.0004%, the most precise test of the equivalence of mass and energy to date. The concept of mass–energy equivalence **connects** the concepts of conservation of mass and conservation of energy, which continue to hold separately in any isolated system (one that is closed to loss of any type of energy, including energy associated with loss of matter). The theory of relativity allows particles which have rest mass to be converted to other forms of mass which require motion, such as kinetic energy, heat, or light. However, the system mass remains. Kinetic energy or light can also be converted to new kinds of particles which have rest mass, but again the energy remains. Both the total mass and the total energy inside an isolated system remain constant over time, as seen by any single observer in a given inertial frame.

In other words, energy can neither be created nor destroyed, **and energy, in all of its forms, has mass. Mass also can neither be created nor destroyed, and in all of its forms, has energy. According** to the theory of relativity, mass and energy as commonly understood, are two names for the same thing, and neither one is changed nor transformed into the other. Rather, **neither one exists without the other existing also, as a property of a system. Rather than mass being changed into energy, the view of special relativity** is that rest mass has been changed to a more mobile form of mass, but remains mass. In the transformation process, neither the amount of mass nor the amount of energy changes, since both are properties which are connected to each other via a simple constant Thus, **if energy leaves a system by changing its form, it simply takes its system mass with it. This view requires that if either mass or energy disappears from a system, it will** always be found that both have simply moved off to another place, where they may both be measured as an increase of both mass and energy corresponding to the loss in the first system.

FAST-MOVING OBJECTS AND SYSTEMS OF OBJECTS

When an object is pulled (velocity increased due to external influences) in the direction of motion, it gains momentum and energy, but when the object is already traveling near the speed of light, it cannot move much faster, no matter how much energy it absorbs. Its momentum and energy continue to increase without bounds, whereas its speed approaches a constant value—the speed of light. This implies that in relativity the momentum of an object cannot be a constant times the velocity, nor can the kinetic energy be a constant times the square of the velocity.

A property called the **relativistic mass** is defined as the ratio of the momentum of an object to its velocity. Relativistic mass depends on the motion of the object, so that different observers in relative motion see different values for it. If the object is moving slowly, the relativistic mass is nearly **equal** to the rest mass and both are nearly **equal** to the usual Newtonian mass. If the object is moving quickly, the relativistic mass is greater than the rest mass by an amount equal to the mass associated with the kinetic energy of the object. As the object approaches the speed of light, the relativistic mass grows infinitely, because the kinetic energy grows infinitely and this energy is **associated** with mass.The relativistic mass is always equal to the total energy (rest energy plus kinetic energy) divided by c^2 .Because the relativistic mass is exactly proportional to the energy, relativistic mass and relativistic energy are nearly synonyms; the only difference between them is the units. If length and time are measured in natural units, the speed of light is equal to 1, and even this difference disappears. Then mass and energy have the same units and are always equal, so it is redundant to speak about relativistic mass, because it is just another name for the energy. This is why physicists usually reserve the useful short word "mass" to mean rest-mass, or invariant mass, and not relativistic mass.The relativistic mass of a moving object is larger than the relativistic mass of an object that is not moving, because a moving object has extra kinetic energy. The rest mass of an object is defined as the mass of an object when it is at rest, so that the rest mass is always the same, independent of the motion of the observer: it is the same in all inertial frames.

For things and systems made up of many parts, like an atomic nucleus, planet, or star, the relativistic mass is the sum of the relativistic masses (or energies) of the parts, because energies are additive in closed systems. This is not true in systems which are open, however, if energy is subtracted. For example, if a system is bound by attractive forces, and the work the forces do in attraction is removed from the system, then mass will be lost with this removed energy. Such work is a form of energy which itself has mass, and thus mass is removed from the system, as it is bound. For example, the mass of an atomic nucleus is less than the total mass of the protons and neutrons that make it up, but this is only true after the energy (work) of binding has been removed in the form of a gamma ray (which in this system, carries away the mass of binding). This mass decrease is also equivalent to the energy required to break up the nucleus into individual protons and neutrons (in this case, work and mass would need to be supplied). Similarly, the mass of the solar system is slightly less than the masses of sun and planets individually.

For a system of particles going off in different directions, the invariant mass of the system is the analog of the rest mass, and is the same for all observers, even those in relative motion. It is defined as the total energy (divided by c^2) in the center of mass frame (where by definition, the system total momentum is zero). A simple example of an object with moving parts but zero total momentum, is a container of gas. In this case, the mass of the container is given by its total energy (including the kinetic energy of the gas molecules), since the system total energy and invariant mass are the same in any reference frame where the momentum is zero, and such a reference frame is also the only frame in which the object can be weighed. In a similar way, the theory of special relativity posits that the thermal energy in all objects (including solids) contributes to their total masses and weights, even though this energy is present as the kinetic and potential energies of the atoms in the object, and it (in a similar way to the gas) is not seen in the rest masses of the atoms that make up the object.

In a similar manner, even photons (light quanta), if trapped in a container space (as a photon gas or thermal radiation), would contribute a mass associated with their energy to the container. Such an extra mass, in theory, could be weighed in the same way as any other type of rest mass. This is true in special relativity theory, even though individually, photons have no rest mass. The property that trapped energy in any form adds weighable mass to systems that have no net momentum is one of the characteristic and notable consequences of relativity. It has no classical counterpart in classical Newtonian physics, in which radiation, light, heat, and kinetic energy never exhibit weighable mass under any circumstances.

APPLICABILITY OF THE STRICT MASS–ENERGY EQUIVALENCE FORMULA, $E = MC^2$

As is noted above, two different definitions of mass have been used in special relativity, and also two different definitions of energy. The simple equation $E = mc^2$ is not generally applicable to all these types of mass and energy, except in the special case that the total additive momentum is zero for the system under consideration. In such a case, which is always guaranteed when observing the system from either its center of mass frame or its center of momentum frame, $E = mc^2$ is always true for any type of mass and energy that are chosen. Thus, for example, in the center of mass frame, the total energy of an object or system is equal to its rest mass times c^2, a useful equality. This is the relationship used for the container of gas in the previous example. It is not true in other reference frames where the center of mass is in motion. In these systems or for such an object, its total energy will depend on both its rest (or invariant) mass, and also its (total) momentum.

In inertial reference frames other than the rest frame or center of mass frame, the equation $E = mc^2$ remains true if the energy is the relativistic energy and the mass the relativistic mass. It is also correct if the energy is the rest or invariant energy (also the minimum energy), and the mass is the rest mass, or the invariant mass. However, connection of the total **or relativistic energy** (**E_r**) with the **rest or invariant mass** (**m_0**) requires consideration of the system total momentum, in systems and reference frames where the total momentum has a non-zero value. The formula then required to connect the two different kinds of mass and energy, is the extended version of Einstein's equation, called the relativistic energy–momentum relationship:

$$E_r^2 - |\vec{p}|^2 c^2 = m_0^2 c^4$$
$$E_r^2 - (pc)^2 = (m_0 c^2)^2$$
$$E_r = \sqrt{(m_0 c^2)^2 + (pc)^2}$$

Here the $(pc)^2$ term represents the square of the Euclidean norm (total vector length) of the various momentum vectors in the system, which reduces to the square of the simple momentum magnitude, if only a single particle is considered. This equation reduces to E = mc² when the momentum term is zero. **E-mc^2 clearly states that the factor mc$^{2 \text{ dissipates}}$ the 'E' and such a dissipation has time lag. This is most salient and cardinal point that is to be borne in mind in the analysis of the model.**

In relativity, all of the energy that moves along with an object (that is, all the energy which is present in the object's rest frame) **contributes** to the total mass of the body, which measures how much it resists acceleration. **Each potential and kinetic energy makes a proportional contribution to the mass**. As noted above, even if a box of ideal mirrors "contains" light, then the individually mass less photons still contribute to the total mass of the box, by the amount of their energy divided by c^2.

In relativity, removing energy is removing mass, and for an observer in the center of mass frame, the formula m = E/c² indicates how much mass is lost when energy is removed. In a nuclear reaction, the mass of the atoms that come out is less than the mass of the atoms that go in, and the difference in mass shows up as heat and light which has the same relativistic mass as the difference (and also the same invariant mass in the center of mass frame of the system). In this case, the E in the formula is the energy released and removed, and the mass m is how much the mass decreases. In the same way, when any sort of energy is added to an isolated system, the increase in the mass is equal to the added energy divided by c². For example, when water is heated it gains about 1.11×10^{-17} kg of mass for every joule of heat added to the water.

An object moves with different speed in different frames, depending on the motion of the observer, so the kinetic energy in both Newtonian mechanics and relativity is frame dependent. This means that the amount of relativistic energy, and therefore the amount of relativistic mass, that an object is measured to have depends on the observer. The rest mass is defined as the mass that an object has when it is not moving (or when an inertial frame is chosen such that it is not moving). The term also applies to the invariant mass of systems when the system as a whole is not "moving" (has no net momentum). The rest and invariant masses are the smallest possible value of the mass of the object or system. They also are conserved quantities, so long as the system is closed. Because of the way they are calculated, the effects of moving observers are subtracted, so these quantities do not change with the motion of the observer.

The rest mass is almost never additive: the rest mass of an object is not the sum of the rest masses of its parts. The rest mass of an object is the total energy of all the parts, including kinetic energy, as measured by an observer that sees the center of the mass of the object to be standing still. The rest mass adds up only if the parts are standing still and do not attract or repel, so that they do not have any extra kinetic or potential energy. The other possibility is that they have a positive kinetic energy and a negative potential energy that exactly cancels. Time variable cosmological constant (TVCC) of holographic origin with interaction in Brans-Dicke theory is one example which allows investigation on similar grounds. Expanding Universe **using** Dark Energy is another that is of useful significance.. It can be shown that in this scenario **an accelerating universe can be obtained and the evolution of EOS for dark energy can cross over the boundary of phantom divide**. In addition, a geometrical diagnostic method, jerk parameter is applied to this model to distinguish it with cosmological constant.

BINDING ENERGY AND THE "MASS DEFECT"

Whenever any type of energy is removed from a system, the mass associated with the energy is also removed, and the system therefore loses mass. This mass defect in the system may be simply calculated as $\Delta m = \Delta E/c^2$, but use of this formula in such circumstances has led to the false idea that mass has been "converted" to energy. This may be particularly the case when the **energy (and mass**) removed from the system is a**ssociated** with the binding energy of the system. In such cases, the binding energy is observed as a "mass defect" or deficit in the new system and the fact that the released energy is not easily weighed may cause its mass to be neglected.

The difference between the rest mass of a bound system and of the unbound parts is the binding energy of the system, if this energy has been removed after binding. For example, a water molecule weighs a little less than two free hydrogen atoms and an oxygen atom; the minuscule mass difference is the energy that is needed to split the molecule into three individual atoms (divided by c^2), and which was given off as heat when the molecule formed (this heat had mass). Likewise, a stick of dynamite in theory weighs a little bit more than the fragments after the explosion, but this is true only so long as the fragments are cooled and the heat removed. In this case the mass difference is the energy/heat that is released when the dynamite explodes, and when this heat escapes, the mass associated with it escapes, only to be deposited in the surroundings which absorb the heat (so that total mass is conserved).

Such a change in mass may only happen when the system is open, and the energy and mass escapes. Thus, if a stick of dynamite is blown up in a hermetically sealed chamber, the mass of the chamber and fragments, the heat, sound, and light would still be **equal t**o the original mass of the chamber and dynamite. If sitting on a scale, the weight and mass would not change. This would in theory also happen even with a nuclear bomb, if it could be kept in an ideal box of infinite strength, which did not rupture or pass radiation Thus, a 21.5 kiloton (9×10^{13}joule) nuclear bomb produces about one gram of heat and electromagnetic radiation, but the mass of this energy would not be detectable in an exploded bomb in an ideal box sitting on a scale; instead, the contents of the box would be heated to millions of degrees without changing total mass and weight. If then, however, a transparent window (passing only electromagnetic radiation) were opened in such an ideal box after the explosion, and a beam of X-rays and other lower-energy light allowed to escape the box, it would eventually be found to weigh one gram less than it had before the explosion. This weight-loss and mass-loss would happen as the box was cooled by this process, to room temperature. However, any surrounding mass which had absorbed the X-rays (and other "heat") would **gain** this gram of mass from the resulting heating, so the mass "loss" would represent merely its relocation. Thus, no mass (or, in the case of a nuclear bomb, no matter) would be "converted" to energy in such a process. **Mass and energy, as always, would both be separately conserved.**

MASSLESS PARTICLES

Mass less particles have zero rest mass. Their relativistic mass is simply their relativistic energy, divided by c^2, or m(relativistic) = E/c [1]The energy for photons is **E = hf** where **h** is Planck's constant and **f** is the photon frequency. This frequency and thus the relativistic energy are frame-dependent.

If an observer runs away from a photon in the direction it travels from a source, having it catch up with the observer, then when the photon catches up it will be seen as having less energy than it had at the source. The faster the observer is traveling with regard to the source when the photon catches up, **the less energy** the photon will have. As an observer approaches the speed of light with regard to the source, the **photon looks redder and redder,** by relativistic Doppler effect (the Doppler shift is the relativistic formula), and the **energy of a very long-wavelength photon** approaches zero. This is why a photon is massless; this means that the rest mass of a photon is zero.

Two photons moving in different directions cannot both be made to have arbitrarily small total energy by changing frames, or by moving toward or away from them. The reason is that in a two-photon system, the energy of one photon is **decreased** by chasing after it, but the energy of the other will i**ncrease** with the same shift in observer motion. Two photons not moving in the same direction will exhibit an inertial framewhere the combined energy is smallest, but not zero. This is called the center of mass frame or the center of momentum frame; these terms are almost synonyms (the center of mass frame is the special case of a center of momentum frame where the center of mass is put at the origin). The most that chasing a pair of photons can accomplish to decrease their energy is to put the observer in frame where the photons have equal energy and are moving directly away from each other. In this frame, the observer is now moving in the same direction and speed as the center of mass of the two photons. The total momentum of the photons is now zero, since their momentums are equal and opposite. In this frame the two photons, as a system, have a mass equal to their total energy divided by c^2. This mass is called **the invariant mass** of the pair of photons together. It is the smallest mass and energy the system may be seen to have, by any observer. It is only the invariant mass of a two-photon system that can be used to make a single particle with the same rest mass.

If the photons are formed by the **collision** of a particle and an antiparticle, the invariant mass is the same as the total energy of the particle and antiparticle (their rest energy plus the kinetic energy), in the center of mass frame, where they will automatically be moving in equal and opposite directions (since they have equal momentum in this frame). If the photons are formed by the **disintegration** of a single particle with a well-defined rest mass, like the neutral **pion**, the invariant mass of the photons is equal to rest mass of the pion. In this case, the center of mass frame for the pion is just the frame where the pion is at rest, and the center of mass does not change after it disintegrates into two photons. After the two photons are formed, their center of mass is still moving the same way the pion did, and their total energy in this frame adds up to the mass energy of the pion. Thus, by calculating the invariant mass of pairs of photons in a particle detector, pairs can be identified that were probably **produced** by pion disintegration.

Max Planck pointed out that the mass–energy equivalence formula implied that bound systems would have a mass less than the sum of their constituents, once the binding energy had been allowed to escape. However, Planck was thinking about chemical reactions, where the binding energy is too small to measure. Einstein suggested that radioactive materials such as radium would provide a test of the theory, but even though a large amount of energy is released per atom in radium, due to the half-life of the substance (1602 years), only a small fraction of radium atoms decay over experimentally measurable period of time.

Once the nucleus was discovered, experimenters realized that the very high binding energies of the atomic nuclei should allow calculation of their binding energies, simply from mass differences. But it was not until the discovery of the neutron in 1932, and the measurement of the neutron mass, that this calculation could actually be performed (see nuclear binding energy for example calculation). A little while later, the first transmutation reactions (such as the Cockcroft-Walton experiment: Li + p $\rightarrow$ 2 ^{4}He) verified Einstein's formula to an accuracy of ±0.5%. In 2005, Rainville et al. published a direct test of the energy-equivalence of mass lost in the binding-energy of a neutron to atoms of particular isotopes of silicon and sulfur, by comparing the mass-lost to the energy of the emitted gamma ray associated with the neutron capture. The binding mass-loss agreed with the gamma ray energy to a precision of ±0.00004 %, the most accurate test of $E=mc^2$ to date

The mass–energy equivalence formula was used in the development of the atomic bomb. By measuring the mass of different atomic nuclei and **subtracting** from that number the total mass of the protons and neutrons as they would weigh separately, one gets the **exact binding energy** available in an atomic nucleus. This is used to calculate the energy released in any nuclear reaction, as the difference in the total mass of the nuclei that enter and exit the reaction.

PRACTICAL EXAMPLES

Einstein used the CGS system of units (centimeters, grams, seconds, dynes, and ergs), but the formula is independent of the system of units. In natural units, the speed of light is defined to equal 1, and the formula expresses an identity: E = m. In the SI system (expressing the ratio E / m in joules per kilogram using the value of c in meters per second):

Any time energy is generated, the process can be evaluated from an $E = mc^2$ perspective. For instance, the "Gadget"-style bomb used in the Trinity and the bombing of Nagasaki had an explosive yield equivalent to 21 kt of TNT. About 1 kg of the approximately 6.15 kg of plutonium in each of these bombs fissioned into lighter elements totaling almost exactly one gram less, after cooling [The electromagnetic radiation and kinetic energy (thermal and blast energy) released in this explosion carried **the missing one gram of mass**.] This occurs because nuclear binding energy is released whenever elements with more than 62 nucleons fission.

Another example is hydroelectric generation. The electrical energy produced by Grand Coulee Dam's turbines every 3.7 hours represents one gram of mass. This mass passes to the electrical devices (such as lights in cities) which are powered by the generators, where it appears as a gram of heat and light. Turbine designers look at their equations in terms of pressure, torque, and RPM. However, Einstein's equations show that all energy has mass, and thus the electrical energy produced by a dam's generators, and the heat and light which result from it, all retain their mass, which is equivalent to the energy. The potential energy—and equivalent mass—represented by the waters of the Columbia River as it descends to the Pacific Ocean would be **converted to heat** due to viscous friction and the turbulence of white water rapids and waterfalls were it not for the dam and its generators. **This heat would remain as mass on site at the water, were it not for the equipment which converted some of this potential and kinetic energy** into electrical energy, which can be moved from place to place (taking mass with it).

Whenever energy is added to a system, the system A spring's mass increases whenever it is put into compression or tension. Its added mass arises from the added potential energy stored within it, which is bound in the stretched chemical (electron) bonds linking the atoms within the spring.

Raising the temperature of an object (increasing its heat energy) increases its mass. For example, consider the world's primary mass standard for the kilogram, made of platinum/iridium. If its temperature is allowed to change by 1°C, its mass will change by 1.5 picograms (1 pg = 1×10^{-12} g).

A spinning ball will weigh more than a ball that is not spinning. Its increase of mass is exactly the equivalent of the mass of energy of rotation, which is itself the sum of the kinetic energies of all the moving parts of the ball. For example, the Earth itself is more massive due to its daily rotation, than it would be with no rotation. This rotational energy (2.14×10^{29} J) represents 2.38 billion metric tons of added mass Note that no net mass or energy is really created or lost in any of these examples and scenarios. Mass/energy simply moves from one place to another. These are some examples of the transfer of energy and mass in accordance with the principle of mass–energy conservation

Note further that in accordance with Einstein's Strong Equivalence Principle (SEP), all forms of mass and energy produce a gravitational field in the same waySo all radiated and transmitted energy retains its mass. Not only does the matter comprising Earth create gravity, but the gravitational field itself has mass, and that mass contributes to the field too. This effect is accounted for in ultra-precise laser ranging to the Moon as the Earth orbits the Sun when testing Einstein's general theory of relativity.

According to $E=mc^2$, no closed system (any system treated and observed as a whole) **ever loses mass, even when rest mass is converted to energy**. All types of energy contribute to mass, including potential energies. In relativity, interaction potentials are always due to local fields, not to direct nonlocal interactions, because signals cannot travel faster than light. The field energy is stored in field gradients or, in some cases (for massive fields), where the field has a nonzero value. The mass associated with the potential energy is the mass–energy of the field energy. The mass associated with field energy can be detected, in principle, by gravitational experiments, by checking how the field **attracts** other objects gravitationally.

The energy in the gravitational field itself has some differences from other energies. There are several consistent ways to define the **location of the energy in a gravitational field**, all of which agree on the total energy when space is mostly flat and empty. But because the gravitational field can be made to vanish locally at any point by choosing a free-falling frame, the precise location of the energy becomes dependent on the observer's frame of reference, and thus has no exact location, even though it exists somewhere for any given observer. In the limit for low field strengths, this gravitational field energy is the familiar Newtonian gravitational potential energy.

EFFICIENCY

Although mass cannot be converted to energy, **matter particles can be**. Also, a certain amount of the "matter" in ordinary objects can be converted to active energy (light and heat), even though no identifiable real particles are destroyed**. Such conversions happen in nuclear weapons, in which the protons and neutrons in atomic nuclei lose a small fraction of their average mass, but this mass-loss is not due to the destruction of any protons or neutrons (or even, in general, lighter particles like electrons). Also the mass is not destroyed, but simply removed from the system in the form of heat and light from the reaction.**

In nuclear reactions, typically only a small fraction of the total mass–energy of the bomb is converted into heat, light, radiation and motion, which are "active" forms which can be used. When an atom fissions, it loses only about 0.1% of its mass (which escapes from the system and does not disappear), and in a bomb or reactor not all the atoms can fission. In a fission based atomic bomb, the efficiency is only 40%, so only 40% of the fissionable atoms actually fission, and only 0.04% of the total mass appears as energy in the end. In nuclear fusion, more of the mass is released as usable energy, roughly 0.3%. But in a fusion bomb (see nuclear weapon yield), the bomb mass is partly casing and non-reacting components, so that in practicality, no more than about 0.03% of the total mass of the entire weapon is released as usable energy (which, again, retains the "missing" mass).

In theory, it should be possible to convert all of the mass in matter into heat and light (which would of course have the same mass), but none of the theoretically known methods are practical. One way to convert all matter into usable energy is to annihilate matter with antimatter. But antimatter is rare in our universe, and must be made first. Due to inefficient mechanisms of production, making antimatter always requires far more energy than would be released when it was annihilated.

Since most of the mass of ordinary objects resides in protons and neutrons, in order to convert all ordinary matter to useful energy, the protons and neutrons must be converted to lighter particles. In the standard model of particle physics, the number of protons plus neutrons is nearly exactly conserved. Still, Gerard 't Hooft showed that there is a process which will convert protons and neutrons to anti electrons and neutrinos This is the weak SU(2) instanton proposed by Belavin Polyakov Schwarz and Tyupkin. This process, can in principle convert all the mass of matter into neutrinos and usable energy, but it is normally extraordinarily slow. Later it became clear that this process will happen at a fast rate at very high temperatures, since then instanton-like configurations will be copiously produced from thermal fluctuations. The temperature required is so high that it would only have been reached shortly after the big bang.

Many extensions of the standard model contain magnetic monopoles, and in some models of grand unification, these monopoles cataly zeproton decay, a process known as the Callan–Rubakov effect.[23] This process would be an efficient mass–energy conversion at ordinary temperatures, but it requires making monopoles and anti-monopoles first. The energy required to produce monopoles is believed to be enormous, but magnetic charge is conserved, so that the lightest monopole is stable. All these properties are deduced in theoretical models—magnetic monopoles have never been observed, nor have they been produced in any experiment so far.

A third known method of total matter–energy conversion is using gravity, specifically black holes. Stephen Hawking theorized that black holes radiate thermally with no regard to how they are formed. So it is theoretically possible to throw matter into a black hole and use the emitted heat to generate power. According to the theory of Hawking radiation, however, the black hole used will radiate at a higher rate the smaller it is, producing usable powers at only small black hole masses, where usable may for example be something greater than the local background radiation. It is also worth noting that the ambient irradiated power would change with the mass of the black hole, increasing as the mass of the black hole decreases, or decreasing as the mass increases, at a rate where power is proportional to the inverse square of the mass. In a "practical" scenario, mass and energy could be dumped into the black hole to regulate this growth, or keep its size, and thus power output, near constant. This could result from the fact that mass and energy are lost from the hole with its thermal radiation.

