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Echoes from the Eleventh Dimensions – Musings of Physics from Outer Space

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If God knows everything, does he know the last digit of π? 36 essays on physics from entropy to extra – vehicular activity, supersymmetry to supergiants, sonoluminescence to heliomagnetodynamics, Bohr radius to Brachistochrone curve, satellite mechanisms to Hawking radiation, chaos to ekpyrotic cosmology, Karman to Kruskal, Tachyon to Missile equations and many more.

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A collection of Essays in Physics:

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1 Heliophysics

The intense solar flares that get occurred in the Sun are due to the twisting and bending of the flux lines in effect of Coriolis force. Those flux lines with the plasma trapped in them are comparatively of lower temperature than the chromosphere Which Is 1,00,000 Joules. Therefore due to the low density, the buoyant plasma rises upwards through the flux ropes from the photosphere or the surface of the Sun. Here, the strange phenomena called magnetic reconnection takes place, which can be thought of a rubber band analogy. Imagine a Rubber band being stretched and twisted; but when you released the band - the band will fly away due to the trapped kinetic energy embedded in it during the stretching of it. Those flux lines with trapped plasma is a "Toroidal" magnetic field. When a magnetic field moves, the electric field associated with it also moves along the magnetic field orthogonally called the "Polaroid" field lines (as Sun is a body of plasma; differential rotations take place where part of the body movements differ from other parts). But in Sun, the twisted fields are so much deformed that, instead of moving orthogonally, they moves in a deformed way with some in a 'closed connecting loop' and some 'open connecting loop'. The CMEs or "Coronal mass ejections" occurring in the trapped plasma of those field raises an intense temperature of (1×10^6) Joules due to the electromagnetic γ-radiation and free ionized atoms with some loose electrons that floats on the peripheral of that field. Those "S" or "Ƨ" shaped lines when appears on the Sun; then it's a sign of the intense magnetic flux which will eventually sprout as flares. The kinetic energy is so strong that, sometimes even the speed is [although] much lesser than the escape velocity but still the flux plasma makes it's way out of the photosphere at 480 km/sec (escape velocity is 618 Km/Sec); some plasma flux even gets discharged at 2000 km/sec and therefore are unable to drop back to the Sun; hence formed a magnetic highway of open flux layers which spreads out to the Sun's atmosphere.

2 Kessler Syndrome

LEO (Low Earth Orbit), the orbits nearest to the Earth at less than 2,000 Km, is full of space debris and space junk. These junks come from defunct human made objects in space like the ejected payload fairing, the upper stage separation of rockets, solidified liquids which are ejected from spacecrafts, old and non-functional satellites, paint flecks, the fuels from spacecrafts which expanded due to low gravity and defrag the combustion chambers, un-burnt particles from solid rocket propellants, anti-satellite missiles which destroys satellites producing thousands of smaller fragments poses rick to spacecraft, satellites, solar panels, star tracker, scopes of numerous artificial satellites orbiting the Earth. From High Earth Orbits, those objects have been dragged down to the LEO causing it densely populated with increasing risks to orbiting functional satellites. As per the data of Oct. 2019, more than 20,000 artificial objects are there orbiting Earth including 1,419 operational satellites. There have been an estimation of debris as small as 1 cm are there about 128 million pieces with 9,00,000 from 1 to 10 cm and debris above 10 cm are counted as 34,000. The space debris, from higher orbits have been dragged into lower orbits by gravitational perturbations, lunar perturbations, solar wind, solar radiation pressure and this results in a high density of objects in the LEO Plane, which increases the chance of head to head collisions at a speed of twice the orbital speed, theorized above or equal to 16 Km/Sec with space, being a hard vacuum results in tremendous impact and harm the operational satellites, also de-orbit them. Sometimes the MMOD (Micro-meteoroid and Orbital Debris) posed serious hazards to spacecrafts which couldn’t be protected by ballistic shields.

Kessler Syndrome propped by NASA Scientist Donald J. Kessler, is a scenario, where high density objects in LEO becomes so large that, collisions started to occur between objects and this cascade of collisions gives a chain reaction, that further, increases the chance of collisions. The critical density has almost been reached in LEO as regards to space debris. According to the “National Academy of Sciences” a 1-Kg object travelling at 10 Km/Sec is capable in breaking up a 1000 Kg Spacecraft on a head to head collisions giving rise to numerous 1-Kg debris that results in space junks.

To avoid these issues and to make space safe for explorations, the space industries can use a controlled atmospheric reentry system, boosting to graveyard orbit or shift the craft from MEO (Medium Earth Orbit) to an unstable resonating orbit with the Sun or Moon, which speeds up the orbital decay. For the debris, ranging from 1 to 10 cm, a multi-megawatt laser-band called as ‘laser broom’ could hit the debris by laser, ablates it, changes the eccentricity of the orbital plane until it re-enters the earth atmosphere harmlessly.