Following points are to be remembered. It is written (e) in brackets to represent engulf and (eb) engulfed by for easy comprehension for generalized strain of rationalized consistency in the cognitive orientation and choice of

variables

1. The expansion rate of the universe =K .(Energy content)

2. Gravity (e) expanding arte universe containing matter (experimentally the rate is increasing)

3. the acceleration of the expanding universe (e) dark energy or vacuum energy

4. Total energy density of the universe (e) 73 percent of the dark energy

5. Total energy density of the universe (e) 23percent of dark matter

6. Total energy density of the universe (e) four percent of the visible matter like atoms..

7. Energy Shifts of the hydrogen atom are attributable (e) vacuum energy.

8. Vacuum energy term(e or eb) time variance

9. Gravitational mass= inertial mass

10. Movement of bodies as if they are affected by a force(e)curving of spacetime

11. Instability of the universe (e) Cosmological constant

12. Non staticity of the Universe (e) perturbations

13. The red shift of an object (depends) =K(on its velocity radially away from us) the velocity of the nebulae (e) (move faster than the) Velocity of Milky Way escape velocity.

14. The Cepheids are pulsating giants with a) characteristic relation between- luminosity and(e and eb)

15. the time interval between peaks in brightness,

16. A galaxy's distance is proportional = K(to its radial recession velocity).

17. Nebulae farther away recede faster (e) than closer ones.

18. What observer A perceives=What observer b perceives(Universe looks the same on cosmological scales to all observers, independent of their location and independent of in which direction they look in) wn.

19. General metric of space time consistent (e and eb)with the Cosmological Principle and showed that it was not tied e(e and eb) specifically to Einstein's equations, as had been assumed by Friedmann and Lema

20. The space time metric $g\mu\nu$ (e) gravity, where the indices run over the time and the three space coordinates, and where the metric varies in spacetime.

21. (Ten) gravity fields act over (e and eb) the four space time coordinates. However, the symmetries of the theory stemming from the Equivalence Principle reduce that to two 5

22. Cosmological Principle implies (eb) that the energy-momentum tensor has a form =similar to that of the

energy-momentum tensor in relativistic hydrodynamic, for a homogeneous and isotropic fluid with density ρ and pressure p (which both may depend on time).

23. The Hubble constant, with its present value H0. It is seen to Depend=K (on both the energy density of the Universe as well as its curvature and possible cosmological constant)

24. cosmological constant could be=considered as a vacuum energy

25. Static universe cannot be (e) stablility.

26. Supernovae occur(eb) occasionally in binary systems, when a low-mass white dwarf accreting (+)matter from a nearby companion approaches the limit of 1.4 solar masses, and becomes (eb)=unstable

27. A thermonuclear explosion ensues(eb) and an immense amount of energy is suddenly released.(eb) The evolution(eb) of the supernova brightness with time – the so-called light curve – can be observed over a few weeks

28. The supernova 1987A (not of type Ia) in the nearby galaxy the Large Magellanic Cloud, at a distance of 160 000 light years, was observed both in light and in neutrinos (Nobel Prize in Physics2002). For a review of supernova Ia properties, and their use as standard candles, see, e.g., there view by David Branch and Gustav Tammann . SNe Ia are identified through their spectral signatures: The absence of hydrogen features and the presence of a silicon absorption line.

29. Their spectra and light curves are amazingly uniform**, indicating** a common origin and a common intrinsic luminosity. The small deviations from uniformity can be investigated and corrected.

30. Observations of how the brightness of these SNe **varies** with red shift, therefore, allow studies of the expansion history of the Universe.

31. According to theory the expansion rate is **determined** by the energy-momentum density of the Universe and the curvature of space time, discovery of the ultimate fate of the Universe appears possible.

32. The homogeneity of SNe Ia spectra makes this class of objects eminent standard candle candidates. Because the peak luminosity of supernova **occurs a**fter only a short time after high explosiont There is also another catch: SNe Ia are rare, occurring only a couple of times per millennium in any given galaxy. However, to get a statistically significant determination of cosmological parameters, a large observational sample is needed, including SNe at fairly high redshifts ($z > 0.3$).The first systematic search for SNe Ia at high redshifts was made during the late 1980s by a Danish-British collaboration working at the 1.5 m Danish telescope at La Silla, Chile. Two years of observations resulted in the discovery of two distant SNe –one of them of Type Ia, the SN1988U at $z = 0.31$. However,

33. This supernova was observed after its maximum which hampered (e)the precision of the peak brightness determination. So, it seemed that discovery of distant SNe was possible but difficult

34. Gravity should eventually cause the (e) expansion to slow down.

35. To address the problem of sufficient statistics, Erl mutter and collaborators developed a strategy that they dubbed Supernova on Demand. Using a CCD-based wide-field imager at a 4 m telescope, the group would observe thousands of galaxies over two to three nights just after new Moon. Imaging the same patches of the sky about three weeks later and using improved image-processing techniques, allowed selection of entire batches of about a dozen or so new SNe at a time. The timing ensured that many SNe would be close to peak brightness, making essential calibration possible.

36. Expansion of the Universe does not slow e(e) down but actually accelerates, were submitted for publication

later that year.

37. Deceleration parameter q0 is negative, and that the expansion at the present epoch unexpectedly (e)decelerates (see above). The result of the analyses of the two collaborations, showing that $\Omega\Lambda = 0$ is excluded with high significance,

38. Intervening dust (e)luminosity of the distant supernovae

39. The expansion of the Universe accelerates has been confirmed during the last decade by precision measurements of the CMB and by studies of galaxy clustering, see Fig. 3.

40. The driving force behind the acceleration is unknown, but the current belief is that the cause of the expansion is vacuum energy (in this context called dark energy)

41. Expansion of the universe takes place by (e) utilization of Dark Energy. The SN results emerged at a time when some cosmologists, for many different reasons, argued that the Universe might be vacuum dominated. Others were, however, reluctant to accept such a claim implying a non-zero cosmological constant. The SN observations were the crucial link in support of vacuum dominance, directly testing models with $\Lambda > 0$. The currently accepted cosmological standard model – the Concordance Model or the ΛCDM model – **includes both a cosmological constant Λ and Cold (i.e. non-relativistic) Dark Matter. The SNe results combined with the CMB** data and interpreted in terms of the Concordance Model allow a precise determination of ΩM and ΩΛ

ENERGY

ASSUMPTIONS:

Total energy density of the universe is classified into three categories belong to higher age than that of category 1 and category 2.This is concomitant to category 3 of energy density classification .In this connection, it is to be noted that there is no sacrosanct time scale as far as the above pattern of classification is concerned. Any operationally feasible scale with an eye on the mass-energy duo stratification would be in the fitness of things. For category 3 "**Over and above**" nomenclature could be used. Similarly, a "**less than**" scale for category 1 can be used.

The speed of growth of energy density AS MEASURED FROM THE POINT OF BIG bang under category 1 is proportional to the speed of growth of energy density (SINCE THE BIGBANG) in the universe under category 2. In essence the accentuation coefficient in the model is representative of the constant of proportionality between energy under category 1 and category 2 this assumptions is made to foreclose the necessity of addition of one more variable, that would render the systemic equations unsolvable

The transformation of energy(due to transformation from one form to another ,notwithstanding the law of conservation of energy which is concomitant with the matter in the corresponding category in all the three categories is attributable to the following two phenomenon :

Aging phenomenon: The aging process energy density vis-à-vis matter(Please see introduction for detailed discussion) leads to transference of the that part of the energy density corresponding to expanding/ universe namely concomitant energy to the next category, no sooner than the age of the energy density vis a vis the matter categorized below in that part of the universe which is aged crosses the boundary of demarcation.

Depletion phenomenon: Natural calamities leading to destruction of universe and galaxy dissipates the growth speed of the total energy density,(notwithstanding the conservation of energy-note that individual transformations also follow the conservation principle like in a Bank individual Credits and Debits are balance in addition to the total quantum of slips are taken sorted and then balanced again) by an equivalent extent. Model makes allowance for new babies also which continually come thereby counterpoising such a "loss". This factor has been explicitly dilated and expatiated upon in the introduction.

NOTATION :

G_{13} : Energy density corresponding to the matter in category 1

G_{14} : Energy density corresponding to the matter in category 2

G_{15} : Energy density corresponding to matter in category 3

$(a_{13})^{(1)}, (a_{14})^{(1)}, (a_{15})^{(1)}$: Accentuation coefficients

$(a'_{13})^{(1)}, (a'_{14})^{(1)}, (a'_{15})^{(1)}$: Dissipation coefficients

FORMULATION OF THE SYSTEM :

In the light of the assumptions stated in the foregoing, we infer the following:-

(a) The growth speed in category 1 is the sum of a accentuation term $(a_{13})^{(1)}G_{14}$ and a dissipation term $-(a'_{13})^{(1)}G_{13}$, the amount of transformation taken to be proportional to the concomitant category of energy density in the universe which has been classified depending upon the age of the matter.

(b) The growth speed in category 2 is the sum of two parts $(a_{14})^{(1)}G_{13}$ and $-(a'_{14})^{(1)}G_{14}$ the inflow from the category 1 ,

(c) The growth speed in category 3 is equivalent to $(a_{15})^{(1)}G_{14}$ and $-(a'_{15})^{(1)}G_{15}$ dissipation, or the slowing down of the pace of energy density due to galactic or natural calamities with distorts and has disastrous consequences, It may also be due to transformation of one type of energy in to another. which accentuates the "loss* or "gain"

GOVERNING EQUATIONS:

The differential equations governing the above system can be written in the following form

$$\frac{dG_{13}}{dt} = (a_{13})^{(1)}G_{14} - (a'_{13})^{(1)}G_{13} \quad 1$$

$$\frac{dG_{14}}{dt} = (a_{14})^{(1)}G_{13} - (a'_{14})^{(1)}G_{14} \quad 2$$

$$\frac{dG_{15}}{dt} = (a_{15})^{(1)}G_{14} - (a'_{15})^{(1)}G_{15} \quad 3$$

$$(a_i)^{(1)} > 0 \quad , \quad i = 13,14,15 \quad 4$$

$$(a'_i)^{(1)} > 0 \quad , \quad i = 13,14,15 \quad 5$$

$(a_{14})^{(1)} < (a'_{13})^{(1)}$ 6

$(a_{15})^{(1)} < (a'_{14})^{(1)}$ 7

We can rewrite equation 1, 2 and 3 in the following form

$$\frac{dG_{13}}{(a_{13})^{(1)}G_{14}-(a'_{13})^{(1)}G_{13}} = dt \quad 8$$

$$\frac{dG_{14}}{(a_{14})^{(1)}G_{13}-(a'_{14})^{(1)}G_{14}} = dt \quad 9$$

Or we write a single equation as

$$\frac{dG_{13}}{(a_{13})^{(1)}G_{14}-(a'_{13})^{(1)}G_{13}} = \frac{dG_{14}}{(a_{14})^{(1)}G_{13}-(a'_{14})^{(1)}G_{14}} = \frac{dG_{15}}{(a_{15})^{(1)}G_{14}-(a'_{15})^{(1)}G_{15}} = dt \quad 10$$

The equality of the ratios in equation (10) remains unchanged in the event of multiplication of numerator and denominator by a constant factor.

For constant multiples α ,β ,γ all positive we can write equation (10) as

$$\frac{\alpha dG_{13}}{\alpha\left((a_{13})^{(1)}G_{14}-(a'_{13})^{(1)}G_{13}\right)} = \frac{\beta dG_{14}}{\beta\left((a_{14})^{(1)}G_{13}-(a'_{14})^{(1)}G_{14}\right)} = \frac{\gamma dG_{15}}{\gamma\left((a_{15})^{(1)}G_{14}-(a'_{15})^{(1)}G_{15}\right)} = dt \quad 11$$

$\alpha_i G_i \mid \beta_i G_i \mid \gamma_i G_i = C_i e_i^{\lambda_i t}$ Where $i = 13,14,15$ and C_{13}, C_{14}, C_{15} are arbitrary constant coefficients.

STABILITY ANALYSIS :

Supposing $G_i(0) = G_i^0(0) > 0$, and denoting by λ_i the characteristic roots of the system, it easily results that

1. If $(a'_{13})^{(1)}(a'_{14})^{(1)} - (a_{13})^{(1)}(a_{14})^{(1)} > 0$ all the components of the solution, i.e all the three parts in the expanding universe tend to zero, and the solution is stable with respect to the initial data.

2. If $(a'_{13})^{(1)}(a'_{14})^{(1)} - (a_{13})^{(1)}(a_{14})^{(1)} < 0$ and $(\lambda_{14} + (a'_{13})^{(1)})G_{13}^0 - (a_{13})^{(1)}G_{14}^0 \neq 0, (\lambda_{14} < 0)$, the first two components of the solution tend to infinity as t→∞, and $G_{15} \to 0$, ie. The category 1 and category 2 parts grows to infinity, whereas the third part category 3 tend to zero

3. If $(a'_{13})^{(1)}(a'_{14})^{(1)} - (a_{13})^{(1)}(a_{14})^{(1)} < 0$ and $(\lambda_{14} + (a'_{13})^{(1)})G_{13}^0 - (a_{13})^{(1)}G_{14}^0 = 0$ Then all the three parts tend to zero, but the solution is not stable i.e. at a small variation of the initial values of G_i, the corresponding solution tends to infinity.

From the above stability analysis we infer the following:

1.The adjustment process is stable in the sense that the system of system of energy density in the expanding universe converges to equilibrium

.2.The approach to equilibrium is a steady one , and there exists progressively diminishing oscillations around the equilibrium point

3.Conditions 1 and 2 are independent of the size and direction of initial disturbance

4.The actual shape of the energy density path in the expanding universe is determined by efficiency parameter , the strength of the response of the portfolio in question, and the initial disturbance

5. Result 3 warns us that we need to make an exhaustive study of the behavior of any case in which generalization derived from the model do not hold.

6. Growth studies as the one in the extant context are related to the systemic growth paths with full employment of resources that are available in question.

7. It is to be noted some systems pose extremely difficult stability problems. As an instance, one can quote example of pockets of open cells and drizzle in complex networks in marine stratocumulus. Other examples are clustering and synchronization of lightning flashes adjunct to thunderstorms, coupled studies of microphysics and aqueous chemistry, gravitational collapse of the black hole ,etc.,.(Please see deliberation at the end)

MC^2 –MATTER

MATTER is classified into three categories analogous to the stratification that was resorted to in energy density in expanding universe. Process of transmission from one category to another is based on the such phenomenon that take place on the expanding universe,. When dark matter is **destroyed,** it leaves behind a burst of **exotic particles**, according to theory. Now scientists have found a possible signature of these remains. The discovery could help prove the existence of dark matter and reveal what it's made of. No one knows what dark matter is, but scientists think it exists because there is not enough gravity from visible matter to explain how galaxies rotate. Conceptually, Gravitational force produced by the visible matter thus is far less in contrast to that of the Dark matter. Over abundance of particles called positrons, which are the antimatter **counterpart** to electrons (matter and antimatter annihilate each other) were found recently.

This positron signature could have a variety of causes, but a prime candidate is dark matter, the intangible stuff thought to make up about 98 percent of all matter in the universe. When two dark matter particles collide they can sometimes **destroy e**ach other and release a burst of energy that includes **positrons.**Many think this could be a signal from dark matter, because for positrons this behavior fits very well with many theories of dark matter.

Positrons are often c**reated** when cosmic **rays interact** with atoms in the gas and dust between stars. Another possibility is that the positrons PAMELA (Sweden's Shuttle) found were produced by dense spinning stars called pulsars. To distinguish between this option and dark matter, more data will be necessary, either from PAMELA or from the Fermi Gamma-ray Space Telescope, launched last year.

Kane's personal bet for the particle behind dark matter in these findings is called a **wino** (pronounced WEE-no) — a specific type of neutralino, which is a theorized category of particles that could exist as "super symmetric partners" for all the Standard Model particles such as electrons, quarks, etc. The wino is the super symmetric partner of a particle called **the W boson**."It does particularly well at producing positrons in the annihilation, and the positrons have energies that are about right for these results," (Kane)

If dark matter is made up of neutralinos, then dark matter particles would be their own antimatter particles, because the anti-neutralino is simply a neutralino. Thus, when two dark matter particles collide, they can self-destruct like any other interaction of matter and anti-matter. Luckily, this does not happen very often. Dark matter particles are thought to be extremely tiny, and the chances of them hitting each other perfectly square on, and under the right conditions for destruction, are very low. This fact allows dark matter to clump together throughout the universe, scaffolding up galaxies and clusters, without destroying itself every time two dark matter particles come near each other. Even though annihilations are rare, the positrons they produce could survive for up to a few million years, so they can stick around long enough for detectors like PAMELA to find them.

AN OVERVIEW OF MASS ENERGY EQUIVALENCE:

One of Einstein's great insights was to realize that matter and energy are really different forms of the same thing. Matter can be turned into energy, and energy into matter.

For example, consider a simple hydrogen atom, basically composed of a single proton. This subatomic particle has a mass of 0.000 000 000 000 000 000 000 000 001 672 kg This is a tiny mass indeed. But in everyday quantities of matter there are a lot of atoms! For instance, in one kilogram of pure water, the mass of hydrogen atoms amounts to just slightly more than 111 grams, or 0.111 kg. Einstein's formula tells us the amount of energy this mass would be equivalent to, if it were all suddenly turned into energy. It says that to find the energy, you multiply the mass by the square of the speed of light, this number being 300,000,000meterspersecond (a very large number): $E=mc^2$ = 0.111 x 300,000,000 x 300,000,000= 10,000,000,000,000,000 Joules

This process involves the complete destruction of matter, and occurs only when that matter meets an equal amount of antimatter ... a substance composed of mass with a negative charge. Antimatter does exist; it is observable as single subatomic particles in radioactive decay, and has been created in the laboratory. But it is rather short-lived (!), since it annihilates itself and an equal quantity of ordinary matter as soon as it encounters anything. Another phenomenon peculiar to small elementary particles like protons is that **they combine**. A single proton forms the nucleus of a hydrogen atom. Two protons are found in the nucleus of a helium atom. This is how the elements are formed ... all the way up to the heaviest naturally occuring substance, uranium, which has 92 protonsin its nucleus.It is possible to make two free protons (Hydrogen nuclei) come together to make the beginnings of a helium nucleus. This requires that the protons **be hurled** at each other at a very high speed. This process occurs in the sun, but can also be replicated on earth with lasers, magnets, or in the center of an atomic bomb.Theprocessiscalled **nuclearfusion.**What makes it interesting is that when the two protons are forced to combine, they don't need as much of their energy (or mass). Two protons stuck together have less mass than two single separate protons! **When the protons are forced together, this extra mass is released ... as energy**! Typically this amounts to about 0.7% of the total mass, converted to an amount of energy predictable using the formula $E=mc^2$.

Baryon Destruction by Asymmetric Dark matter

New and unusual signals that arise in theories where dark matter is asymmetric and carries a net anti baryon number, as may occur when the dark matter abundance is **linked** to the baryon abundance. **Dark matter can increase baryonic matter or decrease it for that matter.** Anti baryonic dark matter can cause /**produce** induced nucleon decay by **annihilating** visible baryons through inelastic scattering. These processes l**ead** to an effective nucleon lifetime of 10^{29}-10^{32} years in terrestrial nucleon decay experiments, if baryon number transfer between visible and dark sectors arises through new physics at the weak scale. The possibility of induced nucleon decay motivates a novel approach for direct detection of cosmic dark matter in nucleon decay experiments. Monojet searches (and related signatures) at hadron colliders also provide a complementary probe of weak-scale dark-matter--induced baryon number violation. Effects of baryon-destroying dark matter on stellar systems and show that it can be consistent.

ANTIMATTER:AND MATTER(FOR GOVERNING EQUATIONS PLEASE SEE ANNEXURE-Problem can be solved by using the same techniques as the one hereinfore)

In particle physics, **antimatter** is the extension of the concept of the antiparticle to matter, where antimatter is composed of antiparticles in the same way that normal matter is composed of particles. For example, a positron (the antiparticle of the electron or e+) and an antiproton (p) can form anantihydrogen atom in the same way that an electron and a proton form a "normal matter" hydrogen atom. Furthermore, mixing matter and antimatter can lead to the annihilation of both, in the same way that mixing antiparticles and particles does, thus giving rise to high-energy photons (gamma rays) or other particle–antiparticle pairs. The result of antimatter meeting matter is an explosion.There is considerable speculation as to why the observable universe is apparently composed almost entirely of matter (as opposed to a mixture of matter and antimatter), whether there exist other places that are almost entirely composed of antimatter instead, and what sorts of technology might be possible if antimatter could be harnessed. At this time, the apparent asymmetry of matter and antimatter in the visible

Idea of negative matter has appeared in past theories of matter, theories which have now been abandoned. Using the once popular vortex theory of gravity, the possibility of matter with negative gravity was discussed by William Hicks in the 1880s. Between the 1880s and the 1890s, Karl Pearson proposed the existence of "squirts" (sources) and sinks of the flow of aether. The squirts represented normal matter and the sinks represented negative matter, a term which Pearson is credited with coining. Parson's theory required a fourth dimension for the aether to flow . Arthur Schuster hypothesized anti atoms, as well as whole antimatter solar systems, and discussed the possibility of matter and antimatter annihilating each other. Schuster's ideas were not a serious theoretical proposal, merely speculation, and like the previous ideas, differed from the **modern concept of antimatter in that it possessed negative gravity.**

Dirac realized that his relativistic version of the Schrödinger wave equation for electrons predicted the possibility of anti electrons. These were discovered by Carl D. Anderson in 1932 and named positrons (a contraction of "positive electrons"). Although Dirac did not himself use the term antimatter, its use follows on naturally enough from anti electrons, antiprotons, etc. A complete periodic table of antimatter was envisaged by Charles Janet in 1929

Notation

One way to denote an antiparticle is by adding a bar over the particle's symbol. For example, the proton and antiproton are denoted as p and p, respectively. The same rule applies if one were to address a particle by its constituent components. A proton is made up of uud quarks, so an antiproton must therefore be formed from uud antiquarks. Another convention is to distinguish particles by their electric charge. Thus, the electron and positron are denoted simply as e− and e+ respectively.

Origin and asymmetry

Almost all matter observable from the Earth seems to be made of matter rather than antimatter. If antimatter-dominated regions of space existed, the **gamma rays produced** in annihilation reactions along the boundary between matter and antimatter regions would be detectable. Antiparticles are **created e**verywhere in the universe where high-energy particle collisions take place. High-energy cosmic rays impacting Earth's atmosphere (or any other matter in the Solar System) **produce** minute quantities of antiparticles in the **resulting** particle jets, which are immediately **annihilated** by contact with nearby matter. They may similarly be produced in regions like the center of the Milky Way and other galaxies, where very energetic celestial events occur (principally the interaction of relativistic jets with the interstellar medium). The presence of the resulting antimatter is detectable by the two gamma rays produced every time **positrons annihilate** with nearby matter. The frequency and wavelength of the gamma rays indicate that each carries 511 keV of energy (i.e., the rest mass of an electron multiplied by c^2).

Recent observations by the European Space Agency's INTEGRAL satellite may explain the origin of a giant cloud of antimatter surrounding the galactic center. The observations show that the cloud is asymmetrical and matches the pattern of X-ray binaries (binary star systems containing black holes or neutron stars), mostly on one side of the galactic center. While the mechanism is not fully understood, it is likely to involve the production of electron–positron pairs, as ordinary matter gains tremendous energy while falling into a stellar remnant.[9][10]

Antimatter may exist in relatively large amounts in far-away galaxies due to cosmic inflation in the primordial time of the universe. Antimatter galaxies, if they exist, are expected to have the same chemistry and absorption and emission spectra as normal-matter galaxies, and their astronomical objects would be observationally identical, making them difficult to distinguish. NASA is trying to determine if such galaxies exist by looking for X-ray and gamma-ray signatures of annihilation events in colliding superclusters.