3 Composite motion of Earth

The earth is 24,900 miles in circumference at the equator & takes 24 hours to make one rotation. So: 24,900 / 24 = 1,037 MPH or 1,666 KPH. The Earth is roughly 93 million miles (150 million km) away from the sun, giving its orbit a circumference of 584 million miles (942 million km). That works out to 66,666 MPH or 107,000 KPH. Our solar system itself is also moving in an orbit around the galactic core. The solar system is 25,000 light years away from the center of the galaxy, and the galaxy makes one rotation every 250 million years with a speed of something like 420,000 MPH or 675,000 KPH. The Milky Way & Andromeda are approaching each other with a speed of about 130 km/s. Our galaxy and neighbors are moving at 600 km/s in the direction of the constellation Hydra. Milky Way moves through space in the direction of the constellation Virgo is approximately 300 km/s. So the galaxy is moving through the universe at a speed of 1,000 km/s, which means 3,600,000 KPH or 2,237,000 MPH. Adding it all up, you get: 1000 + 66,666 + 420,000 + 2,237,000 = 2,724,666 MPH Or 1,660 + 107,000 + 675,000 + 3,600,000 = 4,383,670 KPH In other words, you are hurling through space & Time at 2.7 million MPH (4.4 million KPH) even though it feels like you are sitting still.

4 Sonic Phenomenology

Now a days all fighter planes are Supersonic. So, to move faster than sound with a Mach # 2 or 3 or 4… The aircraft has to pass from a subsonic to transonic to supersonic stage. All this 3 stages and their flowing interconnected-ness has make the aircraft body a smoother one without any curvature so that the friction between the air molecules with the body can be reduced or else the temperature will be around 600°C which will kill the Pilot. Moreover a DELTA shaped aircraft is needed for a much larger sweep back which helps in the steady flow of the air around the craft when the barrier of the speed of the sound is crossed. Which is called the Bow Shock or Shock Wave.

When the craft is moving subsonic then the air pressure behind it is travelling at the speed of the sound which communicated to the air pressure at the front of the plane that the craft is approaching and this makes the air at the front of the craft to adjust its pressure gradient before the craft is approaching on it. But if the plane travels at a supersonic speed then the pressure waves will be lagging behind the speed of the craft or plane and this will create a position in which the air at the frontier part of the craft is still uninformed and so it is still remains compressed and when the craft approaches the pressure gradient then the air comes as a shock to the plane in the form of a shock wave which results in an immense jerking of the plane along with the increase in air pressure, air density & a decrease in the craft velocity accompanied by the sonic boom. The boom spreads as a comic structure behind the craft and the object in which it hits gets torn apart. This sonic boom acts in 4 Stages….

- ***Stage 1*** – The air at the front part of the craft is when at .8 Mach # then a small small shock wave I screamed at the front but the air at the rare portion of the plane is still subsonic.
- ***Stage 2*** – The air at the front part comes to the trailing edge when the speed is .9 Mach # and therefore acts as a inclined shock wave with a greater frequency and starts to move back wards even more & more.
- ***Stage 3*** – When the speed is transonic or 1 Mach # then the air at the back or trailing edge of the plane is quite supersonic and the air at the front edge of the plane is more than supersonic which creates two separate shockwaves at the leading & the trailing edge which is accompanied by a high pressure gradient.
- ***Step 4*** – When the speed is more than 1 Mach # then the shock wave will get inclined towards the plane with a more acute angle in between them and thereby producing sonic booms which breaks the barrier of the sound by the ordination of two separate shock waves counteracting with the plane in the opposite directions from the front and rear thereby giving the plane a supersonic speed and breaks the barrier of the sound with a high velocity of craft in the air compared to the speed of the sound.

5 Fraunhofer Lines of Sun

In 1802, a scientist called W.H. Wollaston noticed that the visible spectrum from the Sun had several dark lines in it.

Fraunhofer found that visible spectrum of the SUN has many dark lines in the spectrum than Wollaston had suspected. Fraunhofer showed that these were a feature of sunlight and not an illusion nor an optical effect, and he labelled them with letters of the alphabet (A,B,C etc.). We now call these dark lines Fraunhofer lines.

What are the Fraunhofer lines and how are they formed?

When the visible light from below the Sun's surface passes through the layers above it (the photosphere and chromosphere), some of the light at particular wavelengths is absorbed by atoms and ions and so is missing in the spectrum we see. When there is no light it appears as black in the spectrum.

When light passes through material and is absorbed by atoms and ions of each element (hydrogen, calcium, sodium, iron etc.) a unique set of dark lines is formed in the spectrum. These are called absorption lines.

A sudden dip in 'brightness' at a particular wavelength (colour) in a spectrum. This means that either the radiation was not produced by the emitting object in the first place, or, more likely, something else has absorbed the radiation at that wavelength before it reached your eye or detector. In the case of the Sun and other stars, this absorption takes place near the surface and in the lower atmosphere.