Natural production

Positrons are produced naturally in β^+ decays of naturally occurring radioactive isotopes (for example, potassium-40) and in interactions of gamma quanta (emitted by radioactive nuclei) with matter. Antineutrinos are another kind of antiparticles created by natural radioactivity (β^- decay). Many different kinds of antiparticles are also produced by (and contained in) cosmic rays. Recent (as of January 2011) research by the American Astronomical Society has discovered antimatter (positrons) originating above thunderstorm clouds; positrons are produced in gamma-ray flashes created by electrons which are accelerated by strong electric fields in the clouds.[13] Antiprotons have also been found to exist in the Van Allen Belts around the Earth by the PAMELA module.[14][15]

Artificial production

Antiparticles are also produced in any environment with a sufficiently high temperature (mean particle energy greater than the pair production threshold). During the period of baryogenesis, when the universe was extremely hot and dense, matter and antimatter were continually produced and annihilated. The presence of remaining matter, and absence of detectable remaining antimatter,[16] also called baryon asymmetry, is attributed to violation of the CP-symmetry relating matter to antimatter. The exact mechanism of this violation during baryogenesis remains a mystery.Positrons were reported in November 2008 to have been generated by Lawrence Livermore National Laboratory in larger numbers than by any previous synthetic process. A laser drove e lectrons through a millimeter-radius gold target's nuclei, which caused the incoming electrons to emit energy quanta that decayed into both matter and antimatter. Positrons were detected at a higher rate and in greater density than ever previously detected in a laboratory. Previous experiments made smaller quantities of positrons using lasers and paper-thin targets; however, new simulations showed that short, ultra-intense lasers and millimeter-thick gold are a far more effective source.

Antiprotons, antineutrons, and antinuclei

The existence of the antiproton was experimentally confirmed in 1955 by University of California, Berkeley physicists Emilio Segrè and Owen Chamberlain, for which they were awarded the 1959 Nobel Prize in Physics.[19] An antiproton consists of two up antiquarks and one down antiquark (uud). The properties of the antiproton that have been measured all match the corresponding properties of the proton, with the exception of the antiproton having opposite electric charge and magnetic moment from the proton. Shortly afterwards, in 1956, the antineutron was discovered in proton–proton collisions at the Bevatron (Lawrence Berkeley National Laboratory) by Bruce Cork and colleagues.

In addition to antibaryons, anti-nuclei consisting of multiple bound antiprotons and antineutrons have been created. These are typically produced at energies far too high to form antimatter atoms (with bound positrons in place of electrons). In 1965, a group of researchers led by Antonino Zichichi reported production of nuclei of antideuterium at the Proton Synchrotron atCERN.[21] At roughly the same time, observations of antideuterium nuclei were reported by a group of American physicists at the Alternating Gradient Synchrotron at Brookhaven National Laboratory.[. The primary goal of these collaborations is the creation of less energetic ("cold") ant hydrogen, better suited to study.In 1999, CERN activated the Antiproton Decelerator, a device capable of decelerating antiprotons from 3.5 GeV to 5.3 MeV — still too "hot" to produce study-effective antihydrogen, but a huge leap forward. In late 2002 the ATHENA project announced that they had created the world's first "cold" ant hydrogen. The ATRAP project released similar results very shortly thereafter.] The antiprotons used in these experiments were cooled by **decelerating** them with the Antiproton Decelerator, passing them through a thin sheet of foil, and finally capturing them in a Penning-Malmberg trap .The overall cooling process is workable, but highly inefficient; approximately 25 million antiprotons leave the Antiproton Decelerator and roughly 25,000 make it to the Penning-Malmberg trap, which is about $^1/_{1000}$ or 0.1% of the original amount.

The antiprotons are still hot when initially trapped. To cool them further, they are **mixed** into an electron plasma. The electrons in this plasma cool via **cyclotron radiation**, and then sympathetically cool the antiprotons via Coulomb collisions. Eventually, the electrons are removed by the application of short-duration electric fields, leaving the antiprotons with energies less than 100 meV.[26] While the antiprotons are being cooled in the first trap, a small cloud of positrons is captured from radioactive sodium in a Surko-style positron accumulatorThis cloud is then recaptured in a second trap near the antiprotons. Manipulations of the trap electrodes then tip the antiprotons into the positron plasma, where some combine with antiprotons to form antihydrogen. This neutral antihydrogen is unaffected by the electric and magnetic fields used to trap the charged positrons and antiprotons, and within a few microseconds the antihydrogen hits the trap walls, where it **annihilates**. Some hundreds of millions of antihydrogen atoms have been made in this fashion.

Most of the sought-after high-precision tests of the properties of antihydrogen could only be performed if the antihydrogen were trapped, that is, held in place for a relatively long time. While antihydrogen atoms are electrically neutral, the spins of their component particles **produce** a magnetic moment. These magnetic moments can i**nteract** with an inhomogeneous magnetic field; some of the antihydrogen atoms can be attracted to a magnetic minimum. Such a minimum can be created by a combination of mirror and multipole fields Antihydrogen can be trapped in such a magnetic minimum (minimum-B) trap; in November 2010, the ALPHA collaboration announced that they had so trapped 38 antihydrogen atoms for about a sixth of a second. This was the first time that neutral antimatter had been trapped.

Antimatter(Antimatter causes the destruction of matter)

In 1930, Paul Dirac developed the first description of the electron that was consistent with both quantum mechanics and special relativity. One of the remarkable predictions of this theory was that an anti-particle of the electron should exist. This antielectron would be expected to have the same mass as the electron, but opposite electric charge and magnetic moment. In 1932, Carl Anderson, was examining tracks produced by cosmic rays in a cloud chamber. One particle made a track like an electron, but the curvature of its path in the magnetic field showed that it was positively charged. He named this positive electron a positron. We know that the particle Anderson detected was the anti-electron predicted by Dirac. In the 1950's, physicists at the Lawrence Radiation Laboratory used the Bevatron accelerator to produce the anti-proton, that is a particle with the same mass and spin as the proton, but with negative charge and opposite magnetic moment to that of the proton. In order to create the anti-proton, protons were accelerated to very high energy and then smashed into a target containing other protons. Occasionally, the energy brought into the collision would produce a proton-antiproton pair in addition to the original two protons. This result gave credibility to the idea that for every particle there is a corresponding antiparticle.

A particle and its antimatter particle annihilate when they meet: they disappear and their kinetic plus rest-mass energy is converted into other particles ($E = mc^2$). For example, when an electron and a positron annihilate at rest, two gamma rays, each with energy 511 keV, are produced. These gamma rays go off in opposite directions because both energy and momentum must be conserved. The annihilation of positrons and electrons is the basis of Positron Emission Tomography (PET) discussed in the section on Applications (Chapter 14). When a proton and an antiproton annihilate at rest, other particles are usually produced, but the total kinetic plus rest mass energies of these products adds up to twice the rest mass energy of the proton (2 x 938 MeV).

Antimatter is also produced in some radioactive decays. When ^{14}C decays, a neutron decays to a proton plus an electron and an electron antineutrino, $\bar{\nu}_e$. When ^{19}Ne decays, a proton decays to a neutron plus a positron, e^+, and an electron neutrino, ν_e.

^{14}C --> $^{14}N + e^- + \bar{\nu}_e$ ^{19}Ne --> $^{19}F + e^+ + \nu_e$

The neutrino and electron are leptons while the antineutrino and positron are anti-leptons. Leptons are point-like particles that interact with the electromagnetic, weak and gravitational interaction, but not the strong interaction. An antilepton is an antiparticle. In each reaction, one lepton and one antilepton are produced. These processes show a fundamental law of physics - that for each new lepton that is produced there is a corresponding new antilepton.Although from a distance matter and antimatter would look essentially identical, there appears to be very little antimatter in our universe. This conclusion is partly based on the low observed abundance of antimatter in the cosmic rays, which are particles that constantly rain down on us from outer space. All of the antimatter present in the cosmic rays can be accounted for by radioactive decays or by nuclear reactions involving ordinary matter like those described above. We also do not see the signatures of electron-positron annihilation, or proton-proton annihilation coming from the edges of galaxies, or from places where two galaxies are near each other. As a result, we believe that essentially all of the objects we see in the universe are made of matter not antimatter.

Elementary particle physicists create massive particles by accelerating lower mass particles close to the speed of light, and then smashing them together. The mass/energy of the colliding particles becomes the mass of the created particles. One method includes taking positrons and electrons, accelerating both of them, and smashing them into each other. Out of this energy, very massive particles such as quarks, tau-particles, and the Z^0 can be created. Studies of such electron-positron annihilations are carried out at the Stanford Linear Accelerator and at the LEP facility at CERN. A similar technique is used at the Fermi National Accelerator Laboratory except that it involves colliding protons with anti-protons. Collisions of this kind were recently used to produce the sixth type of quark, known as the top. This particle has a rest mass energy of approximately 160,000 MeV, which is nearly the same as the mass of nucleus of a gold atom!

Atoms of anti-hydrogen, which consist of a positron orbiting an antiproton, are believed to have been created in 1995 at the CERN laboratory in Europe. Physicists are now searching for very small differences between the properties of matter atoms and antimatter atoms. This will help confirm or confound our understanding of the symmetry between matter and anti-matter.

Dark Energy And Creative Destruction

Breaking down is often an essential part of building up. Athletes break down their muscles during hard workouts to build stronger ones for better performances. Construction workers tear down ruins to build skyscrapers. And scientists find flaws in accepted theories and use them to build even better models of how nature actually works."Creative destruction," is the term Joseph Schumpeter coined for the process, which he applied to economics. According to its website http://www.darkenergysurvey.org/ the Dark Energy Survey, "Is designed to probe the origin of the accelerating universe and help uncover the nature of dark energy by measuring the 14-billion-year history of **cosmic expansion** with high precision."Let's back up and break that down. About eighty years ago, an astronomer named Edwin Hubble discovered that the universe was expanding. And for the next fifty years or so, scientists figured—based on well-founded evidence—that gravity would gradually **slow** the expansion down. However, in 1998, two independent teams of scientists, one of which was led by Dr. Saul Perlmutter of Berkeley National Laboratory, announced that instead of slowing, the universe was actually expanding at an accelerating rate. That made precisely no sense—the equivalent of seeing a shot basketball slowly rise to the top of its arc…and then shoot rapidly into the sky—but it seems to be the way the universe began working some five billion years ago.Fermilab will look at **dark energy's effects on large scales, on the galaxies racing away from one another across space and time. That will allow the members of the Dark Energy Survey team to make their** most accurate picture of the universe yet, and perhaps poke a few holes in today's popular theories along the way.

NOTATION :

T_{13} : Balance standing in the category 1

T_{14} : Balance standing in the category 2

T_{15} : Balance standing in the category 3. By balance we mean the (total quantum of the matter multiplied by c^2)

$(b_{13})^{(1)}, (b_{14})^{(1)}, (b_{15})^{(1)}$: Accentuation coefficients

$(b'_{13})^{(1)}, (b'_{14})^{(1)}, (b'_{15})^{(1)}$: Dissipation coefficients

FORMULATION OF THE SYSTEM :

Under the above assumptions, we derive the following :

The growth speed in category 1 is the sum of two parts:

A term $+(b_{13})^{(1)}T_{14}$ proportional to the balance of the mc^2 in the expanding universe in the category2.A term $-(b'_{13})^{(1)}T_{13}$ representing the quantum of balance dissipated from category 1 .This comprises of energy density vis-à-vis matter which have grown old qualified to be classified under category 2.

The growth speed in category 2 is the sum of two parts:

(1)term $+(b_{14})^{(1)}T_{13}$ constitutive of the amount of inflow from the category 1

(2)A term $-(b'_{14})^{(1)}T_{14}$ the dissipation factor arising due to energy density, notwithstanding the conservation of energy-see the bank example given above. Transformations take place, but that shall not disturb the conservation of energy for individual transformations themselves have followed the conservation principle, like Bank's Debit and Credit.

The growth speed under category 3 is attributable to inflow from category 2 Any stalling, deceleration, of the energy density attributable to collapse of gravitational force/field like in black holes (Please see different types of conversion, essay at the end)

GOVERNING EQUATIONS:

Following are the differential equations that govern the growth in the Matter Portfolio:

$$\frac{dT_{13}}{dt} = (b_{13})^{(1)}T_{14} - (b'_{13})^{(1)}T_{13} \quad 12$$

$$\frac{dT_{14}}{dt} = (b_{14})^{(1)}T_{13} - (b'_{14})^{(1)}T_{14} \quad 13$$

$$\frac{dT_{15}}{dt} = (b_{15})^{(1)}T_{14} - (b'_{15})^{(1)}T_{15} \quad 14$$

$$(b_i)^{(1)} > 0 \quad , \quad i = 13,14,15 \quad 15$$

$$(b'_i)^{(1)} > 0 \quad , \quad i = 13,14,15 \quad 16$$

$$(b_{14})^{(1)} < (b'_{13})^{(1)} \quad 17$$

$$(b_{15})^{(1)} < (b'_{14})^{(1)} \quad 18$$

Following the same procedure outlined in the previous section , the general solution of the governing equations is $\alpha'_i T_i + \beta'_i T_i + \gamma'_i T_i = C'_i e_i^{\lambda' i t}$, $i = 13,14,15$ where $C'_{13}, C'_{14}, C'_{15}$ are arbitrary constant coefficients and $\alpha'_{13}, \alpha'_{14}, \alpha'_{15}, \gamma'_{13}, \gamma'_{14}, \gamma'_{15}$ corresponding multipliers to the characteristic roots of the system.

MASS AND ENERGY-DUAL SYSTEM PROBLEM

We will denote

1) By $T_i(t), i = 13,14,15$, the three parts of the matter vis-à-vis energy density analogously to the G_i of the matter in expanding universe portfolio
2) By $(a_i'')^{(1)}(T_{14},t)$ $(T_{14} \geq 0, t \geq 0)$,the contribution of the matter to the dissipation coefficient of the energy density in the expanding universe
3) By $(-b_i'')^{(1)}(G_{13}, G_{14}, G_{15}, t) = -(b_i'')^{(1)}(G, t)$, the contribution of the matter to the dissipation coefficient of the energy density in the universe.

GOVERNING EQUATIONS

$$\frac{dG_{13}}{dt} = (a_{13})^{(1)} G_{14} - \left[(a_{13}')^{(1)} + (a_{13}'')^{(1)}(T_{14}, t) \right] G_{13}$$ 19

$$\frac{dG_{14}}{dt} = (a_{14})^{(1)} G_{13} - \left[(a_{14}')^{(1)} + (a_{14}'')^{(1)}(T_{14}, t) \right] G_{14}$$ 20

$$\frac{dG_{15}}{dt} = (a_{15})^{(1)} G_{14} - \left[(a_{15}')^{(1)} + (a_{15}'')^{(1)}(T_{14}, t) \right] G_{15}$$ 21

$$\frac{dT_{13}}{dt} = (b_{13})^{(1)} T_{14} - \left[(b_{13}')^{(1)} - (b_{13}'')^{(1)}(G, t) \right] T_{13}$$ 22

$$\frac{dT_{14}}{dt} = (b_{14})^{(1)} T_{13} - \left[(b_{14}')^{(1)} - (b_{14}'')^{(1)}(G, t) \right] T_{14}$$ 23

$$\frac{dT_{15}}{dt} = (b_{15})^{(1)} T_{14} - \left[(b_{15}')^{(1)} - (b_{15}'')^{(1)}(G, t) \right] T_{15}$$ 24

$+(a_{13}'')^{(1)}(T_{14}, t) =$ First augmentation factor attributable to matter dissipating the energy density in the expanding universe

$-(b_{13}'')^{(1)}(G, t) =$ First detrition factor contributed by total energy density in the EXPANDING UNIVERSE(by that we are making the point in the exclusive preserve that there shall be increase or decrease in energy density(and concomitant mc^2 term),not withstanding the conservation of energy in consideration to the fact that individual transformations also testify law of conservation of energy and law of conservation of mass

Where we suppose

A. $(a_i)^{(1)}, (a_i')^{(1)}, (a_i'')^{(1)}, (b_i)^{(1)}, (b_i')^{(1)}, (b_i'')^{(1)} > 0, \ i, j = 13, 14, 15$

The functions $(a_i'')^{(1)}, (b_i'')^{(1)}$ are positive continuous increasing and bounded.

B. **<u>Definition of</u>** $(p_i)^{(1)}, (r_i)^{(1)}$:

$$(a_i'')^{(1)}(T_{14}, t) \leq (p_i)^{(1)} \leq (\hat{A}_{13})^{(1)}$$ 25

$$(b_i'')^{(1)}(G, t) \leq (r_i)^{(1)} \leq (b_i')^{(1)} \leq (\hat{B}_{13})^{(1)}$$ 26

$lim_{T_2\to\infty}(a_i'')^{(1)}(T_{14},t) = (p_i)^{(1)}$ 27

$\lim_{G\to\infty}(b_i'')^{(1)}(G,t) = (r_i)^{(1)}$ 28

C. **Definition of** $(\hat{A}_{13})^{(1)}, (\hat{B}_{13})^{(1)}$:

Where $\boxed{(\hat{A}_{13})^{(1)}, (\hat{B}_{13})^{(1)}, (p_i)^{(1)}, (r_i)^{(1)}}$ are positive constants and $\boxed{i = 13,14,15}$

They satisfy Lipschitz condition:

$|(a_i'')^{(1)}(T_{14}',t) - (a_i'')^{(1)}(T_{14},t)| \leq (\hat{k}_{13})^{(1)}|T_{14} - T_{14}'|e^{-(\hat{M}_{13})^{(1)}t}$ 29

$|(b_i'')^{(1)}(G',t) - (b_i'')^{(1)}(G,T)| < (\hat{k}_{13})^{(1)}||G - G'||e^{-(\hat{M}_{13})^{(1)}t}$ 30

With the Lipschitz condition, we place a restriction on the behavior of functions $(a_i'')^{(1)}(T_{14}',t)$ and $(a_i'')^{(1)}(T_{14},t)$. (T_{14}',t) and (T_{14},t) are points belonging to the interval $[(\hat{k}_{13})^{(1)}, (\hat{M}_{13})^{(1)}]$. It is to be noted that $(a_i'')^{(1)}(T_{14},t)$ is uniformly continuous. In the eventuality of the fact, that if $(\hat{M}_{13})^{(1)} = 1$ then the function $(a_i'')^{(1)}(T_{14},t)$, the first augmentation coefficient , would be absolutely continuous.

D. **Definition of** $(\hat{M}_{13})^{(1)}, (\hat{k}_{13})^{(1)}$:

$(\hat{M}_{13})^{(1)}, (\hat{k}_{13})^{(1)}$, are positive constants

$$\frac{(a_i)^{(1)}}{(\hat{M}_{13})^{(1)}}, \frac{(b_i)^{(1)}}{(\hat{M}_{13})^{(1)}} < 1$$ 31

E. **Definition of** $(\hat{P}_{13})^{(1)}, (\hat{Q}_{13})^{(1)}$:

There exists two constants $(\hat{P}_{13})^{(1)}$ and $(\hat{Q}_{13})^{(1)}$ which together with $(\hat{M}_{13})^{(1)}, (\hat{k}_{13})^{(1)}, (\hat{A}_{13})^{(1)} and (\hat{B}_{13})^{(1)}$ and the constants $(a_i)^{(1)}, (a_i')^{(1)}, (b_i)^{(1)}, (b_i')^{(1)}, (p_i)^{(1)}, (r_i)^{(1)}, i = 13,14,15,$ satisfy the inequalities 32

$$\frac{1}{(\hat{M}_{13})^{(1)}}[(a_i)^{(1)} + (a_i')^{(1)} + (\hat{A}_{13})^{(1)} + (\hat{P}_{13})^{(1)}(\hat{k}_{13})^{(1)}] < 1$$ 33

$$\frac{1}{(\hat{M}_{13})^{(1)}}[(b_i)^{(1)} + (b_i')^{(1)} + (\hat{B}_{13})^{(1)} + (\hat{Q}_{13})^{(1)}(\hat{k}_{13})^{(1)}] < 1$$

Theorem 1: if the conditions (A)-(E) above are fulfilled, there exists a solution satisfying the conditions

Definition of $G_i(0), T_i(0)$:

$G_i(t) \leq \left(\hat{P}_{13} \right)^{(1)} e^{(\hat{M}_{13})^{(1)} t}$, $\boxed{G_i(0) = G_i^0 > 0}$

$T_i(t) \leq \left(\hat{Q}_{13} \right)^{(1)} e^{(\hat{M}_{13})^{(1)} t}$, $\boxed{T_i(0) = T_i^0 > 0}$

Proof:

Consider operator $\mathcal{A}^{(1)}$ defined on the space of sextuples of continuous functions G_i, $T_i: \mathbb{R}_+ \to \mathbb{R}_+$ which satisfy

$G_i(0) = G_i^0$, $T_i(0) = T_i^0$, $G_i^0 \leq (\hat{P}_{13})^{(1)}$, $T_i^0 \leq (\hat{Q}_{13})^{(1)}$, 34

$0 \leq G_i(t) - G_i^0 \leq (\hat{P}_{13})^{(1)} e^{(\hat{M}_{13})^{(1)} t}$ 35

$0 \leq T_i(t) - T_i^0 \leq (\hat{Q}_{13})^{(1)} e^{(\hat{M}_{13})^{(1)} t}$ 36

By

37

$$\bar{G}_{13}(t) = G_{13}^0 + \int_0^t \left[(a_{13})^{(1)} G_{14}(s_{(13)}) - \left((a'_{13})^{(1)} + a''_{13})^{(1)} \left(T_{14}(s_{(13)}), s_{(13)} \right) \right) G_{13}(s_{(13)}) \right] ds_{(13)}$$

$$\bar{G}_{14}(t) = G_{14}^0 + \int_0^t \left[(a_{14})^{(1)} G_{13}(s_{(13)}) - \left((a'_{14})^{(1)} + (a''_{14})^{(1)} \left(T_{14}(s_{(13)}), s_{(13)} \right) \right) G_{14}(s_{(13)}) \right] ds_{(13)} \quad 38$$

$$\bar{G}_{15}(t) = G_{15}^0 + \int_0^t \left[(a_{15})^{(1)} G_{14}(s_{(13)}) - \left((a'_{15})^{(1)} + (a''_{15})^{(1)} \left(T_{14}(s_{(13)}), s_{(13)} \right) \right) G_{15}(s_{(13)}) \right] ds_{(13)} \quad 39$$

40

$$\bar{T}_{13}(t) = T_{13}^0 + \int_0^t \left[(b_{13})^{(1)} T_{14}(s_{(13)}) - \left((b'_{13})^{(1)} - (b''_{13})^{(1)} \left(G(s_{(13)}), s_{(13)} \right) \right) T_{13}(s_{(13)}) \right] ds_{(13)}$$

$$\bar{T}_{14}(t) = T_{14}^0 + \int_0^t \left[(b_{14})^{(1)} T_{13}(s_{(13)}) - \left((b'_{14})^{(1)} - (b''_{14})^{(1)} \left(G(s_{(13)}), s_{(13)} \right) \right) T_{14}(s_{(13)}) \right] ds_{(13)} \quad 41$$

$$\bar{T}_{15}(t) = T_{15}^0 + \int_0^t \left[(b_{15})^{(1)} T_{14}(s_{(13)}) - \left((b'_{15})^{(1)} - (b''_{15})^{(1)} \left(G(s_{(13)}), s_{(13)} \right) \right) T_{15}(s_{(13)}) \right] ds_{(13)} \quad 42$$

Where $s_{(13)}$ is the integrand that is integrated over an interval $(0, t)$

(c) The operator $\mathcal{A}^{(1)}$ maps the space of functions satisfying 34,35,36 into itself .Indeed it is obvious that

43

$$G_{13}(t) \leq G_{13}^0 + \int_0^t \left[(a_{13})^{(1)} \left(G_{14}^0 + (\hat{P}_{13})^{(1)} e^{(\hat{M}_{13})^{(1)} s_{(13)}} \right) \right] ds_{(13)} = \left(1 + (a_{13})^{(1)} t \right) G_{14}^0 + \frac{(a_{13})^{(1)} (\hat{P}_{13})^{(1)}}{(\hat{M}_{13})^{(1)}} \left(e^{(\hat{M}_{13})^{(1)} t} - 1 \right)$$

From which it follows that

$$(G_{13}(t) - G_{13}^0) e^{-(\hat{M}_{13})^{(1)} t} \leq \frac{(a_{13})^{(1)}}{(\hat{M}_{13})^{(1)}} \left[\left((\hat{P}_{13})^{(1)} + G_{14}^0 \right) e^{\left(-\frac{(\hat{P}_{13})^{(1)} + G_{14}^0}{G_{14}^0} \right)} + (\hat{P}_{13})^{(1)} \right] \quad 44$$

(G_i^0) is as defined in the statement of theorem 1

Analogous inequalities hold also for $G_{14}, G_{15}, T_{13}, T_{14}, T_{15}$

It is now sufficient to take $\frac{(a_i)^{(1)}}{(\hat{M}_{13})^{(1)}}, \frac{(b_i)^{(1)}}{(\hat{M}_{13})^{(1)}} < 1$ and to choose $(\hat{P}_{13})^{(1)}$ and $(\hat{Q}_{13})^{(1)}$ large to have

$$\frac{(a_i)^{(1)}}{(\hat{M}_{13})^{(1)}}\left[(\hat{P}_{13})^{(1)} + ((\hat{P}_{13})^{(1)} + G_j^0)e^{-\left(\frac{(\hat{P}_{13})^{(1)}+G_j^0}{G_j^0}\right)}\right] \le (\hat{P}_{13})^{(1)}$$ 45

$$\frac{(b_i)^{(1)}}{(\hat{M}_{13})^{(1)}}\left[((\hat{Q}_{13})^{(1)} + T_j^0)e^{-\left(\frac{(\hat{Q}_{13})^{(1)}+T_j^0}{T_j^0}\right)} + (\hat{Q}_{13})^{(1)}\right] \le (\hat{Q}_{13})^{(1)}$$ 46

In order that the operator $\mathcal{A}^{(1)}$ transforms the space of sextuples of functions G_i, T_i satisfying 34,35,36 into itself

The operator $\mathcal{A}^{(1)}$ is a contraction with respect to the metric 47

$$d\left(\left(G^{(1)}, T^{(1)}\right), \left(G^{(2)}, T^{(2)}\right)\right) =$$
$$\sup_i\{\max_{t\in\mathbb{R}_+} G_i^{(1)}(t) - G_i^{(2)}(t)|e^{-(\hat{M}_{13})^{(1)}t}, \max_{t\in\mathbb{R}_+}|T_i^{(1)}(t) - T_i^{(2)}(t)|e^{-(\hat{M}_{13})^{(1)}t}\}$$

Indeed if we denote

Definition of $\tilde{G}, \tilde{T}$: $\left(\tilde{G}, \tilde{T}\right) = \mathcal{A}^{(1)}(G, T)$ 48

It results

$$|\tilde{G}_{13}^{(1)} - \tilde{G}_i^{(2)}| \le \int_0^t (a_{13})^{(1)} |G_{14}^{(1)} - G_{14}^{(2)}| e^{-(\hat{M}_{13})^{(1)}s_{(13)}} e^{(\hat{M}_{13})^{(1)}s_{(13)}} ds_{(13)} +$$
$$\int_0^t \{(a'_{13})^{(1)}|G_{13}^{(1)} - G_{13}^{(2)}|e^{-(\hat{M}_{13})^{(1)}s_{(13)}}e^{-(\hat{M}_{13})^{(1)}s_{(13)}} +$$
$$(a''_{13})^{(1)}(T_{14}^{(1)}, s_{(13)})|G_{13}^{(1)} - G_{13}^{(2)}|e^{-(\hat{M}_{13})^{(1)}s_{(13)}}e^{(\hat{M}_{13})^{(1)}s_{(13)}} -$$ 49
$$G_{13}^{(2)}|(a''_{13})^{(1)}(T_{14}^{(1)}, s_{(13)}) - (a''_{13})^{(1)}(T_{14}^{(2)}, s_{(13)})|\ e^{-(\hat{M}_{13})^{(1)}s_{(13)}}e^{(\hat{M}_{13})^{(1)}s_{(13)}}\}ds_{(13)}$$

Where $s_{(13)}$ represents integrand that is integrated over the interval $[0, t]$

From the hypotheses on 25,26,27,28 and 29 it follows

$$|G^{(1)} - G^{(2)}|e^{-(\hat{M}_{13})^{(1)}t} \le$$
$$\frac{1}{(\hat{M}_{13})^{(1)}}\left((a_{13})^{(1)} + (a'_{13})^{(1)} + (\hat{A}_{13})^{(1)} + (\hat{P}_{13})^{(1)}(\hat{k}_{13})^{(1)}\right)d\left(\left(G^{(1)}, T^{(1)}; G^{(2)}, T^{(2)}\right)\right)$$ 50

And analogous inequalities for G_i *and* T_i. Taking into account the hypothesis (34,35,36) the result follows

Remark 1: The fact that we supposed $(a''_{13})^{(1)}$ and $(b''_{13})^{(1)}$ depending also on t can be considered as not conformal with the reality, however we have put this hypothesis ,in order that we can postulate condition necessary to prove the uniqueness of the solution bounded by $(\hat{P}_{13})^{(1)}e^{(\hat{M}_{13})^{(1)}t}$ and $(\hat{Q}_{13})^{(1)}e^{(\hat{M}_{13})^{(1)}t}$ respectively of $\mathbb{R}_+$. 51

If instead of proving the existence of the solution on $\mathbb{R}_+$, we have to prove it only on a compact then it suffices to consider that $(a''_i)^{(1)}$ and $(b''_i)^{(1)}, i = 13,14,15$ depend only on T_{14} and respectively on $G(and\ not\ on\ t)$ and hypothesis can replaced by a usual Lipschitz condition.

Remark 2: There does not exist any t where $G_i(t) = 0$ and $T_i(t) = 0$ 52

From 19 to 24 it results

$$G_i(t) \geq G_i^0 e^{\left[-\int_0^t \{(a'_i)^{(1)} - (a''_i)^{(1)}(T_{14}(s_{(13)}), s_{(13)})\} ds_{(13)}\right]} \geq 0$$

$$T_i(t) \geq T_i^0 e^{(-(b'_i)^{(1)} t)} > 0 \quad \text{for } t > 0$$

Definition of $\left((\hat{M}_{13})^{(1)}\right)_1, \left((\hat{M}_{13})^{(1)}\right)_2$ and $\left((\hat{M}_{13})^{(1)}\right)_3$:

Remark 3: if G_{13} is bounded, the same property have also G_{14} and G_{15} . indeed if 53

$G_{13} < (\hat{M}_{13})^{(1)}$ it follows $\frac{dG_{14}}{dt} \leq \left((\hat{M}_{13})^{(1)}\right)_1 - (a'_{14})^{(1)}G_{14}$ and by integrating

$$G_{14} \leq \left((\hat{M}_{13})^{(1)}\right)_2 = G_{14}^0 + 2(a_{14})^{(1)}\left((\hat{M}_{13})^{(1)}\right)_1/(a'_{14})^{(1)}$$

In the same way , one can obtain

$$G_{15} \leq \left((\hat{M}_{13})^{(1)}\right)_3 = G_{15}^0 + 2(a_{15})^{(1)}\left((\hat{M}_{13})^{(1)}\right)_2/(a'_{15})^{(1)}$$

If G_{14} or G_{15} is bounded, the same property follows for G_{13} , G_{15} and G_{13} , G_{14} respectively.

Remark 4: If G_{13} is bounded, from below, the same property holds for G_{14} and G_{15} . The proof is analogous with the preceding one. An analogous property is true if G_{14} is bounded from below. 54

Remark 5: If T_{13} is bounded from below and $\lim_{t\to\infty}((b''_i)^{(1)}(G(t),t)) = (b'_{14})^{(1)}$ then $T_{14} \to \infty$. 55

Definition of $(m)^{(1)}$ and ε_1 :

Indeed let t_1 be so that for $t > t_1$

$$(b_{14})^{(1)} - (b''_i)^{(1)}(G(t),t) < \varepsilon_1, T_{13}(t) > (m)^{(1)}$$

Then $\frac{dT_{14}}{dt} \geq (a_{14})^{(1)}(m)^{(1)} - \varepsilon_1 T_{14}$ which leads to

$T_{14} \geq \left(\frac{(a_{14})^{(1)}(m)^{(1)}}{\varepsilon_1}\right)(1 - e^{-\varepsilon_1 t}) + T_{14}^0 e^{-\varepsilon_1 t}$ If we take t such that $e^{-\varepsilon_1 t} = \frac{1}{2}$ it results

$T_{14} \geq \left(\frac{(a_{14})^{(1)}(m)^{(1)}}{2}\right)$, $t = log\frac{2}{\varepsilon_1}$ By taking now ε_1 sufficiently small one sees that T_{14} is unbounded. The same property holds for T_{15} if $\lim_{t\to\infty}(b''_{15})^{(1)}(G(t),t) = (b'_{15})^{(1)}$

We now state a more precise theorem about the behaviors at infinity of the solutions of equations 37 to 42

Behavior of the solutions of equation 37 to 42

Theorem 2: If we denote and define

Definition of $(\sigma_1)^{(1)},(\sigma_2)^{(1)},(\tau_1)^{(1)},(\tau_2)^{(1)}$: 56

(d) $\sigma_1)^{(1)},(\sigma_2)^{(1)},(\tau_1)^{(1)},(\tau_2)^{(1)}$ four constants satisfying

57

$-(\sigma_2)^{(1)} \leq -(a'_{13})^{(1)} + (a'_{14})^{(1)} - (a''_{13})^{(1)}(T_{14},t) + (a''_{14})^{(1)}(T_{14},t) \leq -(\sigma_1)^{(1)}$ 58

$-(\tau_2)^{(1)} \leq -(b'_{13})^{(1)} + (b'_{14})^{(1)} - (b''_{13})^{(1)}(G,t) - (b''_{14})^{(1)}(G,t) \leq -(\tau_1)^{(1)}$

Definition of $(\nu_1)^{(1)},(\nu_2)^{(1)},(u_1)^{(1)},(u_2)^{(1)},\nu^{(1)},u^{(1)}$: 59

(e) By $(\nu_1)^{(1)} > 0,(\nu_2)^{(1)} < 0$ and respectively $(u_1)^{(1)} > 0,(u_2)^{(1)} < 0$ the roots of the equations

$(a_{14})^{(1)}(\nu^{(1)})^2 + (\sigma_1)^{(1)}\nu^{(1)} - (a_{13})^{(1)} = 0$ 60

61

and $(b_{14})^{(1)}(u^{(1)})^2 + (\tau_1)^{(1)}u^{(1)} - (b_{13})^{(1)} = 0$ and

Definition of $(\bar{\nu}_1)^{(1)},, (\bar{\nu}_2)^{(1)},(\bar{u}_1)^{(1)},(\bar{u}_2)^{(1)}$: 62

By $(\bar{\nu}_1)^{(1)} > 0,(\bar{\nu}_2)^{(1)} < 0$ and respectively $(\bar{u}_1)^{(1)} > 0,(\bar{u}_2)^{(1)} < 0$ the

roots of the equations $(a_{14})^{(1)}(\nu^{(1)})^2 + (\sigma_2)^{(1)}\nu^{(1)} - (a_{13})^{(1)} = 0$ 63

and $(b_{14})^{(1)}(u^{(1)})^2 + (\tau_2)^{(1)}u^{(1)} - (b_{13})^{(1)} = 0$ 64

Definition of $(m_1)^{(1)},(m_2)^{(1)},(\mu_1)^{(1)},(\mu_2)^{(1)},(\nu_0)^{(1)}$:- 65

(f) If we define $(m_1)^{(1)},(m_2)^{(1)},(\mu_1)^{(1)},(\mu_2)^{(1)}$ by

66

67

$(m_2)^{(1)} = (\nu_0)^{(1)},(m_1)^{(1)} = (\nu_1)^{(1)},\ if\ (\nu_0)^{(1)} < (\nu_1)^{(1)}$ 68

$(m_2)^{(1)} = (\nu_1)^{(1)},(m_1)^{(1)} = (\bar{\nu}_1)^{(1)},if\ (\nu_1)^{(1)} < (\nu_0)^{(1)} < (\bar{\nu}_1)^{(1)},$

and $\boxed{(\nu_0)^{(1)} = \frac{G^0_{13}}{G^0_{14}}}$

69

$(m_2)^{(1)} = (\nu_1)^{(1)},(m_1)^{(1)} = (\nu_0)^{(1)},\ if\ (\bar{\nu}_1)^{(1)} < (\nu_0)^{(1)}$

and analogously

70

$(\mu_2)^{(1)} = (u_0)^{(1)},(\mu_1)^{(1)} = (u_1)^{(1)},\ if\ (u_0)^{(1)} < (u_1)^{(1)}$

$(\mu_2)^{(1)} = (u_-)^{(1)}, (\mu_1)^{(1)} = (\bar{u}_1)^{(1)}, if\ (u_1)^{(1)} < (u_0)^{(1)} < (\bar{u}_-)^{(1)},$
and $\boxed{(u_0)^{(1)} = \frac{T_{13}^0}{T_{14}^0}}$ 71

$(\mu_2)^{(1)} = (u_1)^{(1)}, (\mu_1)^{(1)} = (u_0)^{(1)}, if\ (\bar{u}_1)^{(1)} < (u_0)^{(1)}$ where $(u_1)^{(1)}, (\bar{u}_1)^{(1)}$
are defined by 59 and 61 respectively

Then the solution of 19,20,21,22,23 and 24 satisfies the inequalities

$$G_{13}^0 e^{((S_1)^{(1)} - (p_{13})^{(1)})t} \leq G_{13}(t) \leq G_{13}^0 e^{(S_1)^{(1)}t}$$ 72

where $(p_i)^{(1)}$ is defined by equation 25

$$\frac{1}{(m_1)^{(1)}} G_{13}^0 e^{((S_1)^{(1)} - (p_{13})^{(1)})t} \leq G_{14}(t) \leq \frac{1}{(m_2)^{(1)}} G_{13}^0 e^{(S_1)^{(1)}t}$$ 73

$$\left(\frac{(a_{15})^{(1)} G_{13}^0}{(m_1)^{(1)}((S_1)^{(1)} - (p_{13})^{(1)} - (S_2)^{(1)})} \left[e^{((S_1)^{(1)} - (p_{13})^{(1)})t} - e^{-(S_2)^{(1)}t} \right] + G_{15}^0 e^{-(S_2)^{(1)}t} \leq G_{15}(t) \leq \right.$$ 74
$$\left. \frac{(a_{15})^{(1)} G_{13}^0}{(m_2)^{(1)}((S_1)^{(1)} - (a'_{15})^{(1)})} [e^{(S_1)^{(1)}t} - e^{-(a'_{15})^{(1)}t}] + G_{15}^0 e^{-(a'_{15})^{(1)}t} \right)$$

$$\boxed{T_{13}^0 e^{(R_1)^{(1)}t} \leq T_{13}(t) \leq T_{13}^0 e^{((R_1)^{(1)} + (r_{13})^{(1)})t}}$$ 75

$$\frac{1}{(\mu_1)^{(1)}} T_{13}^0 e^{(R_1)^{(1)}t} \leq T_{13}(t) \leq \frac{1}{(\mu_2)^{(1)}} T_{13}^0 e^{((R_1)^{(1)} + (r_{13})^{(1)})t}$$ 76

$$\frac{(b_{15})^{(1)} T_{13}^0}{(\mu_1)^{(1)}((R_1)^{(1)} - (b'_{15})^{(1)})} \left[e^{(R_1)^{(1)}t} - e^{-(b'_{15})^{(1)}t} \right] + T_{15}^0 e^{-(b'_{15})^{(1)}t} \leq T_{15}(t) \leq$$ 77

$$\frac{(a_{15})^{(1)} T_{13}^0}{(\mu_2)^{(1)}((R_1)^{(1)} + (r_{13})^{(1)} + (R_2)^{(1)})} \left[e^{((R_1)^{(1)} + (r_{13})^{(1)})t} - e^{-(R_2)^{(1)}t} \right] + T_{15}^0 e^{-(R_2)^{(1)}t}$$

Definition of $(S_1)^{(1)}, (S_2)^{(1)}, (R_1)^{(1)}, (R_2)^{(1)}$:-

Where $(S_1)^{(1)} = (a_{13})^{(1)}(m_2)^{(1)} - (a'_{13})^{(1)}$ 78

$(S_2)^{(1)} = (a_{15})^{(1)} - (p_{15})^{(1)}$

$(R_1)^{(1)} = (b_{13})^{(1)}(\mu_2)^{(1)} - (b'_{13})^{(1)}$ 79

$(R_2)^{(1)} = (b'_{15})^{(1)} - (r_{15})^{(1)}$

Proof : From 19,20,21,22,23,24 we obtain 80

$$\frac{d\nu^{(1)}}{dt} = (a_{13})^{(1)} - \left((a'_{13})^{(1)} - (a'_{14})^{(1)} + (a''_{13})^{(1)}(T_{14}, t) \right) - (a''_{14})^{(1)}(T_{14}, t)\nu^{(1)} - (a_{14})^{(1)}\nu^{(1)}$$

Definition of $\nu^{(1)}$:- $\boxed{\nu^{(1)} = \frac{G_{13}}{G_{14}}}$

It follows

$$-\left((a_{14})^{(1)}(\nu^{(1)})^2+(\sigma_2)^{(1)}\nu^{(1)}-(a_{13})^{(1)}\right)\leq\frac{d\nu^{(1)}}{dt}\leq-\left((a_{14})^{(1)}(\nu^{(1)})^2+(\sigma_1)^{(1)}\nu^{(1)}-(a_{13})^{(1)}\right)$$ 81

From which one obtains

Definition of $(\bar{\nu}_1)^{(1)},(\nu_0)^{(1)}$:-

82

(d) For $0<\boxed{(\nu_0)^{(1)}=\frac{G_{13}^0}{G_{14}^0}}<(\nu_1)^{(1)}<(\bar{\nu}_1)^{(1)}$

$$\nu^{(1)}(t)\geq\frac{(\nu_1)^{(1)}+(C)^{(1)}(\nu_2)^{(1)}e^{\left[-(a_{14})^{(1)}\left((\nu_1)^{(1)}-(\nu_0)^{(1)}\right)t\right]}}{1+(C)^{(1)}e^{\left[-(a_{14})^{(1)}\left((\nu_1)^{(1)}-(\nu_0)^{(1)}\right)t\right]}}\quad,\quad\boxed{(C)^{(1)}=\frac{(\nu_1)^{(1)}-(\nu_0)^{(1)}}{(\nu_0)^{(1)}-(\nu_2)^{(1)}}}$$

it follows $(\nu_0)^{(1)}\leq\nu^{(1)}(t)\leq(\nu_1)^{(1)}$

In the same manner , we get

$$\nu^{(1)}(t)\leq\frac{(\bar{\nu}_1)^{(1)}+(\bar{C})^{(1)}(\bar{\nu}_2)^{(1)}e^{\left[-(a_{14})^{(1)}\left((\bar{\nu}_1)^{(1)}-(\bar{\nu}_2)^{(1)}\right)t\right]}}{1-(\bar{C})^{(1)}e^{\left[-(a_{14})^{(1)}\left((\bar{\nu}_1)^{(1)}-(\bar{\nu}_2)^{(1)}\right)t\right]}}\quad,\quad\boxed{(\bar{C})^{(1)}=\frac{(\bar{\nu}_1)^{(1)}-(\nu_0)^{(1)}}{(\nu_0)^{(1)}-(\bar{\nu}_2)^{(1)}}}$$ 83

From which we deduce $(\nu_0)^{(1)}\leq\nu^{(1)}(t)\leq(\bar{\nu}_1)^{(1)}$

(e) If $0<(\nu_1)^{(1)}<(\nu_0)^{(1)}=\frac{G_{13}^0}{G_{14}^0}<(\bar{\nu}_1)^{(1)}$ we find like in the previous case, 84

$$(\nu_1)^{(1)}\leq\frac{(\nu_1)^{(1)}+(C)^{(1)}(\nu_2)^{(1)}e^{\left[-(a_{14})^{(1)}\left((\nu_1)^{(1)}-(\nu_2)^{(1)}\right)t\right]}}{1+(C)^{(1)}e^{\left[-(a_{14})^{(1)}\left((\nu_1)^{(1)}-(\nu_2)^{(1)}\right)t\right]}}\leq\nu^{(1)}(t)\leq$$

$$\frac{(\bar{\nu}_1)^{(1)}+(\bar{C})^{(1)}(\bar{\nu}_2)^{(1)}e^{\left[-(a_{14})^{(1)}\left((\bar{\nu}_1)^{(1)}-(\bar{\nu}_2)^{(1)}\right)t\right]}}{1+(\bar{C})^{(1)}e^{\left[-(a_{14})^{(1)}\left((\bar{\nu}_1)^{(1)}-(\bar{\nu}_2)^{(1)}\right)t\right]}}\leq(\bar{\nu}_1)^{(1)}$$

(f) If $0<(\nu_1)^{(1)}\leq(\bar{\nu}_1)^{(1)}\leq\boxed{(\nu_0)^{(1)}=\frac{G_{13}^0}{G_{14}^0}}$, we obtain

$$(\nu_1)^{(1)}\leq\nu^{(1)}(t)\leq\frac{(\bar{\nu}_1)^{(1)}+(\bar{C})^{(1)}(\bar{\nu}_2)^{(1)}e^{\left[-(a_{14})^{(1)}\left((\bar{\nu}_1)^{(1)}-(\bar{\nu}_2)^{(1)}\right)t\right]}}{1+(\bar{C})^{(1)}e^{\left[-(a_{14})^{(1)}\left((\bar{\nu}_1)^{(1)}-(\bar{\nu}_2)^{(1)}\right)t\right]}}\leq(\nu_0)^{(1)}$$ 85

And so with the notation of the first part of condition (c) , we have

Definition of $\nu^{(1)}(t)$:-

86

$(m_2)^{(1)} \leq \nu^{(1)}(t) \leq (m_1)^{(1)}, \quad \boxed{\nu^{(1)}(t) = \frac{G_{13}(t)}{G_{14}(t)}}$

In a completely analogous way, we obtain

Definition of $u^{(1)}(t)$:- 87

$(\mu_2)^{(1)} \leq u^{(1)}(t) \leq (\mu_1)^{(1)}, \quad \boxed{u^{(1)}(t) = \frac{T_{13}(t)}{T_{14}(t)}}$

Now, using this result and replacing it in 19, 20,21,22,23, and 24 we get easily the result stated in the theorem.

Particular case :

If $(a''_{13})^{(1)} = (a''_{14})^{(1)}, then\, (\sigma_1)^{(1)} = (\sigma_2)^{(1)}$ and in this case $(\nu_1)^{(1)} = (\bar{\nu}_1)^{(1)}$ if in addition $(\nu_0)^{(1)} = (\nu_1)^{(1)}$ then $\nu^{(1)}(t) = (\nu_0)^{(1)}$ and as a consequence $G_{13}(t) = (\nu_0)^{(1)} G_{14}(t)$ this also defines $(\nu_0)^{(1)}$ for the special case

Analogously if $(b''_{13})^{(1)} = (b''_{14})^{(1)}, then\, (\tau_1)^{(1)} = (\tau_2)^{(1)}$ and then
$(u_1)^{(1)} = (\bar{u}_1)^{(1)}$if in addition $(u_0)^{(1)} = (u_1)^{(1)}$ then $T_{13}(t) = (u_0)^{(1)} T_{14}(t)$ This is an important consequence of the relation between $(\nu_1)^{(1)}$ and $(\bar{\nu}_1)^{(1)}$, and definition of $(u_0)^{(1)}$.