6 Physics of Nuclear Bombs

Nuclear bombs are weapons of mass destruction. They harness the forces that hold the nucleus of an atom together by using the energy released when the particles of the nucleus (neutrons and protons) are either split or merged.There are two ways that nuclear energy can be released from an atom:

- Nuclear fission – the nucleus of an atom is split into two smaller fragments by a neutron. This method usually involves isotopes of uranium (uranium-235, uranium-233) or plutonium (plutonium-239).

- Nuclear fusion – two smaller atoms are brought together, usually hydrogen or hydrogen isotopes (deuterium, tritium), to form a larger one (helium isotopes); this is how the sun produces heat.

The atomic bomb uses nuclear fission and the hydrogen bomb uses nuclear fusion.

- The Atomic bomb – Nuclear fission produces the atomic bomb, a weapon of mass destruction that uses power released by the splitting of atomic nuclei. When a single free neutron strikes the nucleus of an atom of radioactive material like uranium or plutonium, it knocks two or three more neutrons free. Energy is released when those neutrons split off from the nucleus, and the newly released neutrons strike other uranium or plutonium nuclei, splitting them in the same way, releasing more energy and more neutrons. This chain reaction spreads almost instantaneously. Atomic bombs were exploded in war in Hiroshima and Nagasaki at the end of World War II.

- The hydrogen bomb – Nuclear fusion is a reaction that releases atomic energy by the union of light nuclei at high temperatures to form heavier atoms. Hydrogen bombs, which use nuclear fusion, have higher destructive power and greater efficiencies than atomic bombs.

Due to the high temperatures required to initiate a nuclear fusion reaction, the process is often referred to as a thermonuclear explosion. This is typically done with the isotopes of hydrogen (deuterium and tritium) which fuse together to form Helium atoms. This led to the term "hydrogen bomb" to describe the deuterium-tritium fusion bomb.

Tsar Bomba is the largest nuclear bomb ever tested in the world by Russia which is so dangerous that it produces a third degree burn 100 kilometre radius across the place of bombing.

7 Belinski–Khalatnikov–Lifshitz (BKL) singularity

Physics of extreme gravitation occurs at BKL SINGULARITY. The tidal force are oscillating and they will not only stretch you radially and squeeze you transversaly but they will perform the chaotic stretch in 1 direction and squeeze in 2 directions simultaneously. The Black hole which arises are sensitive to perturbations and the warpage of space time is so large that every object classically becomes infinite. But Clasical Physics prohibits infinity and therefore we can say that Quantum gravity takes over. This quantum gravity is essentially powerful in Plank-Wheelers time ($\sqrt{G\hbar/c^3}$)/c ~ 10^{-43} Seconds. This span of time is crucial for the classical physics to break down and Quantum Physics to take over. Generally, Quantum Gravity makes a Probabilistic estimation whether anything goes infinite or not due to oscillating tidal forces. The tidal force of earth is 1/8 but in a Black hole million times greater than sun, tidal force is a billion times greater. Sun ~~3,00,000 Earth Mass.

8 Supercharges

SUSY means SUPERSYMMETRY – An extended symmetry which preserves every Bosons for every distinct Fermions and vice versa.

A supercharge is an aspect of SUSY where each Boson gets converted into fermions. A Z^2 model depicts the Supercharge having a value of Spinor index ½ in all 4 dimensions as similar to Dirac Spinors. It acts as a fermions with a half-integer spin. And as a result of this spin ½ it when couples with Bosons Spin 1 then converted them into fermions as $1 + 1/2 = 3/2$. Similarly a fermions of spin ½ is changed to Bosons of spin 1/2+1/2=1.

Now, Supercharge is Hamiltonian. As because it's an additive of Kinetic and Potential Energy.

$$H = KE + PE$$

Super index is Q and same for supercharge.

Any Superchage is commutable to Hamiltonian as,

$$H \times Q = Q \times H = 0 = [H, Q].$$

Superchage arises from implicit Supersymmetric field theories and it wont commute with the Lagrangian.

A superchage when commutes with a Hamiltonian means that the Supercharge acts over the total energy of the particle while converting its spin from Fermi-Dirac to Bose-Einstein or reverse statistics.

As Supersymmetry is not discovered yet. And as Supercharge has been essential to stop the spontaneous supersymmetry breaking therefore if SUSY acts over Supercharge then proper Yang-Mills mass wont act correctly during the phase of SUSY or SOFT SUSY Breaking Proceduce.

9 How did life originate on earth?

It has been said that life originated from primordial soup consisting of simple molecules, but how did this soup formed or come into existence, let's explore further for this,

The early atmosphere of Earth actually contains less hydrogen but scientists have suggested that volcanic clouds in the early atmosphere might have held methane, ammonia and hydrogen and been filled with lightning as well. This lighting formed the basic spark for the development of life in Earth. Electric sparks can generate amino acids and sugars from an

atmosphere loaded with water, methane, ammonia and hydrogen, and these amino acids may be the basic framework of life.