Theorem 3: If $(a''_i)^{(1)} and\, (b''_i)^{(1)}$ are independent on t , and the conditions (with the notations 25,26,27,28) 88

$(a'_{13})^{(1)}(a'_{14})^{(1)} - (a_{13})^{(1)}(a_{14})^{(1)} < 0$

$(a'_{13})^{(1)}(a'_{14})^{(1)} - (a_{13})^{(1)}(a_{14})^{(1)} + (a_{13})^{(1)}(p_{13})^{(1)} + (a'_{14})^{(1)}(p_{14})^{(1)} + (p_{13})^{(1)}(p_{14})^{(1)} > 0$

$(b'_{13})^{(1)}(b'_{14})^{(1)} - (b_{13})^{(1)}(b_{14})^{(1)} > 0$,

$(b'_{13})^{(1)}(b'_{14})^{(1)} - (b_{13})^{(1)}(b_{14})^{(1)} - (b'_{13})^{(1)}(r_{14})^{(1)} - (b'_{14})^{(1)}(r_{14})^{(1)} + (r_{13})^{(1)}(r_{14})^{(1)} < 0$

$with\ (p_{13})^{(1)}, (r_{14})^{(1)}$ as defined by equation 25 are satisfied , then the system

$(a_{13})^{(1)} G_{14} - \left[(a'_{13})^{(1)} + (a''_{13})^{(1)}(T_{14})\right] G_{13} = 0$ 89

$(a_{14})^{(1)} G_{13} - \left[(a'_{14})^{(1)} + (a''_{14})^{(1)}(T_{14})\right] G_{14} = 0$ 90

$(a_{15})^{(1)} G_{14} - \left[(a'_{15})^{(1)} + (a''_{15})^{(1)}(T_{14})\right] G_{15} = 0$ 91

$(b_{13})^{(1)} T_{14} - [(b'_{13})^{(1)} - (b''_{13})^{(1)}(G)]T_{13} = 0$ 92

$(b_{14})^{(1)} T_{13} - [(b'_{14})^{(1)} - (b''_{14})^{(1)}(G)]T_{14} = 0$ 93

$(b_{15})^{(1)} T_{14} - [(b'_{15})^{(1)} - (b''_{15})^{(1)}(G)]T_{15} = 0$ 94

has a unique positive solution , which is an equilibrium solution for the system (19 to 24)

Proof:

(a) Indeed the first two equations have a nontrivial solution G_{13}, G_{14} if

$$F(T) = (a'_{13})^{(1)}(a'_{14})^{(1)} - (a_{13})^{(1)}(a_{14})^{(1)} + (a'_{13})^{(1)}(a''_{14})^{(1)}(T_{14}) + (a'_{14})^{(1)}(a''_{13})^{(1)}(T_{14}) + (a''_{13})^{(1)}(T_{14})(a''_{14})^{(1)}(T_{14}) = 0$$ 95

Definition and uniqueness of T^*_{14} :-

After hypothesis $f(0) < 0, f(\infty) > 0$ and the functions $(a''_i)^{(1)}(T_{14})$ being increasing, it follows that there exists a unique T^*_{14} for which $f(T^*_{14}) = 0$. With this value , we obtain from the three first equations

$$G_{13} = \frac{(a_{13})^{(1)} G_{14}}{[(a'_{13})^{(1)} + (a''_{13})^{(1)}(T^*_{14})]} \quad , \quad G_{15} = \frac{(a_{15})^{(1)} G_{14}}{[(a'_{15})^{(1)} + (a''_{15})^{(1)}(T^*_{14})]}$$ 96

(d) By the same argument, the equations 92,93 admit solutions G_{13}, G_{14} if

$$\varphi(G) = (b'_{13})^{(1)}(b'_{14})^{(1)} - (b_{13})^{(1)}(b_{14})^{(1)} - [(b'_{13})^{(1)}(b''_{14})^{(1)}(G) + (b'_{14})^{(1)}(b''_{13})^{(1)}(G)] + (b''_{13})^{(1)}(G)(b''_{14})^{(1)}(G) = 0$$ 97

Where in $G(G_{13}, G_{14}, G_{15}), G_{13}, G_{15}$ must be replaced by their values from 96. It is easy to see that φ is a decreasing function in G_{14} taking into account the hypothesis $\varphi(0) > 0 , \varphi(\infty) < 0$ it follows that there exists a unique G^*_{14} such that $\varphi(G^*) = 0$

Finally we obtain the unique solution of 89 to 94

G^*_{14} given by $\varphi(G^*) = 0$, T^*_{14} given by $f(T^*_{14}) = 0$ and

$$G^*_{13} = \frac{(a_{13})^{(1)} G^*_{14}}{[(a'_{13})^{(1)} + (a''_{13})^{(1)}(T^*_{14})]} \quad , \quad G^*_{15} = \frac{(a_{15})^{(1)} G^*_{14}}{[(a'_{15})^{(1)} + (a''_{15})^{(1)}(T^*_{14})]}$$ 98

$$T^*_{13} = \frac{(b_{13})^{(1)} T^*_{14}}{[(b'_{13})^{(1)} - (b''_{13})^{(1)}(G^*)]} \quad , \quad T^*_{15} = \frac{(b_{15})^{(1)} T^*_{14}}{[(b'_{15})^{(1)} - (b''_{15})^{(1)}(G^*)]}$$ 99

Obviously, these values represent an equilibrium solution of 19,20,21,22,23,24

ASYMPTOTIC STABILITY ANALYSIS

Theorem 4: If the conditions of the previous theorem are satisfied and if the functions $(a''_i)^{(1)}$ *and* $(b''_i)^{(1)}$ Belong to $C^{(1)}(\mathbb{R}_+)$ then the above equilibrium point is asymptotically stable.

Proof: Denote

Definition of $\mathbb{G}_i, \mathbb{T}_i$:-

$$G_i = G^*_i + \mathbb{G}_i \quad , T_i = T^*_i + \mathbb{T}_i$$ 100

$$\frac{\partial (a''_{14})^{(1)}}{\partial T_{14}}(T^{*}_{14}) = (q_{14})^{(1)} \quad , \quad \frac{\partial (b''_{i})^{(1)}}{\partial G_j}(G^{*}) = s_{ij}$$ 101

Then taking into account equations 89 to 94 and neglecting the terms of power 2, we obtain from 19 to 24

$$\frac{d\mathbb{G}_{13}}{dt} = -\left((a'_{13})^{(1)} + (p_{13})^{(1)}\right)\mathbb{G}_{13} + (a_{13})^{(1)}\mathbb{G}_{14} - (q_{13})^{(1)}G^{*}_{13}\mathbb{T}_{14}$$ 102

$$\frac{d\mathbb{G}_{14}}{dt} = -\left((a'_{14})^{(1)} + (p_{14})^{(1)}\right)\mathbb{G}_{14} + (a_{14})^{(1)}\mathbb{G}_{13} - (q_{14})^{(1)}G^{*}_{14}\mathbb{T}_{14}$$ 103

$$\frac{d\mathbb{G}_{15}}{dt} = -\left((a'_{15})^{(1)} + (p_{15})^{(1)}\right)\mathbb{G}_{15} + (a_{15})^{(1)}\mathbb{G}_{14} - (q_{15})^{(1)}G^{*}_{15}\mathbb{T}_{14}$$ 104

$$\frac{d\mathbb{T}_{13}}{dt} = -\left((b'_{13})^{(1)} - (r_{13})^{(1)}\right)\mathbb{T}_{13} + (b_{13})^{(1)}\mathbb{T}_{14} + \sum_{j=13}^{15}\left(s_{(13)(j)}T^{*}_{13}\mathbb{G}_j\right)$$ 105

$$\frac{d\mathbb{T}_{14}}{dt} = -\left((b'_{14})^{(1)} - (r_{14})^{(1)}\right)\mathbb{T}_{14} + (b_{14})^{(1)}\mathbb{T}_{13} + \sum_{j=13}^{15}\left(s_{(14)(j)}T^{*}_{14}\mathbb{G}_j\right)$$ 106

$$\frac{d\mathbb{T}_{15}}{dt} = -\left((b'_{15})^{(1)} - (r_{15})^{(1)}\right)\mathbb{T}_{15} + (b_{15})^{(1)}\mathbb{T}_{14} + \sum_{j=13}^{15}\left(s_{(15)(j)}T^{*}_{15}\mathbb{G}_j\right)$$ 107

The characteristic equation of this system is

$$\begin{aligned}
&\left((\lambda)^{(1)} + (b'_{15})^{(1)} - (r_{15})^{(1)}\right)\{\left((\lambda)^{(1)} + (a'_{15})^{(1)} - (p_{15})^{(1)}\right)\\
&\left[\left(\left((\lambda)^{(1)} + (a'_{13})^{(1)} + (p_{13})^{(1)}\right)(q_{14})^{(1)}G^{*}_{14} + (a_{14})^{(1)}(q_{13})^{(1)}G^{*}_{13}\right)\right]\\
&\left(\left((\lambda)^{(1)} + (b'_{13})^{(1)} - (r_{13})^{(1)}\right)s_{(14),(14)}T^{*}_{14} + (b_{14})^{(1)}s_{(13),(14)}T^{*}_{14}\right)\\
&+\left(\left((\lambda)^{(1)} + (a'_{14})^{(1)} + (p_{14})^{(1)}\right)(q_{13})^{(1)}G^{*}_{13} + (a_{13})^{(1)}(q_{14})^{(1)}G^{*}_{14}\right)\\
&\quad\left(\left((\lambda)^{(1)} + (b'_{13})^{(1)} - (r_{13})^{(1)}\right)s_{(14),(13)}T^{*}_{14} + (b_{14})^{(1)}s_{(13),(13)}T^{*}_{13}\right)\\
&\left(\left((\lambda)^{(1)}\right)^2 + \left((a'_{13})^{(1)} + (a'_{14})^{(1)} + (p_{13})^{(1)} + (p_{14})^{(1)}\right)(\lambda)^{(1)}\right)\\
&\quad\left(\left((\lambda)^{(1)}\right)^2 + \left((b'_{13})^{(1)} + (b'_{14})^{(1)} - (r_{13})^{(1)} + (r_{14})^{(1)}\right)(\lambda)^{(1)}\right)\\
&+\left(\left((\lambda)^{(1)}\right)^2 + \left((a'_{13})^{(1)} + (a'_{14})^{(1)} + (p_{13})^{(1)} + (p_{14})^{(1)}\right)(\lambda)^{(1)}\right)(q_{15})^{(1)}G_{15}\\
&+\left((\lambda)^{(1)} + (a'_{13})^{(1)} + (p_{13})^{(1)}\right)\left((a_{15})^{(1)}(q_{14})^{(1)}G^{*}_{14} + (a_{14})^{(1)}(a_{15})^{(1)}(q_{13})^{(1)}G^{*}_{13}\right)\\
&\left(\left((\lambda)^{(1)} + (b'_{13})^{(1)} - (r_{13})^{(1)}\right)s_{(14),(15)}T^{*}_{14} + (b_{14})^{(1)}s_{(13),(15)}T^{*}_{13}\right)\} = 0
\end{aligned}$$ 108

And as one sees, all the coefficients are positive. It follows that all the roots have negative real part, and this proves the theorem.

PERMUTATIONAL AND COMBINATIONAL MECHANICS:MATTER,SPACE,TIME,AND ENERGY: A TESTAMENT FOR CONCATENATED EQUATIONS GIVEN AT THE END;

Matter fields, and particles are "quantum excitations of a mode of the matter field" . In other words, **matter fields are produced by quantum excitations**. **Quantum excitations are utilized to produce matter fields**."With the word "matter" we denote, in this context, the sources of the **interactions,** that is spinor fields (like quarks and leptons), which are believed to be the fundamental components of matter, or scalar fields, like the Higgs particles, which are **used** to introduce mass in a gauge theory (and which, however, could be composed of more fundamental fermion fields).Today, we know that even protons and neutrons are not indivisible, they can be **divided** into quarks, while electrons are **part** of a particle family called leptons. **Both quarks and leptons are elementary particles, and are currently seen as being the fundamental constituents of matter. Higgs Boson is considered as 'God Particle' that is responsible for the mass of the matter.**

These quarks and leptons **interact** through four fundamental forces: gravity, electromagnetism, weak interactions, and strong interactions .It is only described by classical physics (quantum gravity and graviton) .I**nteractions** between quarks and leptons are the **result** of an exchange of force-carrying particles (such as photons) between quarks and leptons. The force-carrying particles are not themselves building blocks. As one consequence, mass and energy (which cannot be created or destroyed) cannot always be related to matter (**which can be created out of non-matter particles such as photons, or even out of pure energy, such as kinetic energy**). **Force carriers are usually not considered matter**: the carriers of the electric force (photons) possess energy (Planck relation) and **the carriers of the weak force (W and Z bosons) are massive, but neither are considered matter either. However, while these particles are not considered matter, they do contribute to the total mass of atoms, subatomic particles**, and all systems which contain them. That is to say, photons loose mass and the subatomic particles gain mass in as sense., **Higgs boson relationship**..and considering it as a proponent and primogeniture for the obtention of the mass of the particles.**There is no broad consensus as to a general definition of matter, and the term "matter" usually is used in conjunction with a specifying modifier.**

Common definition

The observation that matter occupies space **goes back to antiquity. However, an explanation for why matter occupies space is recent, and is argued to be a result of the** Pauli exclusion principle**. Two particular examples where the exclusion principle clearly relates matter to** the occupation or utilization of space are **white dwarf stars and neutron stars. The common definition of matter is anything that has both mass and volume (occupies space) For example, a car would be said to be made of matter, as it occupies space, and has mass. The DNA molecule is an example of matter under the "atoms and molecules" definition.**

Relativity

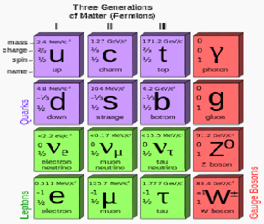
In the context of relativity, mass is not an additive quantity. Thus, in relativity usually a more general view is taken that it is not mass, but the energy–momentum tensor that **quantifies** the amount of matter. Does it mean that energy momentum tensor loses and matter **gains** the mass? This has lead to lot of dialectic deliberation and polemical consideration. Matter therefore is anything that **contributes** to the energy–momentum of a system, that is, anything that is not purely gravity. This view is commonly held in fields that deal with general relativity such as **cosmology.**

Atoms and molecules definition

A definition of "matter" that is based upon its physical and chemical structure is: matter is made up of atoms and molecules. As an example, deoxyribonucleic acid molecules (DNA) are matter under this definition because they are made of atoms. This definition can be extended to include charged atoms and molecules, so as to include plasmas (gases of ions) and electrolytes (ionic solutions), which are not obviously included in the atoms and molecules definition. Alternatively, one can adopt the protons, neutrons and electrons definition.

Protons, neutrons and electrons definition

A definition of "matter" more fine-scale than the atoms and molecules definition is: matter is made up of what atoms and molecules are made of, meaning anything made of positively charged protons, neutral neutrons, and negatively charged electrons This definition goes beyond atoms and molecules, however, to **include s**ubstances made from these building blocks that are not simply atoms or molecules, for example white dwarf matter — typically, carbon and oxygen nuclei in a sea of degenerate electrons. At a microscopic level, the constituent "particles" of matter such as protons, neutrons and electrons obey the laws of quantum mechanics and **exhibit wave–particle duality**. At an even deeper level, protons and neutrons are made up of quarks and the force fields (gluons) that **bind** them together (see Quarks and leptons definition below).



(Courtesy: Matter and Energy: Linus Pauling)

Under the "quarks and leptons" definition, the elementary and composite particles made of the quarks (in purple) and leptons (in green) would be "matter"; while the gauge bosons (in red) would not be "matter". However, **interaction** energy inherent to composite particles (for example, gluons involved in neutrons and protons) contribute to the mass of ordinary matter. **Thus mass of the matter could in a sense be attributable and ascribable to interaction energy inherent to composite particles.**

Leptons (the most famous being the electron), and quarks (of which baryons, such as protons and neutrons, are made) **combine** to form atoms, which in turn **form /produce** molecules. Then, because electrons are leptons, and protons and neutrons are made of quarks, this definition in turn leads to the definition of matter as being "quarks and leptons", which are the two types of elementary fermions. Carithers and Grannis state: Ordinary matter is composed entirely of first-generation particles, namely the [up] and [down] quarks, plus the electron and its neutrino. **Higher generation's** particles quickly **decay** into **first-generation particles**, and thus are not commonly encountered.

This definition of ordinary matter is more subtle than it first appears. All the particles that make up ordinary matter (leptons and quarks) are elementary fermions, **while all the force carriers are elementary bosons**. The W and Z bosons that **mediate** the weak force are not made of quarks or leptons, and so is not ordinary matter, even if they have mass. In other words, **mass is not something that is exclusive to ordinary matter.**

The quark–lepton definition of ordinary matter, however, identifies not only the elementary building blocks of matter, but also includes and incorporates in its Diaspora composites made from the constituents (atoms and molecules, for example). Such composites contain an **interaction energy that holds the constituents together**, and may constitute the bulk of the mass of the composite. As an example, to a great extent, the mass of an atom is simply the sum of the masses of its constituent protons, neutrons and electrons. However, digging deeper, the protons and neutrons are made up of quarks bound together by gluon fields (dynamics of quantum chromo dynamics) and **these gluons fields** c**ontribute** significantly to the **mass of hadrons**. In other words, most of what composes the "mass" of ordinary matter is due to the binding energy of quarks within protons and neutrons For example, the sum of the mass of the three quarks in a nucleon is approximately 12.5 MeV/c^2, which is low compared to the mass of a nucleon (approximately 938 MeV/c^2). The bottom line is that most of the mass of everyday objects **comes from** the interaction energy of its elementary components. **So, Interaction energy of elementary components gives mass to objects. So any model for Higgs Boson has to take in to consideration the interaction of elementary components or componential clusterings.**

Mathematical Theory and Modeling
ISSN 2224-5804 (Paper) ISSN 2225-0522 (Online)
Vol.2, No.5, 2012

Smaller building blocks?

The Standard Model groups matter particles into three generations, where each generation consists of two quarks and two leptons. The first generation is the up and down quarks, the electron and the electron neutrino; the second includes the charm and strange quarks, the muon and the muon neutrino; the third generation consists of the top and bottom quarks and the tau and tau neutrino The most natural explanation for this would be that quarks and leptons of higher generations are **excited states** of the first generations. If this turns out to be the case, it would imply **that quarks and leptons are composite particles**, rather than elementary particles. In particle physics, **fermions are particles which obey Fermi–Dirac statistics**. Fermions can be elementary, like the electron, or composite, like the proton and the neutron. In the **Standard Model** there are two types of elementary fermions: quarks and leptons. .

Pauli's Exclusion Principle and quantum state symmetry

The Pauli exclusion principle with a single-valued many-particle wave function is equivalent to requiring the wave function to be anti symmetric. An anti symmetric two-particle state is represented as a sum of states in which one particle is in state $|x\rangle$ and the other in state $|y\rangle$: $|\psi\rangle = \sum_{x,y} A(x,y)|x,y\rangle$

And anti symmetry under exchange means that A(x,y) = -A(y,x). This implies that A(x,x)=0, which is **Pauli exclusion**. It is true in any basis, since unitary changes of basis keep anti symmetric matrices anti symmetric, although strictly speaking, the quantity A(x,y) is not a matrix but an anti symmetric rank-two tensor.

Conversely, if the diagonal quantities A(x,x) are zero in every basis, then the wave function component:

$$A(x,y) = \langle\psi|x,y\rangle = \langle\psi|(|x\rangle \otimes |y\rangle)$$

is necessarily anti symmetric. To prove it, consider the matrix element:

$$\langle\psi|((|x\rangle + |y\rangle) \otimes (|x\rangle + |y\rangle))$$

This is zero, because the two particles have zero probability to both be in the superposition state $|x\rangle+|y\rangle$. But this is equal to

$$\langle\psi|x,x\rangle + \langle\psi|x,y\rangle + \langle\psi|y,x\rangle + \langle\psi|y,y\rangle$$

The first and last terms on the right hand side are diagonal elements and are zero, and the whole sum is equal to zero. So the wave function matrix elements obey:

$$\langle\psi|x,y\rangle + \langle\psi|y,x\rangle = 0.$$

$$A(x,y) = -A(y,x)$$

Pauli principle in advanced quantum theory

According to the **spin-statistics theorem**, particles with integer spin **occupy** symmetric quantum states, and particles with half-integer **spin occupy** anti symmetric states; furthermore, only integer or half-integer values of spin are allowed by the principles of quantum mechanics. In relativistic quantum field theory, the Pauli principle follows from **applying** a **rotation operator in imaginary time** to **particles of half-integer spin**. Since, non relativistically, particles can have any statistics and any spin, there is no way to prove a spin-statistics theorem in non relativistic quantum mechanics.

In one dimension, bosons, as well as fermions, can obey the exclusion principle. **A one-dimensional Bose gas with**

delta function repulsive interactions of infinite strength is equivalent to a gas of free fermions. The reason for this is that, in one dimension, exchange of particles requires that they pass through each other; for infinitely strong repulsion this cannot happen. This model is described by a quantum nonlinear Schrödinger equation. In momentum space the exclusion principle is valid also for finite repulsion in a Bose gas with delta function interactions, as well as for **interacting s**pins and Hubbard model in one dimension, and for other models solvable by Bethe ansatz. The ground state in models solvable by Bethe ansatz is a Fermi sphere.

Atoms and the Pauli principle

The Pauli exclusion principle helps explain a wide variety of physical phenomena. One particularly important consequence of the principle is the elaborate electron shell structure of atoms and the way **atoms share electrons**,(like **a sorting box in a bank**) explaining the variety of chemical elements and their chemical combinations. An **electrically neutral atom** contains **bound electrons equal in number to the protons in the nucleus**. Electrons, being fermions, cannot occupy the same quantum state, so electrons have to "stack" within an atom, i.e. **have different spins** while at the same place. Like most of the Indian buses are stacked like sardines.

An example is the neutral helium atom, which has two bound electrons, both of which can occupy the lowest-energy (1s) states by acquiring opposite spin; as **spin i**s part of the quantum state of the electron, the two electrons are in different quantum states and **do not violate** the Pauli principle. However, the spin can take only two different values (eigen values). In a lithium atom, with three bound electrons, the third electron cannot reside in a 1s state, and must occupy one of the higher-energy 2s states instead. Similarly, successively larger elements must have shells of successively higher energy. The chemical properties of an element largely depend on the number of electrons in the outermost shell; atoms with different numbers of shells but the same number of electrons in the outermost shell have similar properties, which give rise to the periodic table of the elements.

Solid state properties and the Pauli principle

In conductors and semi-conductors, free electrons have to share entire bulk space. Thus, their **energy levels stack up, creating band structure out of each atomic energy level**. In strong conductors (metals) electrons are so degenerate that they cannot even contribute much to the thermal capacity of a metal. Many mechanical, electrical, magnetic, optical and chemical properties of solids are the direct consequence of Pauli exclusion.

Stability of matter

The stability of the electrons in an atom itself is not related to the exclusion principle, but is described by the quantum theory of the atom. The underlying idea is that **close approach of an electron to the nucleus** of the atom necessarily **increases its kinetic energy,** an application of the uncertainty principle of Heisenberg. However, stability of large systems with many electrons and many nuclei is a different matter, and requires the Pauli exclusion principle

It has been shown that the Pauli exclusion principle is **responsible** for the fact that ordinary bulk matter is stable and occupies volume. This suggestion was first made in 1931 by Paul Ehrenfest, who pointed out that the electrons of each atom cannot all fall into the lowest-energy orbital and must occupy successively larger shells. Atoms therefore occupy a volume and cannot be squeezed too closely together

A more rigorous proof was provided in 1967 by Freeman Dyson and Andrew Lenard, who considered the **balance** of attractive (electron-nuclear) and repulsive (electron-electron and nuclear-nuclear) forces and showed that ordinary matter would **collapse and occupy** a much smaller volume without violation of the Pauli Exclusion Principle. The consequence of the Pauli principle here is **that electrons of the same** spin are kept **apart** by a **repulsive exchange interaction**, which is a short-range effect, **acting** simultaneously with the long-range electrostatic or columbic force. This effect is partly **responsible** for the everyday observation in the macroscopic world that two solid objects cannot be in the same place in the same time.

Astrophysics and the Pauli principle

Dyson and Lenard did not consider the extreme magnetic or gravitational forces which occur in some astronomical objects. In 1995 Elliott Lieb and coworkers showed that the Pauli principle still **leads** to stability in intense magnetic fields such as in neutron stars, although at a much higher density than in ordinary matter. It is a consequence of general relativity that, in sufficiently **intense gravitational fields**, matter **collapses t**o form **a black hole**.

Astronomy provides a spectacular demonstration of the effect of the Pauli principle, in the form of white dwarf and neutron stars. In both types of body, **atomic structure** is **disrupted** by **large gravitational forces**, **leaving** the constituents supported by "degeneracy pressure" alone. This exotic form of matter is known as degenerate matter. In white dwarfs atoms are held **apart** by electron degeneracy pressure. In neutron stars, subject to even stronger gravitational forces, electrons have **merged** with protons to form neutrons. Neutrons are capable of **producing an even higher degeneracy pressure**, albeit over a shorter range. This can **stabilize neutron stars from further collapse**, but at a smaller size and higher density than a white dwarf. Neutrons are the most "rigid" objects known; their Young modulus (or more accurately, bulk modulus) is 20 orders of magnitude larger than that of diamond. However, even this enormous rigidity can be **overcome** by the gravitational field of a massive star or by the pressure of a supernova, leading to the **formation** of a black hole.

Quarks

Quarks are particles of spin-$\frac{1}{2}$, implying that they are fermions. They carry an electric charge of $-\frac{1}{3}$ e (down-type quarks) or $+\frac{2}{3}$ e (up-type quarks). For comparison, an electron has a charge of −1 e. They also carry colour charge, which is the equivalent of the electric charge for the strong interaction. Quarks also undergo radioactive decay, meaning that they are subject to the weak interaction. Quarks are massive particles, and therefore are also subject to **gravity.**

Quark properties

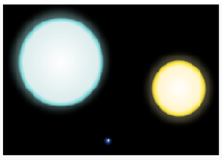
name	symbol	spin	electric charge (e)	mass (MeV/c^2)	mass comparable to	antiparticle	antiparticle symbol
up-type quarks							
up	u	$\frac{1}{2}$	$+\frac{2}{3}$	1.5 to 3.3	~ 5 electrons	antiup	u
charm	c	$\frac{1}{2}$	$+\frac{2}{3}$	1160 to 1340	~ 1 proton	anticharm	c
top	t	$\frac{1}{2}$	$+\frac{2}{3}$	169,100 to 173,300	~ 180 protons or ~ 1 tungsten atom	antitop	t
down-type quarks							
down	d	$\frac{1}{2}$	$-\frac{1}{3}$	3.5 to 6.0	~ 10 electrons	antidown	d
strange	s	$\frac{1}{2}$	$-\frac{1}{3}$	70 to 130	~ 200 electrons	antistrange	s
bottom	b	$\frac{1}{2}$	$-\frac{1}{3}$	4130 to 4370	~ 5 protons	antibottom	b

Quark structure of a proton: 2 up quarks and 1 down quark.(Please see references)

Baryonic matter ,the strongly interacting fermions

Baryons are strongly interacting fermions, and so are subject to Fermi-Dirac statistics. Amongst the baryons are the protons and neutrons, which occur in atomic nuclei, but many other unstable baryons exist as well. The term baryon is usually used to refer to triquarks — particles made of three quarks. "Exotic" baryons made of four quarks and one antiquark is known as the pentaquarks, but their existence is not generally accepted.

Baryonic matter is the **part** of the universe that is made of **baryons (including all atoms)**. This part of the universe does not include dark energy, dark matter, black holes or various forms of degenerate matter, such as compose white dwarf stars and neutron stars. Baryonic matter thus has not got connection with the hereinabove mentioned forms of degenerate matter. Microwave light seen by Wilkinson Microwave Anisotropy Probe (WMAP), suggests that only about 4.6% of that part of the universe within range of the best telescopes (that is, matter that may be visible because light could reach us from it), is made of baryonic matter. **About 23% is dark matter, and about 72% is dark energy**.



A comparison between the white dwarf IK Pegasi B (center), its A-class companion IK Pegasi A (left) and the Sun (right). This white dwarf has a surface temperature of 35,500 K.(Please see references)

Degenerate matter, that is produced during evolution of heavy stars

In physics, **degenerate matter** refers to the ground state of a gas of fermions at a temperature near absolute zero The Pauli exclusion principle requires that only two fermions can occupy a quantum state, one spin-up and the other spin-down. Hence, at zero temperature, the fermions fill up sufficient levels to accommodate all the available fermions, and for the case of many fermions the maximum kinetic energy called the Fermi energy and the pressure of the gas becomes very large and dependent upon the number of fermions rather than the temperature, unlike normal states of matter.

Degenerate matter is thought **to occur** during the evolution of heavy stars. **Evolution of heavy stars thus produces degenerate matter**. The demonstration by that **white dwarf stars have a maximum allowed mass** because of the **exclusion principle** is important in the theory of star evolution Degenerate matter includes the part of the universe that is made up of neutron stars and white dwarfs.

Strange matter that occur in the core of neutron stars:

Strange matter **is a particular form of quark matter, usually thought of as a 'liquid' of up, down, and strange quarks. It is to be contrasted with nuclear matter, which is a liquid of neutrons and protons (which themselves are built out of produced by combination of up and down quarks), and with non-strange quark matter, which is a quark liquid containing only up and down quarks. At high enough density, strange matter is expected to be color superconducting. Strange matter is hypothesized to occur in the core of neutron stars, or, more speculatively, as isolated droplets that may vary in size from femtometers (strangelets) to kilometers (quark stars).**

Two meanings of the term "strange matter"

In particle physics and astrophysics, the term is used in two ways, one broader and the other more specific. The broader meaning is just quark matter that **contains** three flavors of quarks: up, down, and strange. In this definition, there is a critical pressure and an associated critical density, and when nuclear matter (made of protons and neutrons) is **compressed beyond this density**, the protons and neutrons **dissociate** into quarks, **yielding** quark matter (probably strange matter)The narrower meaning is quark matter that is more stable than nuclear matter. The idea that this could happen is the "strange matter hypothesis" of Bodmer and Witten. In this definition, the critical pressure is zero: the true ground state of matter is always quark matter. **The nuclei** that we see in the matter around us, which are droplets of nuclear matter, are actually meta stable, and given enough time (or the right external stimulus) would **decay** into droplets of strange matter, i.e. **strangelets.**

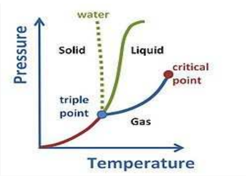
Leptons ,massive particles that are affected by gravity:

Leptons are particles of spin-½, meaning that they are fermions. They carry an electric charge of −1 e (charged leptons) or 0 e (neutrinos). Unlike quarks, leptons do not carry colour charge, meaning that they do not experience the strong interaction. Leptons also undergo radioactive decay, meaning that they are subject to the weak interaction. Leptons are massive particles, therefore are **subject** to gravity. **In other words, leptons are affected by gravity**.

Lepton properties

name	**symbol**	**spin**	**electric charge (e)**	**mass (MeV/c^2)**	**mass comparable to**	**antiparticle**	**antiparticle symbol**
charged leptons[71]							
electron	e−	½	−1	0.5110	1 electron	antielectron	e+
muon	μ−	½	−1	105.7	~ 200 electrons	antimuon	μ+
tau	τ−	½	−1	1,777	~ 2 protons	antitau	τ+
Neutrinos							
electron neutrino	ν e	½	0	< 0.000460	< 1/1000 electron	electron antineutrino	ν e
muon neutrino	ν μ	½	0	< 0.19	< ½ electron	muon antineutrino	ν μ
tau neutrino	ν τ	½	0	< 18.2	< 40 electrons	tau antineutrino	ν τ

Phases, the coexistence of three phases of matter ,their utility in nano materials:



Phase diagram for a typical substance at a fixed volume. Vertical axis is Pressure, horizontal axis is Temperature. The green line marks the freezing point (above the green line is solid, below it is liquid) and the blue line the boiling point (above it is liquid and below it is gas). So, for example, at higher T, a higher P is necessary to maintain the substance in liquid phase**. At the triple point the three phases; liquid, gas and solid; can coexist**. Above the critical point there is no detectable difference between the phases. The dotted line shows the anomalous behavior of water: ice melts at constant temperature with increasing pressure. (Diagrammatic representation from the Wikipedia on the work done in the field-Kindly see references also)In bulk, matter can exist in several different forms, or states of aggregation, known as phases, depending on ambient pressure, temperature and volume A phase is a form of matter that has a relatively uniform chemical composition and physical properties (such as density, specific heat, refractive index, and so forth). These phases include the three familiar ones (solids, liquids, and gases), as well as more exotic states of matter (such as plasmas, superfluids, supersolids, Bose–Einstein condensates, ...). **A fluid may be a liquid, gas or plasma**. There are also paramagnetic and ferromagnetic phases of magnetic materials. As conditions change, matter may **change** from one phase into another. In nano materials, the vastly increased ratio of surface area to volume **results** in matter that can exhibit properties entirely different from those of bulk material, and not well described by any bulk phase

Phases are sometimes called **states of matter**, but this term can lead to confusion with thermodynamic states. For example, two gases maintained at different pressures are in different thermodynamic states (different pressures), but in the same phase (both are gases).

Antimatter, another avenue for the dissipation of matter, the result of radioactive decay of lightning or cosmic rays:

Physicists are puzzled about the fact as to why there is more matter in the universe than antimatter? Why is there more prey than the predator? May be this approach would help solve the problem

In quantum chemistry, **antimatter** is matter that is composed of the antiparticles of those that constitute ordinary matter. If a particle and its antiparticle come into contact with each other, the two **annihilate**; that is, they may both be converted into **other particles with equal energy** in accordance with Einstein's equation $E = mc^2$. These new particles may be high-energy photons (gamma rays) or other particle–antiparticle pairs. The resulting particles are endowed with an amount of kinetic energy equal to the **difference** between the **rest mass of the products** of the annihilation and the **rest mass of the original particle-antiparticle pair**, which is often quite large.

Antimatter is not found naturally on Earth, except very briefly and in vanishingly small quantities (as the result of radioactive decay lightning or cosmic rays). This is because antimatter which came to exist on Earth outside the confines of a suitable physics laboratory would almost instantly meet the ordinary matter that Earth is made of, and be annihilated. Antiparticles and some stable antimatter (such as anti hydrogen) can be made in tiny amounts, but not in enough quantity to do more than test a few of its theoretical properties.

There is considerable speculation both in physics about the observable universe is apparently almost entirely matter, and whether other places are almost entirely antimatter instead. In the early universe, it is thought that matter and antimatter were equally represented, and the disappearance of antimatter requires an **asymmetry in physical laws called the charge parity (or CP symmetry) violation**. CP symmetry violation can be obtained from the Standard Model, but at this time the apparent asymmetry of matter and antimatter in the visible universe is one of the great unsolved problems in physics. Possible processes by which it came about are explored in more detail under baryogenesis.

Total matter, in the quarks and leptons definition, constitutes about 4% of the energy of the observable universe. The remaining energy is theorized to be due to exotic forms, of which 23% is dark matter and 73% is dark energy, We can think of the total matter or the energy density of the matter made up of the above combination,in the same type of the model.

Dark matter(Composition of dark matter unknown)that will not emit or reflect electromagnetic radiation:

In astrophysics and cosmology, **dark matter** is matter of unknown composition that does not emit or reflect enough electromagnetic radiation to be observed directly, but whose presence can be inferred from **gravitational effects on visible matter**. Observational evidence of the early universe and the big bang theory require that this **matter have energy and mass**, but is not composed of either elementary fermions (as above) OR gauge bosons. The commonly accepted view is that most of the dark-matter is non-baryonic in nature As such, it is composed of particles as yet unobserved in the laboratory. Perhaps they are supersymmetric particles which are not Standard Model particles, but relics formed at very high energies in the early phase of the universe and still floating about

Dark energy

In cosmology, **dark energy** is the name given to the **anti gravitating influence that is accelerating the rate of expansion of the universe. Dark energy is responsible for the accelerated expansion of the universe**. It is known not to be composed of known particles like protons, neutrons or electrons, nor of the particles of dark matter, because these all gravitate . Fully 70% of the **matter density** in the universe appears to be in the form of dark energy. **Seventy percent of mass density of the Universe produces Dark Energy**. Twenty-six percent of matter is dark matter. Only 4% is ordinary matter. So less than 1 part in 20 is made out of matter we have observed experimentally or described in the standard model of particle physics. Of the other 96%, apart from the properties just mentioned, we know absolutely nothing.(Lee Smolin : The Trouble with Physics, p. 16)

Exotic matter, one type of matter that is repelled by gravity and posses negative mass:

Exotic matter is a hypothetical concept of particle physics. It covers any material which violates one or more classical conditions or is not made of known baryonic particles. Such materials would possess qualities like negative mass or being repelled rather than attracted by gravity.

In physics, **energy** (Greek: ἐνέργεια energeia "activity, operation") is an indirectly observed quantity. It is often understood as the ability a physical system has to do work on other physical systems.[Since work is defined as a force acting through a distance (a length of space), **energy is always equivalent (=)to the ability to exert pulls or pushes against the basic forces of nature, along a path of a certain length**.

The total energy contained in an object is identified with its mass, and energy (like mass), cannot be created or destroyed. When matter (ordinary material particles) is **changed** into energy (such as energy of motion, or into radiation), the **mass** of the system does not change through the transformation process. However, there may be mechanistic limits as to how much of the matter in an object may be changed into other types of energy and thus into work, on other systems. **Energy, like mass, is a scalar physical quantity**. In the International System of Units (SI), **energy is measured in joules**, but in many fields other units, such as kilowatt-hours and kilocalories, are customary. All of these units translate to units of work, which is always defined in terms of forces and the distances that the forces act through.

A system can **transfer** energy to another system by simply transferring **matter** to it (since matter is equivalent to energy, in accordance with its mass). However, when energy **is transferred** by means other than matter-transfer, the transfer produces **changes** in the second system, as a **result** of work done on it. This work **manifests** itself as the **effect** of force(s) applied through distances within the target system. For example, a system can **emit** energy to another by transferring (radiating) electromagnetic energy, but this **creates** forces upon the particles that **absorb** the radiation. Similarly, a system may transfer energy to another by physically i**mpacting** it, but in that case the energy of motion in an object, called kinetic energy, **results** in forces acting over distances (new energy) to appear in another object that is struck. Transfer of thermal energy by heat occurs by both of these mechanisms: heat can be t**ransferred** by electromagnetic radiation, or by physical contact in which direct particle-particle impacts transfer kinetic energy.

Energy may be stored in systems without being present as matter, or as kinetic or electromagnetic energy. Stored energy is **created** whenever a particle has been moved through **a field it interacts** with (requiring a force to do so), but the energy to accomplish this is stored as a new position of the particles in the field—a configuration that must be **"held" or** fixed by a different type of force (otherwise, the new configuration would **resolve itself** by the field pushing or pulling the particle back toward its previous position). This type of energy "stored" by force-fields and particles that have been forced into a new physical configuration in the field by doing work on them by another system, is referred to as potential energy. A simple example of potential energy is the work needed to lift an object in a gravity field, up to a support. Each of the basic forces of nature is **associated** with a different type of potential energy, and all types of potential energy (like all other types of energy) **appears** as system mass, whenever present. For example, a compressed spring will be slightly more massive than before it was compressed. Likewise, whenever energy is transferred between systems by any mechanism, an **associated** mass is **transferred** with it.

Any form of energy may be transformed into another form. **For example, all types of potential energy are converted into kinetic energy when the objects are given freedom to move to different position (as for example, when an object falls off a support). When energy is in a form other than thermal energy, it may be transformed with good or even perfect efficiency, to any other type of energy, including electricity or production of new particles of matter. With thermal energy, however, there are often limits to the efficiency of the conversion to other forms of energy, as described by the second law of thermodynamics.**

In all such energy transformation processes, the total energy remains the same, and a transfer of energy from one system to another, results in a loss to compensate for any gain. This principle, the conservation Matter fields, and particles are "quantum excitations of a mode of the matter field" . In other words, **matter fields are produced by quantum excitations. Quantum excitations are utilized to produce matter fields**."With the word "matter" we denote, in this context, the sources of the **interactions,** that is spinor fields (like quarks and leptons), which are believed to be the fundamental components of matter, or scalar fields, like the Higgs particles, which are **used** to introduce mass in a gauge theory (and which, however, could be composed of more fundamental fermion fields).Today, we know that even protons and neutrons are not indivisible, they can be **divided** into quarks, while electrons are **part** of a particle family called leptons. **Both quarks and leptons are elementary particles, and are currently seen as being the fundamental constituents of matter**

These quarks and leptons **interact** through four fundamental forces: gravity, electromagnetism, weak interactions, and strong interactions.It is only described by classical physics (quantum gravity and graviton) .I**nteractions** between quarks and leptons are the **result** of an exchange of force-carrying particles (such as photons) between quarks and leptons. The force-carrying particles are not themselves building blocks. As one consequence, mass and energy (which cannot be created or destroyed) cannot always be related to matter (which can be **created** out of non-matter particles such as **photons**, or even out of **pure energy**, such as kinetic energy). **Force carriers are usually not considered matter**: the carriers of the electric force (photons) possess energy (Planck relation) and the carriers of the weak force (W and Z bosons) are massive, but neither are considered matter either. However, while these particles are not considered matter, they do **contribute** to the total mass of atoms, subatomic particles, and all systems which contain them. That is to say, photons loose mass and the subatomic particles gain mass in as sense., **Higgs boson relationship**..and considering it as a proponent and primogeniture for the obtention of the mass of the particles.

The term "matter" is used throughout physics in a bewildering variety of contexts: for example, one refers to "condensed matter physics", "elementary matter", "partonic" matter, "dark" matter, "anti"-matter, "strange" matter, and "nuclear" matter. In discussions of matter and antimatter, normal matter has been referred to by Alfvén as koinomatter. There is no broad consensus as to a general definition of matter, and the term "matter" usually is used in conjunction with a specifying modifier.

In the context of relativity, mass is not an additive quantity. Thus, in relativity usually a more general view is taken that it is not mass, but the energy–momentum tensor that **quantifies** the amount of matter. Does it mean that energy momentum tensor loses and matter **gains** the mass? This has lead to lot of dialectic deliberation and polemical consideration. Matter therefore is anything that **contributes** to the energy–momentum of a system, that is, anything that is not purely gravity. This view is commonly held in fields that deal with general relativity such as **cosmology.**

Atoms and molecules definition

A definition of "matter" that is based upon its physical and chemical structure is: matter is made up of atoms and molecules. As an example, deoxyribonucleic acid molecules (DNA) are matter under this definition because they are made of atoms. This definition can be extended to include charged atoms and molecules, so as to include plasmas (gases of ions) and electrolytes (ionic solutions), which are not obviously included in the atoms and molecules definition. Alternatively, one can adopt the protons, neutrons and electrons definition.

Protons, neutrons and electrons definition

A definition of "matter" more fine-scale than the atoms and molecules definition is: matter is made up of what atoms and molecules are made of, meaning anything made of positively charged protons, neutral neutrons, and negatively charged electrons This definition goes beyond atoms and molecules, however, to **include s**ubstances made from these building blocks that are not simply atoms or molecules, for example white dwarf matter — typically, carbon and oxygen nuclei in a sea of degenerate electrons. At a microscopic level, the constituent "particles" of matter such as protons, neutrons and electrons obey the laws of quantum mechanics and **exhibit wave–particle duality**. At an even deeper level, protons and neutrons are made up of quarks and the force fields (gluons) that **bind** them together (see Quarks and leptons definition below).Under the "quarks and leptons" definition, the elementary and composite particles made of the quarks (in purple) and leptons (in green) would be "matter"; while the gauge bosons (in red) would not be "matter". However, **interaction** energy inherent to composite particles (for example, gluons involved in neutrons and protons) contribute to the mass of ordinary matter. **Thus mass of the matter could in a sense be attributable and ascribable to interaction energy inherent to composite particles.**

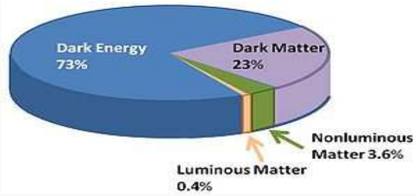
Leptons (the most famous being the electron), and quarks (of which baryons, such as protons and neutrons, are made) **combine** to form atoms, which in turn **form /produce** molecules. Then, because electrons are leptons, and protons and neutrons are made of quarks, this definition in turn leads to the definition of matter as being "quarks and leptons", which are the two types of elementary fermions. Carithers and Grannis state: Ordinary matter is composed entirely of first-generation particles, namely the [up] and [down] quarks, plus the electron and its neutrino. **Higher generations** particles quickly **decay** into **first-generation particles**, and thus are not commonly encountered.

This definition of ordinary matter is more subtle than it first appears. All the particles that make up ordinary matter (leptons and quarks) are elementary fermions, while all the force carriers are elementary bosons. The W and Z bosons that **mediate** the weak force are not made of quarks or leptons, and so are not ordinary matter, even if they have mass. In other words, **mass is not something that is exclusive to ordinary matter.**

The quark–lepton definition of ordinary matter, however, identifies not only the elementary building blocks of matter, but also includes and incorporates in its diasporas composites made from the constituents (atoms and molecules, for example). Such composites contain an **interaction energy that holds the constituents together**, and may constitute the bulk of the mass of the composite. As an example, to a great extent, the mass of an atom is simply the sum of the masses of its constituent protons, neutrons and electrons. However, digging deeper, the protons and neutrons are made up of quarks bound together by gluon fields (dynamics of quantum chromo dynamics) and **these gluons fields** c**ontribute** significantly to the **mass of hadrons**. In other words, most of what composes the "mass" of ordinary matter is due to the binding energy of quarks within protons and neutrons For example, the sum of the mass of the three quarks in a nucleon is approximately 12.5 MeV/c^2, which is low compared to the mass of a nucleon (approximately 938 MeV/c^2). The bottom line is that most of the mass of everyday objects **comes from** the interaction energy of its elementary components. **So, Interaction energy of elementary components gives mass to objects.**

Smaller building blocks?

The Standard Model groups matter particles into three generations, where each generation consists of two quarks and two leptons. The first generation is the up and down quarks, the electron and the electron neutrino; the second includes the charm and strange quarks, the muon and the muon neutrino; the third generation consists of the top and bottom quarks and the tau and tau neutrino The most natural explanation for this would be that quarks and leptons of higher generations are **excited states** of the first generations. If this turns out to be the case, it would imply **that quarks and leptons are composite particles**, rather than elementary particles. In particle physics, **fermions are particles which obey Fermi–Dirac statistics**. Fermions can be elementary, like the electron, or composite, like the proton and the neutron. In the Standard Model there are two types of elementary fermions: quarks and leptons. .



(Please see references. Diagram is taken from Home page of Antimatter and Dark energy)

Pie chart showing the fractions of **energy in the universe**(**total energy**) contributed by different sources. Ordinary matter is divided into luminous matter (the stars and luminous gases and 0.005% radiation) and non luminous matter (intergalactic gas and about 0.1% neutrinos and 0.04% super massive black holes). Ordinary matter is uncommon. Modeled after Ostriker and Steinhardt. For more information, see NASA. articles collated by Wikipedia.

Ordinary matter, in the quarks and leptons definition, constitutes about 4% of the energy of the observable universe. The remaining energy is theorized to be due to exotic forms, of which 23% is dark matter and 73% is dark energy

In all energy transformation processes, the total energy remains the same, and a transfer of energy from one system to another, results in a loss to compensate for any gain. This principle, the conservation of energy, was first postulated in the early 19th century, and applies to any isolated system. According to Noether's theorem, the conservation of energy is a **consequence** of the fact that the laws of physics do not change over time. This has a striking similarity and compatibility in the preparation of the General Ledger in the Bank, where in individual debits and credits are tallied, or conserved, while in addition the holistic debits and credits are tallied to write a final book called General Ledger, which forms the bastion for the preparation of Assets and Liabilities Appraisal. In the above model, we have given in details the reasons, raison d 'etre, and fons et origio as to why both energy and matter or for that mattermc^2 gets individually transformed from one to another, and universalisticcaly the Law of Conservation of Mass and Energy shall Hold. Like globally all the debits and credits are conserved.