Perhaps life did not originate in Earth at all. It may have been brought by meteors and comets from outer space to Earth and thereby creating the basic building block of life. This meteors or comets may have bought microbes along with it when they hit the earth. So, there is a chance of developing complex life forms from these microbes actually. But then another question comes… how did life originated in some portions of space then? Or from where does this life came to Earth?

There might have been very simple beginnings in the origin of life on Earth. Instead of developing from complex molecules such as RNA, life might have begun with smaller molecules interacting with each other in cycles of reactions. These reactions further led to the development of complex molecules which in turn generated further complex life forms. But question still remains how RNA forms on Earth? RNA still exists and performs several functions in organisms, including acting as an on-off switch for some genes. But how RNA got here in first place? There are no such possible findings behind that. Now DNA needs proteins in order to form, and proteins require DNA to form, so how could these have formed without each other? The answer may be RNA, serve as an enzyme like proteins, and help create both DNA and proteins and stores information in DNA.

The first life on Earth must have originated from clay. They help in the development of organic compounds and aligned them in a particular pattern in order to originate life. The simple beginnings of life must have been started from the clay itself. The mineral crystals in clay could have arranged organic molecules into organized patterns. After a while, organic molecules took over this job and organized themselves.

Life can be originated in the deep sea vents or under the sea from hydrogen rich molecules which plays a crucial role in the development of life. 3 billion years ago, these oceans might have been covered in ice as the sun was about a third less luminous than it is now. These thick layers of life have protected these organic compounds from the cosmic radiation for millions of years and helps in the development of life in underwater sea.

10 Indexing Supergiants

According to the Spectroscopic Photometry the class is under “B”…. From O-T. The temperature scale is “1”…. From 1-9. The Supergiants falls under class 1b. So Spectral classification of these stars are “B11b”. The stars can be identified by means of declination from the celestial equatorial North Pole to the equatorial pole along with the right ascension from the Declination arc to the first point of Ares. The stars are not tidally locked hence they doses not form clusters in the planetary nebulae. Most abundant element is hydrogen & helium along with CH4 as their atmosphere. Globular cluster is absent. The apparent magnitude is less than the absolute magnitude as the distance is under 10 Parsecs or 1 arc second in stellar parallax angle. The surface temperature is proportional to luminosity that is $L \sim 4\pi r^2 T(eff\odot)^4$. The solar mass is $3\sim4\ M\odot$. The solar radius is $5\ R\odot$. The bolo metric luminiocity is greater than the apparent magnitude. The stars belong to Population II Stars. The Supergiants appears as concentric circles due to the limit of resolution on the parabolic aperture of the telescope due to diffractive images.

11 Noether’s Theorem

Lets describe her ingenious discovery as she was the first to determine the cause of energy “not lost” by gravitational redshift of the expanding universe as observed by Hubble rather they are conversed by means of a symmetry.

So, what exactly is Emmy Noether’s Theorem ?

Noether’s theorem explains the fundamental connection between symmetry and conservation laws. For example, if a physical system behaves the same, regardless of how it is oriented in space, the physical laws that govern it are

rotationally symmetric; from this symmetry, Noether's theorem shows the angular momentum of the system must be conserved.

The physical system Itself need not be symmetric; a jagged asteroid tumbling in space conserves angular momentum despite its asymmetry. Rather, the symmetry of the physical laws governing the system is responsible for the conservation law. As another example, if a physical experiment has the same outcome at any place and at any time, then its laws are symmetric under continuous translations in space and time; by Noether's theorem, these symmetries account for the conservation laws of linear momentum and energy within this system, respectively.

Noether's theorem has become a fundamental tool of modern theoretical physics, both because of the insight it gives into conservation laws, and also, as a practical calculation tool. Her theorem allows researchers to determine the conserved quantities from the observed symmetries of a physical system. Conversely, it facilitates the description of a physical system based on classes of hypothetical physical laws.

For example, suppose that a new physical phenomenon is discovered. Noether's theorem provides a test for theoretical models of the phenomenon: if the theory has a continuous symmetry, then Noether's theorem guarantees that the theory has a conserved quantity, and for the theory to be correct, this conservation must be observable in experiments.

In a letter to The New York Times, Albert Einstein wrote:

[*"In the judgment of the most competent living mathematicians, Fräulein Noether was the most significant creative mathematical genius thus far produced since the higher education of women began. In the realm of algebra, in which the most gifted mathematicians have been busy for centuries, she discovered methods which have proved of enormous importance in the development of the present-day younger generation of mathematicians."*]

An underrated legend of theoretical physics Dr. Emmy Noether (1882-1935).