Although the total energy of a system does not change with time, its value **may depend on the frame of reference**. For example, a seated passenger in a moving airplane has zero kinetic energy relative to the airplane, but non-zero kinetic energy (and higher total energy) relative to the Earth. In the context of chemistry, energy is an attribute of a substance as a consequence of its atomic, molecular or aggregate structure. Since a chemical transformation is accompanied by a change in one or more of these kinds of structure, it is invariably **accompanied** by an increase or decrease of energy of the substances involved. Some energy is transferred between the surroundings and the reactants of the reaction in the form of heat or light; thus the products of a reaction may have more or **less energy** than the reactants. A reaction is said to be exergonic if the final state is l**owe**r on the energy scale than the initial state; in the case of endergonic reactions the situation is the reverse. Chemical reactions are invariably not possible unless the reactants surmount an energy barrier known as the activation energy. The speed of a chemical reaction (at given temperature T) is related to the activation energy E, by the Boltzmann's population factor $e^{-E/kT}$ – that is the probability of molecule to have energy greater than or equal to E at the given temperature T. This exponential **dependence** of a reaction rate on temperature is known as the Arrhenius equation. The activation energy necessary for a chemical reaction can be in the form of thermal energy.

In **biology,** energy is an attribute of all biological systems from the biosphere to the smallest living organism. Within an organism it is responsible for growth and development of a biological cell or an organelle of a biological organism. Energy is thus often said to be **stored** by cells in the structures of molecules of substances such as carbohydrates (including sugars), lipids, and proteins, which release energy when reacted with oxygen in respiration. In human terms, the human equivalent (H-e) (Human energy conversion) indicates, for a given amount of energy expenditure, the relative quantity of energy needed for human metabolism, assuming an average human energy expenditure of 12,500kJ per day and a basal metabolic rate of 80 watts. For example, if our bodies run (on average) at 80 watts, then a light bulb running at 100 watts is running at 1.25 human equivalents (100 ÷ 80) i.e. 1.25 H-e. For a difficult task of only a few seconds' duration, a person can put out thousands of watts, many times the 746 watts in one official horsepower. For tasks lasting a few minutes, a fit human can generate perhaps 1,000 watts. For an activity that must be sustained for an hour, output drops to around 300; for an activity kept up all day, 150 watts is about the maximum The human equivalent assists understanding of energy flows in physical and biological systems by expressing energy units in human terms: it provides a “feel” for the use of a given amount of energy.

In **geology,** continental drift, mountain ranges, volcanoes, and earthquakes are phenomena that can be explained in terms of energy transformations in the Earth's interior. While meteorological phenomena like wind, rain, hail, snow, lightning, tornadoes and hurricanes, are all a result of energy transformations brought about by solar energy on the atmosphere of the planet Earth.

In **cosmology** and astronomy the phenomena of stars, nova, supernova, quasars and gamma ray bursts are the universe's highest-output energy **transformations** of matter. All stellar phenomena (including solar activity) are **driven** by various kinds of energy transformations. Energy in such transformations is either from gravitational collapse of matter (usually molecular hydrogen-**gravitational collapse produces transformation of energy**) into various classes of astronomical objects (stars, black holes, etc.), or from nuclear fusion (of lighter elements, primarily hydrogen).Energy transformations in the universe over time are characterized by various kinds of potential energy that has been available since the Big Bang, later being "released" (**transformed** to more active types of energy such as kinetic or radiant energy), when a **triggering** mechanism is available. Familiar examples of such processes include nuclear decay, in which energy is **released** that was originally "s**tored**" in heavy isotopes (such as uranium and thorium-they undergo loss of energy), bynucleosynthesi s, a process ultimately **using** the gravitational potential energy **released from** the gravitational collapse of supernovae(-), to store energy in the creation of these heavy elements before they were incorporated into the solar system and the Earth. This energy is triggered and released in nuclear fission bombs. In a slower process, **radioactive decay** of these atoms in the core of the Earth **releases** /produces heat. This thermal energy drives plate tectonics and may lift/displace i.e. change the position of mountains, via orogenesis. This slow lifting represents a kind of gravitational potential energy storage of the thermal energy, which may be later released to active kinetic energy in landslides(+), after a triggering event. Earthquakes also **release** stored elastic potential energy in rocks, a store that has been produced ultimately from the same radioactive heat sources. Thus, according to present understanding, familiar events such as landslides and earthquakes release energy that has been stored as potential energy in the Earth's gravitational field or elastic strain (mechanical potential energy) in rocks. Prior to this, they represent release of energy that has been stored in heavy atoms since the collapse of long-destroyed supernova stars created these atoms.

In another similar chain of transformations beginning at the dawn of the universe, **nuclear fusion** of hydrogen in the Sun also releases another store of potential energy which was created at the time of the Big Bang. At that time, according to theory, space expanded and the universe cooled too rapidly for hydrogen to completely fuse into heavier elements. This meant that hydrogen represents a store of potential energy that can be **released** by fusion. Such a fusion process is t**riggere**d by heat and **pressure generated** from gravitational collapse of hydrogen clouds when they produce stars, and some of the fusion energy is then t**ransformed** into sunlight. Such sunlight from our Sun may again be stored as gravitational potential energy after it strikes the Earth, as (for example) water evaporates from oceans and is deposited upon mountains (where, after being released at a hydroelectric dam, it can be used to drive turbines or generators to produce electricity). Sunlight also drives many weather phenomena, save those generated by volcanic events. An example of a solar-mediated weather event is a hurricane, which occurs when large unstable areas of warm ocean, heated over months, give up some of their thermal energy suddenly to power a few days of violent air movement. Sunlight is also captured by plants as chemical potential energy in photosynthesis, when carbon dioxide and water (two low-energy compounds) are converted into the high-energy compounds carbohydrates, lipids, and proteins. Plants also release oxygen during photosynthesis, which is utilized by living organisms as an electron acceptor, to release the energy of carbohydrates, lipids, and proteins. Release of the energy stored during photosynthesis as heat or light may be triggered suddenly by a spark, in a forest fire, or it may be made available more slowly for animal or human metabolism, when these molecules are ingested, and catabolism is triggered by enzyme action.

Through all of these transformation chains, potential energy stored at the time of the Big Bang is later released by intermediate events, sometimes being stored in a number of ways over time between releases, as more active energy. In all these events, one kind of energy is converted to other types of energy, including heat.

Distinction between energy and power

Although in everyday usage the terms energy and power are essentially synonyms, scientists and engineers distinguish between them. In its technical sense, power is not at all the same as energy, but is the **rate** at which energy is converted (or, equivalently, at which work is performed). Thus a hydroelectric plant, by allowing the water above the dam to pass through turbines, converts the water's potential energy into kinetic energy and ultimately into electric energy, whereas the amount of electric energy that is generated **per unit of time** is the electric power generated. The same amount of energy converted through a shorter period of time is more power over that shorter time.Energy is subject to the **law of conservation of energy**. According to this law, energy can neither be created (produced) nor destroyed by itself. It can only be transformed.

Most kinds of energy (with gravitational energy being a notable exception)[are subject to strict local conservation laws as well. In this case, energy can only be e**xchanged** between adjacent regions of space, and all observers agree as to the volumetric density of energy in any given space. There is also a global law of conservation of energy, stating that the total energy of the universe cannot change; this is a corollary of the local law, but not vice versa **Conservation of energy is the mathematical consequence of translational symmetry of** time **(that is, the in distinguish ability of time intervals taken at different time)**[**- see Noether's theorem**.

According to Conservation of energy the total inflow of energy into a system must equal the total outflow of energy from the system, plus the change in the energy contained within the system. There cannot be better testimony and infallible observatory and unequivocal demonstration of the fact that the transfer of energy has all conformality and congruence in the Banking, where individual Debits and Credits are conserved ,and totally ,the holistic Debit and Credits are also conserved.

This law is a fundamental principle of physics. It follows from the translational symmetry of time, a property of most phenomena below the cosmic scale that makes them independent of their locations on the time coordinate. **Put differently, yesterday, today, and tomorrow are physically indistinguishable.**

This is because energy is the quantity which is canonical conjugate to time. This mathematical entanglement of energy and time also results in the uncertainty principle - it is impossible to define the exact amount of energy during any definite time interval. The uncertainty principle should not be confused with energy conservation - rather it provides mathematical limits to which energy can in principle be defined and measured.

In quantum mechanics energy is expressed using the Hamiltonian operator. On any time scales, the uncertainty in the energy is by

$$\Delta E \Delta t \geq \frac{\hbar}{2}$$

which is similar in form to the Heisenberg uncertainty principle (but not really mathematically equivalent thereto, since H and t are not dynamically conjugate variables, neither in classical nor in quantum mechanics).

In particle physics, this inequality permits a qualitative understanding of **virtual particles** which carry momentum, exchange by which and with **real particles**, is responsible for **the creation** of all known fundamental forces (more accurately known as fundamental interactions). Virtual photons (which are simply lowest quantum mechanical energy state of photons) are also responsible for electrostatic interaction between electric charges (which results in Coulomb law), for spontaneous radioactive decay of exited atomic and nuclear states, for the Casimir force, for van der Waals bond forces and some other observable phenomena.

Applications of the concept of energy

Energy is subject to a strict global conservation law; that is, whenever one measures (or calculates) **the total energy of a system of particles whose interactions do not depend explicitly on time**, it is found that the total energy of the system always remains constant.The total energy of a system can be subdivided and classified in various ways. For example, it is sometimes convenient to distinguish potential energy (which is a function of coordinates only) from kinetic energy (which is a function of coordinate time derivatives only). It may also be convenient to distinguish gravitational energy, electric energy, thermal energy, and other forms. These classifications overlap; for instance, thermal energy usually consists partly of kinetic and partly of potential energy .The transfer of energy can take various forms; familiar examples include work, heat flow, and advection, as discussed below. The word "energy" is also used outside of physics in many ways, which can lead to ambiguity and inconsistency. The vernacular terminology is not consistent with technical terminology. For example, while energy is always conserved (in the sense that the total energy does not change despite energy transformations), energy can be converted into a form, e.g., thermal energy, that cannot be utilized to perform work. When one talks about "conserving energy by driving less," one talks about conserving fossil fuels and preventing useful energy from being lost as heat. This usage of "conserve" differs from that of the law of conservation of energy.

In classical physics energy is considered a scalar quantity, the canonical conjugate to time. In special relativity energy is also a scalar (although not a Lorentz scalar but a time component of the energy-momentum 4-vector). In other words, energy is invariant with respect to rotations of space, but not invariant with respect to rotations of space-time .

$$E_{pi} + E_{ki} = E_{pF} + E_{kF}$$

Energy is also transferred from potential energy (E_p) to kinetic energy (E_k) and then back to potential energy constantly. This is referred to as conservation of energy. In this closed system, energy cannot be created or destroyed; therefore, the initial energy and the final energy will be equal to each other. This can be demonstrated by the following:

The equation can then be simplified further since $E_p = mgh$ (mass times acceleration due to gravity times the height) and $E_k = \frac{1}{2}mv^2$ (half mass times velocity squared). Then the total amount of energy can be found by adding $E_p + E_k = E_{total}$.

Energy and the laws of motion

In classical mechanics, energy is a conceptually and mathematically useful property, as it is a conserved quantity. Several formulations of mechanics have been developed using energy as a core concept.

The Hamiltonian

The total energy of a system is sometimes called the Hamiltonian, after William Rowan Hamilton. The classical equations of motion can be written in terms of the Hamiltonian, even for highly complex or abstract systems. These classical equations have remarkably direct analogs in nonrelativistic quantum mechanics.

The Lagrangian

Another energy-related concept is called the Lagrangian, after Joseph Louis Lagrange. This is even more fundamental than the Hamiltonian, and can be used to derive the equations of motion. It was invented in the context of classical mechanics, but is generally useful in modern physics. The Lagrangian is defined as the kinetic energy minus the potential energy.Usually, the Lagrange formalism is mathematically more convenient than the Hamiltonian for non-conservative systems (such as systems with friction).

Noether's Theorem

Noether's (first) theorem (1918) states that **any differentiable symmetry of the action of a physical system has a corresponding conservation law**. In other words, any differentiable symmetry of the action of a physical system **has co- relationship** with the corresponding conservation law.

Noether's theorem has become a fundamental tool of modern theoretical physics and the calculus of variations. A generalization of the seminal formulations on constants of motion in Lagrangian and Hamiltonian mechanics , it does not apply to systems that cannot be modeled with a Lagrangian**; for example**, **dissipative systems with continuous symmetries need not have a corresponding conservation law. Conservation of energy**, was first postulated in the early 19th century, and applies to any isolated system. According to Noether's theorem, the conservation of energy is a **consequence** of the fact that the laws of physics do not change over time.

Although the total energy of a system does not change with time, its value **may depend** on the frame of reference. For example, a seated passenger in a moving airplane has zero kinetic energy relative to the airplane, but non-zero kinetic energy (and higher total energy) relative to the Earth. In the context of chemistry, energy is an attribute of a substance as a consequence of its atomic, molecular or aggregate structure. Since a chemical transformation is accompanied by a change in one or more of these kinds of structure, it is invariably **accompanied** by an increase or decrease of energy of the substances involved. Some energy is transferred between the surroundings and the reactants of the reaction in the form of heat or light; thus the products of a reaction may have more or **less energy** than the reactants. A reaction is said to be exergonic if the final state is l**ower** on the energy scale than the initial state; in the case of endergonic reactions the situation is the reverse. Chemical reactions are invariably not possible unless the reactants surmount an energy barrier known as the activation energy. The speed of a chemical reaction (at given temperature T) is related to the activation energy E, by the Boltzmann's population factor $e^{-E/kT}$ – that is the probability of molecule to have energy greater than or equal to E at the given temperature T. This exponential **dependence** of a reaction rate on temperature is known as the Arrhenius equation. The activation energy necessary for a chemical reaction can be in the form of thermal energy.

:Gravity,, electromagnetism, weak interactions, and strong interactions are the fundamental forces of nature..It is only described by classical physics (quantum gravity and graviton) .I**nteractions** between quarks and leptons are the **result** of an exchange of force-carrying particles (such as photons) between quarks and leptons. The force-carrying particles are not themselves building blocks. **As one consequence, mass and energy (which cannot be created or destroyed) cannot always be related to matter (which can be created out of non-matter particles such as photons, or** even out of **pure energy**, such as kinetic energy). **Force carriers are usually not considered matter**: the carriers of the electric force (photons) possess energy (Planck relation) and the carriers of the weak force (W and Z bosons) are massive, but neither are considered matter either. However, while these particles are not considered matter, they do **contribute** to the total mass of atoms, subatomic particles, and all systems which contain them. That is to say, photons loose mass and the subatomic particles gain mass in as sense. **Higgs boson relationship**..And considering it as a proponent and primogeniture for the obtention of the mass of the particles.

The term "matter" is used throughout physics in a bewildering variety of contexts: for example, one refers to "condensed matter physics", "elementary matter", "partonic" matter, "dark" matter, "anti"-matter, "strange" matter, and "nuclear" matter. In discussions of matter and antimatter, normal matter has been referred to by Alfvén as koinomatter. There is no broad consensus as to a general definition of matter, and the term "matter" usually is used in conjunction with a specifying modifier.

GOVERNING EQUATIONS

TIME

$$\frac{dG_{13}}{dt} = (a_{13})^{(1)}G_{14} - (a'_{13})^{(1)}G_{13}$$ 1a

$$\frac{dG_{14}}{dt} = (a_{14})^{(1)}G_{13} - (a'_{14})^{(1)}G_{14}$$ 2a

$$\frac{dG_{15}}{dt} = (a_{15})^{(1)}G_{14} - (a'_{15})^{(1)}G_{15}$$ 3a

SPACE:

$$\frac{dT_{13}}{dt} = (b_{13})^{(1)}T_{14} - (b'_{13})^{(1)}T_{13}$$ 4a

$$\frac{dT_{14}}{dt} = (b_{14})^{(1)}T_{13} - (b'_{14})^{(1)}T_{14}$$ 5a

$$\frac{dT_{15}}{dt} = (b_{15})^{(1)}T_{14} - (b'_{15})^{(1)}T_{15}$$ 6a

ENERGY :

EINSTEINS FAMOUS EQUATION $E=mc^2$ implies $E\text{-}mc^2=0$, This virtually means mc^2 is removed from the Energy and such a dissipation of matter from energy depend upon the time lag Lest everything would have vanishes. One other factor that is responsible for the maintenance conservation and preservation of energy and mass is that there exists a time lag in the dissipation of mass from energy process.

$$\frac{dG_{16}}{dt} = (a_{16})^{(2)}G_{17} - (a'_{16})^{(2)}G_{16}$$ 7a

$$\frac{dG_{17}}{dt} = (a_{17})^{(2)}G_{16} - (a'_{17})^{(2)}G_{17}$$ 8a

$$\frac{dG_{18}}{dt} = (a_{18})^{(2)}G_{17} \quad (a'_{18})^{(2)}G_{18}$$ 9a

MATTER

$$\frac{dT_{16}}{dt} = (b_{16})^{(2)}T_{17} - (b'_{16})^{(2)}T_{16}$$ 10a

$$\frac{dT_{17}}{dt} = (b_{17})^{(2)}T_{16} - (b'_{17})^{(2)}T_{17}$$ 11a

$$\frac{dT_{18}}{dt} = (b_{18})^{(2)}T_{17} - (b'_{18})^{(2)}T_{18}$$ 12a

GOVERNING EQUATIONS OF DUAL CONCATENATED SYSTEMS

SPACE DISSIPATES TIME

$(-b_i'')^{(1)}(G_{13}, G_{14}, G_{15}, t) = -(b_i'')^{(1)}(G, t)$, $i = 13,14,15$

TIME

$$\frac{dG_{13}}{dt} = (a_{13})^{(1)}G_{14} - \left[(a'_{13})^{(1)} \boxed{+(a''_{13})^{(1)}(T_{14}, t)}\right]G_{13}$$ 13a

$\frac{dG_{14}}{dt} = (a_{14})^{(1)}G_{13} - \left[(a'_{14})^{(1)} \boxed{+(a''_{14})^{(1)}(T_{14},t)}\right]G_{14}$ 14a

$\frac{dG_{15}}{dt} = (a_{15})^{(1)}G_{14} - \left[(a'_{15})^{(1)} \boxed{+(a''_{15})^{(1)}(T_{14},t)}\right]G_{15}$ 15a

Where $\boxed{+(a''_{13})^{(1)}(T_{14},t)}$, $\boxed{+(a''_{14})^{(1)}(T_{14},t)}$, $\boxed{+(a''_{15})^{(1)}(T_{14},t)}$ are first **augmentation** coefficients for category 1, 2 and 3

SPACE

$\frac{dT_{13}}{dt} = (b_{13})^{(1)}T_{14} - \left[(b'_{13})^{(1)} \boxed{-(b''_{13})^{(1)}(G,t)}\right]T_{13}$ 16a

$\frac{dT_{14}}{dt} = (b_{14})^{(1)}T_{13} - \left[(b'_{14})^{(1)} \boxed{-(b''_{14})^{(1)}(G,t)}\right]T_{14}$ 17a

$\frac{dT_{15}}{dt} = (b_{15})^{(1)}T_{14} - \left[(b'_{15})^{(1)} \boxed{-(b''_{15})^{(1)}(G,t)}\right]T_{15}$ 18a

Where $\boxed{-(b''_{13})^{(1)}(G,t)}$, $\boxed{-(b''_{14})^{(1)}(G,t)}$, $\boxed{-(b''_{15})^{(1)}(G,t)}$ are first **detritions** coefficients for category 1, 2 and 3

MATTER AND ENERGY CORRESPONDING CONCATENATED QUATIONS:

ENERGY:

$\frac{dG_{16}}{dt} = (a_{16})^{(2)}G_{17} - \left[(a'_{16})^{(2)} \boxed{+(a''_{16})^{(2)}(T_{17},t)}\right]G_{16}$ 19a

$\frac{dG_{17}}{dt} = (a_{17})^{(2)}G_{16} - \left[(a'_{17})^{(2)} \boxed{+(a''_{17})^{(2)}(T_{17},t)}\right]G_{17}$ 20a

$\frac{dG_{18}}{dt} = (a_{18})^{(2)}G_{17} - \left[(a'_{18})^{(2)} \boxed{+(a''_{18})^{(2)}(T_{17},t)}\right]G_{18}$ 21a

Where $\boxed{+(a''_{16})^{(2)}(T_{17},t)}$, $\boxed{+(a''_{17})^{(2)}(T_{17},t)}$, $\boxed{+(a''_{18})^{(2)}(T_{17},t)}$ are first **augmentation** coefficients for category 1, 2 and 3

MATTER

$\frac{dT_{16}}{dt} = (b_{16})^{(2)}T_{17} - \left[(b'_{16})^{(2)} \boxed{-(b''_{16})^{(2)}(G_{19},t)}\right]T_{16}$ 22a

$\frac{dT_{17}}{dt} = (b_{17})^{(2)}T_{16} - \left[(b'_{17})^{(2)} \boxed{-(b''_{17})^{(2)}(G_{19},t)}\right]T_{17}$ 23a

$\frac{dT_{18}}{dt} = (b_{18})^{(2)}T_{17} - \left[(b'_{18})^{(2)} \boxed{-(b''_{18})^{(2)}(G_{19},t)}\right]T_{18}$ 24a

Where $\boxed{-(b''_{16})^{(2)}(G_{19},t)}$, $\boxed{-(b''_{17})^{(2)}(G_{19},t)}$, $\boxed{-(b''_{18})^{(2)}(G_{19},t)}$ are first **detritions** coefficients for category 1, 2 and 3 of ENERGY

GOVERNING EQUATIONS OF CONCATENATED SYSTEM OF TWO CONCATENATED DUAL SYSTEMS

ENERGY

$\frac{dG_{16}}{dt} = (a_{16})^{(2)}G_{17} - \left[(a'_{16})^{(2)} \boxed{+(a''_{16})^{(2)}(T_{17},t)} \boxed{-(a''_{13})^{(1,1)}(T_{14},t)}\right]G_{16}$ 25a

$\frac{dG_{17}}{dt} = (a_{17})^{(2)}G_{16} - \left[(a'_{17})^{(2)} \boxed{+(a''_{17})^{(2)}(T_{17},t)} \boxed{-(a''_{14})^{(1,1)}(T_{14},t)}\right]G_{17}$ 26a

$\frac{dG_{18}}{dt} = (a_{18})^{(2)}G_{17} - \left[(a'_{18})^{(2)} \boxed{+(a''_{18})^{(2)}(T_{17},t)} \boxed{-(a''_{15})^{(1,1)}(T_{14},t)}\right]G_{18}$ 27a

Where $\boxed{+(a''_{16})^{(2)}(T_{17},t)}$, $\boxed{+(a''_{17})^{(2)}(T_{17},t)}$, $\boxed{+(a''_{18})^{(2)}(T_{17},t)}$ are first **augmentation** coefficients for category 1, 2 and 3

$\boxed{-(a''_{13})^{(1,1)}(T_{14},t)}$, $\boxed{-(a''_{14})^{(1,1)}(T_{14},t)}$, $\boxed{-(a''_{15})^{(1,1)}(T_{14},t)}$ are second **detritions** coefficients for category 1, 2 and 3

SPACE

$\frac{dT_{13}}{dt} = (b_{13})^{(1)}T_{14} - \left[(b'_{13})^{(1)} \boxed{-(b''_{13})^{(1)}(G,t)} \boxed{+(b''_{16})^{(2,2)}(G_{19},t)}\right]T_{13}$ 28a

$\frac{dT_{14}}{dt} = (b_{14})^{(1)}T_{13} \left[(b'_{14})^{(1)} \boxed{(b''_{14})^{(1)}(G,t)} \boxed{\mid (b''_{17})^{(2,2)}(G_{19},t)}\right]T_{14}$ 29a

$\frac{dT_{15}}{dt} = (b_{15})^{(1)}T_{14} - \left[(b'_{15})^{(1)} \boxed{-(b''_{15})^{(1)}(G,t)} \boxed{+(b''_{18})^{(2,2)}(G_{19},t)}\right]T_{15}$ 30a

Where $\boxed{-(b''_{13})^{(1)}(G,t)}$, $\boxed{-(b''_{14})^{(1)}(G,t)}$, $\boxed{-(b''_{15})^{(1)}(G,t)}$ are first **detritions** coefficients for category 1, 2 and 3

$\boxed{+(b''_{16})^{(2,2)}(G_{19},t)}$, $\boxed{+(b''_{17})^{(2,2)}(G_{19},t)}$, $\boxed{+(b''_{18})^{(2,2)}(G_{19},t)}$ are second **augmentation** coefficients for category 1, 2 and 3