12 Detection Mechanism of Extra – Solar Planets

Radial Velocity: It is also known as Doppler spectroscopy. It depends on Doppler effect of red and blue shift of measuring the distance of planets. It depends on the fact that a star does not remain completely stationary when orbited by a planet. It moves in an elliptical way slightly due to the gravitational tug of the smaller planet. If the planet is moving towards the observer, then its wavelength decreases and frequency increases which results in its blue shift and it the planet is moving away from the observer then its wavelength increases and frequency decreases which results in red color or red shift. High quality sectrosoopy allows scientists to locate the changes in the shift of the star. The spectrum becomes red or blue shifted by a periodic interval of days, months or years which clearly classified that some planet is moving surrounding the star which results in its change its shift. The shift becomes blue shifted when the star comes nearer to earth and gain red shifted when the star goes far away from earth. This periodic interval determines the period of revolution of the exoplanet surrounding its parent star.

Transit Photometry: Planets have no light of itself. So when a small object passes in front of a large light source then there occurs a dimming of the light of the star. This one revolution of the planet is called the 'transit'. These dimming of the star can occur after a specific period of days, months or years. This determines that something is orbiting the star and the regular interval determines its revolution period. The amount of dimming is directly proportional to the size of the planet. In this way from this method, along with the revolution period, the size of the planet can also be observed. A small planet transiting a large star will cause a minimal dimming whereas a large planet transiting a small star will cause a noticeable effect.

Microlensing*:* It searches planets at thousands of light years away. It falls in relativity and had effect on Einstein Ring. When one star passes through another star then the light of the distant star will bend by the nearest star due to the bending of starlight effect on relativity. If the source star is positioned behind the intermediary star when seen from earth, then the light rays of the source star will try to come from all sides of the intermediator stars as a result of which the Einstein ring is formed surrounding the intermediator stars. When the lensing star has a smaller companion or exoplanet then the

situation is quite different. If the planet is close enough to the lensing star, then such that it crosses two different light sources from the source star, its gravitational pull will create a third image of the star by shifting the two light rays and producing a third bending of the starlight thereby produces a third image of the source star. This results in an immense brightness which helped in detection of exoplanets.

13 All About Quasars

Quasi Stellar Radio Sources which is at a distance of 3 to 16 billion light years away from earth. It gives of high amount of radio bursts. It emits a high amount of energy and are actually the bright centres of distant galaxies. Quasar actually formed when the galaxies collide with each other therefore the stellar dust and gas merged into one along with the central black hole of the distant galaxies. And this results in giving a jets of high energized gas from the middle of the black hole which are at the center of the quasars. Every galaxy has a black hole in its center and this emanating jets of light from the black holes with the stellar clouds beside them are called the quasars. They are the bright center of the galaxy. The gas and dust from accretion disk falls into the black hole which gets heated to billions of degrees thereby forming the jets of gases giving rise to x-rays and gamma rays.

When a red giant dies by supernova explosion then what remains is a neutron star. A neutron star is actually the iron core of the star which is about 18 kilometers wide but with a mass of about 4 times the mass of our Sun. So, just imagine its density. It is so dense that if a strawberry is dropped on its surface then an explosion of atomic bomb occurs due to its high density and thereby its high gravitational pull. A single tea-spoon of a neutron star will weight as much as a Mount Everest. If a human stand over the neutron star, then he will get collapsed into an atom. Neutron stars are full of neutrons without any proton or electron. As the red giant bursts and then the left over collapses, its gravity is so huge that the protons and electrons are fused together and when a positive and negatively charged particles collapse then nothing remains. So, what only remains is the neutron. That's why it is called a neutron star.

Magnetars are a special type of neutron stars but with a high magnetic field of 1 Billion Tesla. "In the first stage of this process, the more massive star of the pair begins to run out of fuel, transferring its outer layers to its less massive companion — which is destined to become the magnetar — causing it to rotate more and more quickly. This rapid rotation appears to be the essential ingredient in the formation of the magnetar's ultra-strong magnetic field".

Suppose an object is spinning. But its mass remaining the same if its size decreases then its spinning will eventually increase. This is a property of angular momentum. The same thing when happened with a neutron star then it becomes a pulsar, which starts to rotate at about 450 times approx. per second. These pulsars emit high energy jet beams from its magnetic poles which when observed from the night sky seems to pulse, if the direction of the beam is faced towards the earth. That's why, these type of neutron stars are called pulsars.

14 Chaos Theory

Nature is unpredictable. The hidden reality of its structure lies within an infinitesimal limit of what is called fractals. It is the unpredictability that gives the shape of extreme beautifulness to the nature to the extent human eyes can perceive. When seen through the right eye, the nature reveals its structure, as one of the marvelous concept of art one can even imagine. The study of this pattern of nature is known as Chaos Theory.

Chaos Theory being a sub discipline of mathematics, studied the patterns of complex structures like the earth's weather system, the behavior of water boiling on a stove, migratory patterns of birds, or the spread of vegetation across a continent. Chaos is everywhere, from nature's most intimate considerations to art of any kind.

The chaos world or the nature is not a constant. It is random. Always fluctuating. It is this randomness, that a probabilistic structure is needed to study those internal pattern of this complex systems. Such as a falling snow flake is a star shaped. Within this star shaped structure, there are numerous little star shaped structure which makes up this snowflake called fractals. It's called the Koch dimensions of ¾.

This however taught us that nature most often works in patterns, which are caused by the sum of many tiny patterns.

It all started when Edward Lorenz created a weather machine to predict the weather conditions. A sequence of weather prediction is shown in the machine like the clouds blew, winds move, heat happens and then cooled down. But each pattern was different with the previous one. There was no similarity with the weather pattern. It is of so complex structure. But one day Lorentz decided to do something different. He input certain parameters and waited the program to respond according to it just like the previous run. That is as if he wants to do a forecast of the natures outcome. Instead of giving the exact numbers like wind, temperature etcetera, Lorentz had set for approximations. This made the entire system spoiled. The whole weather consists of the different types of patterns that makes up the earth's atmosphere. And a slight change in a single pattern will ruin the entire system as a whole with the so called bogus weather forecasts. This is all because nature doesn't want to let herself be predicted.

Complex systems often appear too chaotic to recognize a pattern with the naked eye. Therefore, we have to probe deeper to recognize its pattern using certain parameters.

Chaos theory is a cycle as if the same thing is repeating in its structure itself with smaller and smaller aspects.

The Poincaré–Bendixson theorem states a two-dimensional differential equation where The Lorenz attractor is generated three differential equations as:

$$dx/dt = \sigma y - \sigma x$$

$$dy/dt = \rho x - xz - y$$

$$dz/dt = xy - \beta z$$

Where $x, y,$ and z makes up the system state, t is time, and σ, ρ, β are the system parameters.

15 Sonoluminescence – Light from Sound

This experiment is defined in a research paper in 1931 but at that time the results of this SONOLUMINESCENCE is still unknown. No scientists can find out the cause but in 70's the science flourished & the cause of this mystical glow of light from sound is deciphered.

How?

Take a jar full of water. Insert a small bubble inside the water in the jar. Bombard the water bubble with sound waves of high intensity from opposite directions. The sound wave will enter inside the bubble & makes the bubble expands… The density decreases and the bubble increases in size. Then suddenly the bubble just can't hold its own weight in its position inside the jar and implodes inward. The density increases. All the water molecules are rushing towards the interior of the bubble with a tremendous high velocity. The friction between the molecules inside the bubble will create a massive heat some trillions of degree Celsius which then tries to make out through the barrier of the bubble with a rush of light and heat. The bubble collapses with its own density and gravity & hence the heat & light which generated upward through the collapsing of the bubble by a process of nuclear fusion. The nucleus inside the atom of the water will try to fuse with each other as they get compacted & comes closer & closer. This results in a shockwave with a high pressure gradient which causes the heat to escape outwards with a speed greater than that of light. As a result, the wavelength of the light will squeezes tremendously & thereby the frequency & energy increases exponentially resulting in a ultraviolet glow…. Starting from blue, then violet, then ultraviolet. The water molecules are actually travelling faster than that of the light and hence the Superluminal glow is observed.

So, Light can be produced from the sound by combining the Mach # with Cherenkov Effect along with the Shockwave relating to the nuclear fusion. The Physics is simple as that of a star collapsing under its own weight to form a black hole.

The star whose core is burning in nuclear fusion radiates energy & when the hydrogen gets burned out and the helium gets deposited in the core followed by a chain of reaction from Lithium to Berilium-8 isotope to Carbon-12, it collapses and make a distorted Spacetime with an escape velocity equal to that of the light – A Black Hole.

16 Heliomagnetodynamics

The sun is 150 trillion miles away from the earth with a gravity of 27g and escape velocity of 618 Km/Sec. The core is the place of intense pressure with a temperature of 10,000 Joules that accelerates the free protons to collide together by a phenomena called quantum tunneling thereby formed a proton linked with a neutron along with a positron & electron neutrino. The positron-electron collides and annehilates thereby making the gamma rays. From two Sides of p-p chain reaction the deutorium is formed which is a hydrogen of 2 protons & 2 neutrons which fuses with another dueterium to make a Helium atom. The Electron-Positron annihilation takes place in every steps thereby forming the gamma radiation which comes out from the core to the surface at a distance of 1,52,000 Km in 1,75,000 Yr thereby making is way to the photosphere at 4 km/Sec. The ionisation of -ve Hydrogen ions occurs accepting the Gamma rays and making the electrons to jump to a higher orbit. But electron tries to stabilise itself by enmitting another photons and comes out from the Photosphere with temperature of 1,00,000 J.