TIME

$$\frac{dG_{13}}{dt} = (a_{13})^{(1)}G_{14} - \left[(a'_{13})^{(1)}\boxed{+(a''_{13})^{(1)}(T_{14},t)}\right]G_{13} \quad 31a$$

$$\frac{dG_{14}}{dt} = (a_{14})^{(1)}G_{13} - \left[(a'_{14})^{(1)}\boxed{+(a''_{14})^{(1)}(T_{14},t)}\right]G_{14} \quad 32a$$

$$\frac{dG_{15}}{dt} = (a_{15})^{(1)}G_{14} - \left[(a'_{15})^{(1)}\boxed{+(a''_{15})^{(1)}(T_{14},t)}\right]G_{15} \quad 33a$$

Where $\boxed{+(a''_{13})^{(1)}(T_{14},t)}$, $\boxed{+(a''_{14})^{(1)}(T_{14},t)}$, $\boxed{+(a''_{15})^{(1)}(T_{14},t)}$ are first augmentation coefficients for category 1, 2 and 3

MATTER:

$$\frac{dT_{16}}{dt} = (b_{16})^{(2)}T_{17} - \left[(b'_{16})^{(2)}\boxed{-(b''_{16})^{(2)}(G_{19},t)}\right]T_{16} \quad 34a$$

$$\frac{dT_{17}}{dt} = (b_{17})^{(2)}T_{16} - \left[(b'_{17})^{(2)}\boxed{-(b''_{17})^{(2)}(G_{19},t)}\right]T_{17} \quad 35a$$

$$\frac{dT_{18}}{dt} = (b_{18})^{(2)}T_{17} - \left[(b'_{18})^{(2)}\boxed{-(b''_{18})^{(2)}(G_{19},t)}\right]T_{18} \quad 36a$$

Where $\boxed{-(b''_{16})^{(2)}(G_{19},t)}$, $\boxed{-(b''_{17})^{(2)}(G_{19},t)}$, $\boxed{-(b''_{18})^{(2)}(G_{19},t)}$ are first **detritions** coefficients for category 1, 2 and 3

GOVERNING EQUATIONS OF MATTER AND TIME

MATTER

$$\frac{dT_{16}}{dt} = (b_{16})^{(2)}T_{17} - \left[(b'_{16})^{(2)}\boxed{-(b''_{16})^{(2)}(G_{19},t)}\boxed{-(b''_{13})^{(1,1)}(G,t)}\right]T_{16} \quad 37a$$

$$\frac{dT_{17}}{dt} = (b_{17})^{(2)}T_{16} - \left[(b'_{17})^{(2)}\boxed{-(b''_{17})^{(2)}(G_{19},t)}\boxed{-(b''_{14})^{(1,1)}(G,t)}\right]T_{17} \quad 38a$$

$$\frac{dT_{6}}{dt} = (b_{18})^{(2)}T_{17} - \left[(b'_{18})^{(2)}\boxed{-(b''_{18})^{(2)}(G_{19},t)}\boxed{-(b''_{15})^{(1,1)}(G,t)}\right]T_{18} \quad 39a$$

Where $\boxed{-(b''_{16})^{(2)}(G_{19},t)}$, $\boxed{-(b''_{17})^{(2)}(G_{19},t)}$, $\boxed{-(b''_{18})^{(2)}(G_{19},t)}$ are **first detrition** coefficients for category 1, 2 and 3

$\boxed{-(b''_{13})^{(1,1)}(G,t)}$, $\boxed{-(b''_{14})^{(1,1)}(G,t)}$, $\boxed{-(b''_{15})^{(1,1)}(G,t)}$ are **second detrition** coefficients for category 1, 2 and 3

TIME

$$\frac{dG_{13}}{dt} = (a_{13})^{(1)}G_{14} - \left[(a'_{13})^{(1)}\boxed{+(a''_{13})^{(1)}(T_{14},t)}\boxed{+(a''_{16})^{(2,2)}(T_{17},t)}\right]G_{13} \quad 40a$$

$$\frac{dG_{14}}{dt} = (a_{14})^{(1)}G_{13} - \left[(a'_{14})^{(1)}\boxed{+(a''_{14})^{(1)}(T_{14},t)}\boxed{+(a''_{17})^{(2,2)}(T_{17},t)}\right]G_{14} \quad 41a$$

$$\frac{dG_{15}}{dt} = (a_{15})^{(1)}G_{14} - \left[(a'_{15})^{(1)}\boxed{+(a''_{15})^{(1)}(T_{14},t)}\boxed{+(a''_{18})^{(2,2)}(T_{17},t)}\right]G_{15} \quad 42a$$

Where $\boxed{(a''_{13})^{(1)}(T_{14},t)}$, $\boxed{(a''_{14})^{(1)}(T_{14},t)}$, $\boxed{(a''_{15})^{(1)}(T_{14},t)}$ are **first augmentation** coefficients for category 1, 2 and 3

$\boxed{+(a''_{16})^{(2,2)}(T_{17},t)}$, $\boxed{+(a''_{17})^{(2,2)}(T_{17},t)}$, $\boxed{+(a''_{18})^{(2,2)}(T_{17},t)}$ are **second augmentation** coefficients for category 1, 2 and 3

ENERGY

$$\frac{dG_{16}}{dt} = (a_{16})^{(2)}G_{17} - \left[(a'_{16})^{(2)}\boxed{+(a''_{16})^{(2)}(T_{17},t)}\right]G_{16} \quad 43a$$

$$\frac{dG_{17}}{dt} = (a_{17})^{(2)}G_{16} - \left[(a'_{17})^{(2)}\boxed{+(a''_{17})^{(2)}(T_{17},t)}\right]G_{17} \quad 44a$$

$$\frac{dG_{18}}{dt} = (a_{18})^{(2)}G_{17} - \left[(a'_{18})^{(2)}\boxed{+(a''_{18})^{(2)}(T_{17},t)}\right]G_{18} \quad 45a$$

Where $\boxed{+(a''_{16})^{(2)}(T_{17},t)}$, $\boxed{+(a''_{17})^{(2)}(T_{17},t)}$, $\boxed{+(a''_{18})^{(2)}(T_{17},t)}$ are **first augmentation** coefficients for category 1, 2 and 3

SPACE:

$$\frac{dT_{13}}{dt} = (b_{13})^{(1)} T_{14} - \left[(b'_{13})^{(1)} \boxed{-(b''_{13})^{(1)}(G,t)} \right] T_{13}$$ 46a

$$\frac{dT_{14}}{dt} = (b_{14})^{(1)} T_{13} \quad \left[(b'_{14})^{(1)} \boxed{(b''_{14})^{(1)}(G,t)} \right] T_{14}$$ 47a

$$\frac{dT_{15}}{dt} = (b_{15})^{(1)} T_{14} - \left[(b'_{15})^{(1)} \boxed{-(b''_{15})^{(1)}(G,t)} \right] T_{15}$$ 48a

Where $\boxed{-(b''_{13})^{(1)}(G,t)}$, $\boxed{-(b''_{14})^{(1)}(G,t)}$, $\boxed{-(b''_{15})^{(1)}(G,t)}$ are **first detrition** coefficients for category 1, 2 and 3 .

GOVERNING EQUATIONS OF THE SYSTEM

ENERGY

$$\frac{dG_{16}}{dt} = (a_{16})^{(2)} G_{17} - \left[(a'_{16})^{(2)} \boxed{+(a''_{16})^{(2)}(T_{17},t)} \boxed{+(a''_{13})^{(1,1,1)}(T_{14},t)} \right] G_{16}$$ 49a

$$\frac{dG_{17}}{dt} = (a_{17})^{(2)} G_{16} - \left[(a'_{17})^{(2)} \boxed{+(a''_{17})^{(2)}(T_{17},t)} \boxed{+(a''_{14})^{(1,1,1)}(T_{14},t)} \right] G_{17}$$ 50a

$$\frac{dG_{18}}{dt} = (a_{18})^{(2)} G_{17} - \left[(a'_{18})^{(2)} \boxed{+(a''_{18})^{(2)}(T_{17},t)} \boxed{+(a''_{15})^{(1,1,1)}(T_{14},t)} \right] G_{18}$$ 51a

Where $\boxed{+(a''_{16})^{(2)}(T_{17},t)}$, $\boxed{+(a''_{17})^{(2)}(T_{17},t)}$, $\boxed{+(a''_{18})^{(2)}(T_{17},t)}$ are **first augmentation** coefficients for category 1, 2 and 3

And $\boxed{+(a''_{13})^{(1,1,1)}(T_{14},t)}$, $\boxed{+(a''_{14})^{(1,1,1)}(T_{14},t)}$, $\boxed{+(a''_{15})^{(1,1,1)}(T_{14},t)}$ are **second augmentation** coefficient for category 1, 2 and 3

SPACE

$$\frac{dT_{13}}{dt} - (b_{13})^{(1)} T_{14} - \left[(b'_{13})^{(1)} \boxed{-(b''_{13})^{(1)}(G,t)} \boxed{-(b''_{16})^{(2,2,2)}(G_{19},t)} \right] T_{13}$$ 52a

$$\frac{dT_{14}}{dt} = (b_{14})^{(1)} T_{13} - \left[(b'_{14})^{(1)} \boxed{-(b''_{14})^{(1)}(G,t)} \boxed{-(b''_{17})^{(2,2,2)}(G_{19},t)} \right] T_{14}$$ 53a

$$\frac{dT_{15}}{dt} = (b_{15})^{(1)} T_{14} - \left[(b'_{15})^{(1)} \boxed{-(b''_{15})^{(1)}(G,t)} \boxed{-(b''_{18})^{(2,2,2)}(G_{19},t)} \right] T_{15}$$ 54a

Where $\boxed{-(b''_{13})^{(1)}(G,t)}$, $\boxed{-(b''_{14})^{(1)}(G,t)}$, $\boxed{-(b''_{15})^{(1)}(G,t)}$ are **first detritions** coefficients for category 1, 2 and 3

$\boxed{-(b''_{16})^{(2,2,2)}(G_{19},t)}$, $\boxed{-(b''_{17})^{(2,2,2)}(G_{19},t)}$, $\boxed{-(b''_{18})^{(2,2,2)}(G_{19},t)}$ are **second detritions** coefficient for category 1, 2 and 3

TIME(SPACE TIME CONTINUUM)

$$\frac{dG_{13}}{dt} = (a_{13})^{(1)} G_{14} - \left[(a'_{13})^{(1)} \boxed{+(a''_{13})^{(1)}(T_{14},t)} \boxed{+(a''_{16})^{(2,2,2)}(T_{17},t)} \right] G_{13}$$ 55a

$$\frac{dG_{14}}{dt} = (a_{14})^{(1)} G_{13} - \left[(a'_{14})^{(1)} \boxed{+(a''_{14})^{(1)}(T_{14},t)} \boxed{+(a''_{17})^{(2,2,2)}(T_{17},t)} \right] G_{14}$$ 56a

$$\frac{dG_{15}}{dt} = (a_{15})^{(1)} G_{14} - \left[(a'_{15})^{(1)} \boxed{+(a''_{15})^{(1)}(T_{14},t)} \boxed{+(a''_{18})^{(2,2,2)}(T_{17},t)} \right] G_{15}$$ 57a

Where $\boxed{+(a''_{13})^{(1)}(T_{14},t)}$, $\boxed{+(a''_{14})^{(1)}(T_{14},t)}$, $\boxed{+(a''_{15})^{(1)}(T_{14},t)}$ are **first augmentation** coefficients for category 1, 2 and 3

$\boxed{+(a''_{16})^{(2,2,2)}(T_{17},t)}$, $\boxed{+(a''_{17})^{(2,2,2)}(T_{17},t)}$, $\boxed{+(a''_{18})^{(2,2,2)}(T_{17},t)}$ **are second augmentation** coefficient for category 1, 2 and 3

MATTER

$$\frac{dT_{16}}{dt} = (b_{16})^{(2)} T_{17} - \left[(b'_{16})^{(2)} \boxed{-(b''_{16})^{(2)}(G_{19},t)} \boxed{-(b''_{13})^{(1,1,1)}(G,t)} \right] T_{16}$$ 58a

$$\frac{dT_{17}}{dt} = (b_{17})^{(2)} T_{16} - \left[(b'_{17})^{(2)} \boxed{-(b''_{17})^{(2)}(G_{19},t)} \boxed{-(b''_{14})^{(1,1,1)}(G,t)} \right] T_{17}$$ 59a

$$\frac{dT_{18}}{dt} - (b_{18})^{(2)} T_{17} - \left[(b'_{18})^{(2)} \boxed{-(b''_{18})^{(2)}(G_{19},t)} \boxed{-(b''_{15})^{(1,1,1)}(G,t)} \right] T_{18}$$ 60a

where $\boxed{-(b''_{16})^{(2)}(G_{19},t)}$, $\boxed{-(b''_{17})^{(2)}(G_{19},t)}$, $\boxed{-(b''_{18})^{(2)}(G_{19},t)}$ **are first detritions coefficients for category 1, 2 and 3**

$\boxed{-(b''_{13})^{(1,1,1)}(G,t)}$, $\boxed{-(b''_{14})^{(1,1,1)}(G,t)}$, $\boxed{-(b''_{15})^{(1,1,1)}(G,t)}$ **are second detrition coefficients for category 1,2**

and 3

VERY IMPORTANT EPILOGUE:

In the above equations, we have explored all the possibilities of SPACE, TIME, MATTER, and ENERGY RELATIONSHIP in various ways. The equations can solved with the application of the processual formalities and procedural regularities of the paper, which has been elucidated in detail. Nevertheless, such possibilities and probabilities would be discussed with reference to both structure orientation and process orientation in future papers. Notwithstanding, it can be said in unmistakable terms that with the same conditionalities and functionalities consummated, We shall obtain the results as has been obtained in the above paper in the consolidated and concretized fashion , in the future papers, with the hereinabove mentioned equations acting as the pillar and post for further discussions, deliberations. Mathematics however would be complicated, and the number of equations doubling up with each such concatenation process.

Acknowledgments:

The introduction is a collection of information from various articles, Books, News Paper reports, Home Pages Of authors, Journal Reviews, the internet including Wikipedia. We acknowledge all authors who have contributed to the same. In the eventuality of the fact that there has been any act of omission on the part of the authors, it is regretted with great deal of compunction, and contrition, remorse. As Newton said, it is only because erudite and eminent people allowed one to piggy ride on their backs; probably an attempt has been made to look slightly further. Once again, it is stated that the references are only illustrative and not comprehensive

REFERENCES

2. Dr K N Prasanna Kumar, Prof B S Kiranagi, Prof C S Bagewadi - MEASUREMENT DISTURBS EXPLANATION OF QUANTUM MECHANICAL STATES-A HIDDEN VARIABLE THEORY - published at: **"International Journal of Scientific and Research Publications, Volume 2, Issue 5, May 2012 Edition".**

3. DR K N PRASANNA KUMAR, PROF B S KIRANAGI and PROF C S BAGEWADI -CLASSIC 2 FLAVOUR COLOR SUPERCONDUCTIVITY AND ORDINARY NUCLEAR MATTER-A NEW PARADIGM STATEMENT - published at: **"International Journal of Scientific and Research Publications, Volume 2, Issue 5, May 2012 Edition**

4. A HAIMOVICI: “On the growth of a two species ecological system divided on age groups”. Tensor, Vol 37 (1982),Commemoration volume dedicated to Professor Akitsugu Kawaguchi on his 80th birthday

5. FRTJOF CAPRA: “The web of life” Flamingo, Harper Collins See "Dissipative structures” pages 172-188

6. HEYLIGHEN F. (2001): "The Science of Self-organization and Adaptivity", in L. D. Kiel, (ed) . Knowledge Management, Organizational Intelligence and Learning, and Complexity, in: The Encyclopedia of Life Support Systems ((EOLSS), (Eolss Publishers, Oxford) [http://www.eolss.net

7. MATSUI, T, H. Masunaga, S. M. Kreidenweis, R. A. Pielke Sr., W.-K. Tao, M. Chin, and Y. J Kaufman (2006), “Satellite-based assessment of marine low cloud variability associated with aerosol, atmospheric stability, and the diurnal cycle”, J. Geophys. Res., 111, D17204, doi:10.1029/2005JD006097

8. STEVENS, B, G. Feingold, W.R. Cotton and R.L. Walko, “Elements of the microphysical structure of numerically simulated non precipitating stratocumulus” J. Atmos. Sci., 53, 980-1006

9. FEINGOLD, G, Koren, I; Wang, HL; Xue, HW; Brewer, WA (2010), “Precipitation-generated oscillations in open cellular cloud fields” Nature, 466 (7308) 849-852, doi: 10.1038/nature09314, Published 12-Aug 2010

10. R WOOD “The rate of loss of cloud droplets by coalescence in warm clouds” J.Geophys. Res., 111, doi:

10.1029/2006JD007553, 2006

11. H. RUND, “The Differential Geometry of Finsler Spaces”, Grund. Math. Wiss. Springer-Verlag, Berlin, 1959

12. A. Dold, “Lectures on Algebraic Topology”, 1972, Springer-Verlag

13. S LEVIN “Some Mathematical questions in Biology vii ,Lectures on Mathematics in life sciences, vol 8” The American Mathematical society, Providence , Rhode island 1976

14. KNP KUMAR etal.,ozone-hydrocarbon problem a model; published in the commemorative volume of 21st century challenges in mathematics, university of Mysore

15. Multiple ozone support function; accepted for publication in sahyadri mathematical society journal

16. KNPKUMAR mathematical models in political science dlitt thesis (degree awarded) Knp kumar etal Newman Raychaudhuri-Penrose equation-a predator prey analysis. This forms part of the DSC thesis of the author to be submitted to Kuvempu University.

17. Sources on special relativistic time dilation, see Albert Einstein's own popular exposition, published in English translation (1920) as "Relativity: The Special and General Theory", especially at "8: On the Idea of Time in Physics", and in following sections 9–12. See also the articles Special relativity, Lorentz transformation and Relativity of simultaneity.

18. CASSIDY, DAVID C.; Holton, Gerald James; Rutherford, Floyd James (2002), Understanding Physics, Springer-Verlag New York, Inc, ISBN 0-387-98756-8, Chapter 9 §9.6, p. 422

19. CUTNER, MARK LESLIE (2003), Astronomy, A Physical Perspective, Cambridge University Press, ISBN 0-521-82196-7,Chapter 7 §7.2, p. 128

20. LERNER, LAWRENCE S. (1996), Physics for Scientists and Engineers, Volume 2, Jones and Bertlett Publishers, Inc, ISBN 0-7637-0460-1, Chapter 38 §38.4, p. 1051,1052

21. ELLIS, GEORGE F. R.; Williams, Ruth M. (2000), Flat and Curved Space-times, Second Edition, Oxford University Press Inc, New York, ISBN 0-19-850657-0, Chapter 3 §1.3, p. 28-29

22. ADAMS, STEVE (1997), Relativity: an introduction to space-time physics, CRC Press, p. 54, ISBN 0-7484-0621-2, Section 2.5, page 54

23. T D MOYER (1981a), "Transformation from proper time on Earth to coordinate time in solar system barycentric space-time frame of reference", Celestial Mechanics 23 (1981) pages 33-56, equations 2 & 3 at pages 35-6 combined here and divided throughout by c^2.

24. A version of the same relationship can also be seen in Neil Ashby (2002), "Relativity and the Global Positioning System", Physics Today (May 2002), at equation (2).

25. HASSELKAMP, D.; Mondry, E.; Scharmann, A. (1979). "Direct observation of the transversal Doppler-shift". Zeitschrift fur Physik a Atoms and Nuclei **289** (2): 151–55. Bibcode1979ZPhyA.289..151H. doi:10.1007/BF01435932.

26. CHOU, C. W.; Hume, D. B.; Rosenband, T.; Wineland, D. J. (2010). "Optical Clocks and Relativity". Science **329** (5999):1630– 1633. Bib code 2010Sci...329.1630C.doi :10.1126/ science.

1192720. PMID 20929843.http://hyperphysics.phy-astr.gsu.edu/hbase/relativ/airtim.html
http://www.npl.co.uk/upload/ pdf/metromnia_issue18.pdf

27. JV STEWART (2001), Intermediate electromagnetic theory, Singapore: World Scientific, p. 705, ISBN 981-02-4470-

28. CALDER, NIGEL (2006). Magic universe: a grand tour of modern science. Oxford University Press. p. 378. ISBN 0-19-280669-6.,Extract of page 378

29. Equations (3), (4), (6), (9) of Iorio, Lorenzo (27-Jun-2004). "An analytical treatment of the Clock Paradox in the framework of the Special and General Theories of Relativity".arXiv:physics/0405038

30. S.CHANDRASHEKAR REVISITED: IT IS A DEBIT CREDIT WORLD-THESIS PART TWO OF DSC IN MATHEMATICS TO BE SUBMITTED TO KUVEMPU UNIVERSITY

31. LOFTS, G; O'Keeffe D; et al. (2004). "11 — Mechanical Interactions". Jacaranda Physics 1 (2 ed.). Milton, Queensland, Australia: John Willey & Sons Australia Ltd.. p. 286. ISBN 0701637773.

32. SMITH, CROSBIE (1998). The Science of Energy – a Cultural History of Energy Physics in Victorian Britain. The University of Chicago Press. ISBN 0-226-76420-6.

33. FEYNMAN, RICHARD (1964) The Feynman Lectures on Physics; Volume 1. U.S.A: Addison Wesley. ISBN 0-201-02115-3.

34. "Earth's Energy Budget". Okfirst.ocs.ou.edu. Retrieved 2010-12-12.

35. "E. NOETHER'S Discovery of the Deep Connection Between Symmetries and Conservation Laws". Physics.ucla.edu. 1918-07-16. Retrieved 2010-12-12.

36. "Time Invariance". Ptolemy.eecs.berkeley.edu. Retrieved 2010-12-12.

37. Berkeley Physics Course Volume 1. Charles Kittel, Walter D Knight and Malvin A Ruderman

38. MISNER, Thorne, Wheeler (1973). Gravitation. San Francisco: W. H. Freeman. ISBN 0716703440.

39. The Hamiltonian MIT Open Thermodynamics - Basic Concepts and Methods, 7th ed., Wiley (2008), p.39 (Kittel and Kroemer (1980). Thermal Physics. New York: W. H. Freeman. ISBN 0-7167-1088-9.

40. V. SLIPHER, “The radial velocity of the Andromeda nebula”, Lowell Observatory Bulletin, 58, vol II:56-57 (1913),

41. E.P. HUBBLE, “Extragalactic nebulae”, Astrophys. J., 64, 321-369, (1926),

42. E.P. HUBBLE, “A relation between distance and radial velocity among extra-galactic nebulae”, Proc. Nat. Acad. Sci., 15, 168-173, (1929),

First Author: [1]**Mr. K. N.Prasanna Kumar** has three doctorates one each in Mathematics, Economics, Political Science. Thesis was based on Mathematical Modeling. He was recently awarded D.litt., for his work on 'Mathematical Models in Political Science'--- Department of studies in Mathematics, Kuvempu University, Shimoga, Karnataka, India **Corresponding Author:drknpkumar@gmail.com**

Second Author: [2]**Prof. B.S Kiranagi** is the Former Chairman of the Department of Studies in Mathematics, Manasa Gangotri and present Professor Emeritus of UGC in the Department. Professor Kiranagi has guided over 25 students and he has received many encomiums and laurels for his contribution to Co homology Groups and Mathematical Sciences. Known for his prolific writing, and one of the senior most Professors of the country, he has over 150 publications to his credit. A prolific writer and a prodigious thinker, he has to his credit several books on Lie Groups, Co Homology Groups, and other mathematical application topics, and excellent publication history.-- UGC Emeritus Professor (Department of studies in Mathematics), Manasagangotri, University of Mysore, Karnataka, India

Third Author: [3]**Prof. C.S. Bagewadi** is the present Chairman of Department of Mathematics and Department of Studies in Computer Science and has guided over 25 students. He has published articles in both national and international journals. Professor Bagewadi specializes in Differential Geometry and its wide-ranging ramifications. He has to his credit more than 159 research papers. Several Books on Differential Geometry, Differential Equations are coauthored by him--- Chairman, Department of studies in Mathematics and Computer science, Jnanasahyadri Kuvempu University, Shankarghatta, Shimoga district, Karnataka, India