The Sun rotates in differential movement in a period of 27 days. As it's of plasma hence different regions rotates with different velocity. The flux lines are dragged by the rotation from east to west which twists the magnetic flux into a "S" shaped Sigmoid which leads to a release of high kinetic energy when they tries to straighten themselves from the twisted position. This results in the formation of secondary & tertiary flux and form flux lines over the Photosphere, The pressure increases in the lower flux lines and forms a pressure gradiant leading to a Buyant flow of the Magnetic Flux Upwards. The plasma is trapped in the flux and it comes out from photosphere in the Form of two interconnecting loop gradiant called the leading & the trailing sunspots. The plasma gets heated due to the constantial Electron-Gamma reaction & the photon Gets trapped in the Chromosphere. The trapped photons about 1 in a 1000 makes its way to the Corona to make coronal mass ejections at around 2000 Km/Sec with 1 million K temperature. The plasma from the equator flows towards the poles making the more magnetic gradiant which results in the sweep of the poles of the sun in a 11 year cycle. Magnetic reconnection & helicity are the most important aspects during the solar flares. The comparatively low energy plasma which is trapped by the flux lines are shooted outwards by coronal mass ejections through the Corona which heats up 1 cm^2 of the Suns Surface by $4 * 10^{36}$ Joules/Sec.

The atmosphere of the sun extends to over 18 billion kilometer. Sun emits the EM radiation in both the visible & invisible Spectrum. The invisible spectrum is a High-Energy spectrum called the UV ray, X ray, Hard X ray and the low energy spectrum is Microwave, Radio, Gamma wave.

17 Radion Field and Higgs in Ekpyrotic Cosmology

Both Radion and Higgs field are Scalers (φ)

Higgs Field properties;

[1] It always tries to move from false vacuum to true vacuum.
[2] Energy 10^{40} Joules/Cubic cm.
[3] Higgs satisfies Bose-Einstein statistics and the phase factor of interference is +1.
[4] Energy $1/\propto$ Higgs Field
[5] Higgs as a boson is a open string with boundary conditions (Dirichlet& Neumann)
[6] All spins of Higgs Boson are 0.
[7] Higgs has a Non-Zero vacuum expectation value.

[8] Higgs as an open string cannot propagate to other dimensions.
[9] Higgs strings are always orientable in the same way no matter how many number they are or else Higgs will get annihilated in Spacetime.
[10] Higgs can be attached to any form of Dirichlet(P)-Brane, P=[1,10].

Radion fields is used to attract and repel 2 D(P)-Brane (P=4) creating a collision as Big Bang. They move away from each other and after a certain interval of times the Branes comes again in contact to form another Big Bang. When they comes too close the universe is destroyed in Big Crunch and then the collision happens which results in the Big Bang. This cycle is repeating from time to time.

In this Ekpyrotic model, the cosmological constant dominates along a certain time but after that it vanishes and allowed gravity to conquer its domain resulting in big crunch. Cosmological constant has a value of 10^{-121} higher than the desired value. The curvature has been assumed as Positive ($\Omega > 1$) and the critical density is also positive. Pressure density is negative.

If the radion fields are strong enough like gravity and inversely proportional to the square of the distance then it can be assumed that the strings which are there emanting from both the 4-Branes which are coming closer, the higgs strings are squeezed to a high intensity. This high intensity means the strings which are an oscillisting wave must have squeezed to lesser wavelength as the two 4-Branes are coming closer and closer. This increases the frequency and energy of the oscilliating strings. Therefore, as Energy is inversely proportional to the strength of the higgs field, so, the higgs field diminishes in high energy. That shows that those parts of the two 4-Branes that collides are a source of high energy Big Bang. Then the wavelength stretches, energy decreses and mass originates.

Conclusion :

- If Radion field is inversely proportional to Higgs field then at the time of Big Bang the strength of the Higgs field is tiny. That means the strength of higgs field fluctuates with time getting higher and higher as universe gets old and ultimately vanishes in big crunch with a 0 Field value in Big Bang.

- As Higgs field is behaving like a non-zero vacuum expectation value, so, all the harmonic oscilliators at ground states picks up energy from this field and increases its modes by KL where L is the length and $K \sim 2\pi/\lambda$ ○ Each Energy level is $E=\hbar\omega$ ○

18 Solar Threats or ~3. 5 microns

How ~3.5 micron lightsails spacecraft takes advantage of solar radiation pressure?

The sun's Chromosphere, the plasma envelope that surrounds the core of Sun emits heavy solar radiation accompanied by turbulent solar flares moving at a speed of 50 Km/Sec with ionic electron & proton.

The atmospheree of Sun has two parts:

The first layer or Photosphere, The second layer or the Corona. The temperature of the outside layer is sometimes cooler and so the solar radiation gets absorbed and thereby providing dark spectral lines known as Faunhoffer Lines of the Sun's atmosphere. The heliosphere is the region dominated by the Sun. The heliosphere extends far apart from the earths atmosphere and comes to an abrupt end in a region called heliopause. Our magnetosphere is the region dominated by earths magnetic fields. The solar particles along with charged protons & electrons got attached to the magnetosphere and forms a donut shaped fiery region called Van Allen Radiation belts. This is a tremendous hazard to any orbiting spacecraft. Moreover the ionosphere is also effected by the Sun's atmosphere. There is a region of hydrostatic equilibrium which according to fluid dynamics is a region where the fluid (in this case air) flow remains constant. The ground station which transmits radio signals to the satellite orbiting above the ionosphere or 1000 Km above the earths sea level is reflected back by a phenomena known as Faraday rotation which is the interruption of the linearly polarised radio waves

interacting with a magnetic field and thereby forces to return back to the earth without reaching the satellite. This is a threat to communication systems. The temperature increases to 600-800 degree Celsius in the ionosphere which is very hot.

So, Sun is a threat to the Spacecraft mechanisms but there are one alternative sources available.

The effect of solar radiation imparts a momentum on the thin fabric and the pressure becomes more as the fabric becomes thinner measured in Cm^3 of area in Pascal. In the region of magnetosphere to the region of heliosphere the pressure of solar radiation increases exponentially and even there is a region at the outer boundary of the heliosphere which is called the heliopause where the solar radiation got a higher intensity of several hundred Pascal's along with a high wind speed of 100 Km/Sec accompanied by supersonic shockwaves.

But the impulse of momentum is extremely useful to lightsails with high surface area making the highest exposure to the solar winds creating a high momentum on fabric to drive the craft by solar radiation pressure. The more it comes closer to the sun, the more will be the solar radiation pressure on the fabric and the more power it can generate from the impart of the solar radiations momentum. But for sufficient power generation it must be atlest 1 Km in cross-section and thereby is very difficult to accommodate in the payload of the rocket but thanks to origami ! it's now possible.

19 Spacesuits and Extra – Vehicular Activity

- Space suit is a garment worn to keep a human alive in the harsh environment of outer space, vacuum and temperature extremes. Space suits are often worn inside spacecraft as a safety precaution in case of loss of cabin pressure, and are necessary for extravehicular activity (EVA), work done outside spacecraft. It must provide:
- A stable internal pressure as it's less than earth's atmosphere. Lower pressure allows for greater mobility, but requires the suit occupant to breathe pure oxygen for a time before going into this lower pressure, to avoid decompression sickness. Supply of breathable oxygen and elimination of carbon dioxide; these gases are exchanged with the spacecraft or a Portable Life Support System (PLSS)
- Temperature regulation. Unlike on Earth, where heat can be transferred by convection to the atmosphere, in space, heat can be lost only by thermal radiation or by conduction to objects in physical contact with the exterior of the suit. Since the temperature on the outside of the suit varies greatly between sunlight and shadow, the suit is heavily insulated, and air temperature is maintained at a comfortable level.
- Advanced suits better regulate the astronaut's temperature with a Liquid Cooling and Ventilation Garment (LCVG) in contact with the astronaut's skin, from which the heat is dumped into space through an external radiator in the PLSS (Portable Life Support System).
- Shielding against ultraviolet radiation.
- Limited shielding against particle radiation.
- Protection against small micrometeoroids, some traveling at up to 27,000 kilometers per hour, provided by a Puncture Resistant – Thermal Micrometeoroid Garment (PR-TMG), which is the outermost layer of the suit.
- The space suit is capable of protecting the astronaut from temperatures ranging from −156 °C (−249 °F) to 121 °C (250 °F).

Dangers of not wearing spacesuits:

- The human body can briefly survive the hard vacuum of space unprotected. Human flesh expands to about twice its size in such conditions, giving the visual effect of a body builder rather than an overfilled balloon due to loss of pressure killing the astronauts.
- In space, there are many different highly energized subatomic protons that will expose the body to extreme radiation.

- Temperature in space can vary extremely depending on where the sun is. Temperatures from solar radiation can reach up to 250 °F (121 °C) and lower down to −387 °F (−233 °C). Because of this, spacesuits must provide proper insulation and cooling.
- Human skin does not need to be protected from vacuum and is gas-tight by itself. Instead, it only needs to be mechanically compressed to retain its normal shape. This can be accomplished with a tight-fitting elastic body suit and a helmet for containing breathing gases, known as a space activity suit (SAS).

20 Why most of the heavenly objects are spherical?

It's because the ratio of the surface area to the volume of a sphere is less than any other platonic solids and therefore it requires less energy to maintain its shape.

See for Example,

There is a sphere of radius 4 unit and There is a cube of each edge 4 unit.

Now,

Surface area of Cube is $6a^2$ that is $6 \times 4 \times 4 = 96$

Volume of Cube is a^3 that is $4 \times 4 \times 4 = 64$

Ratio of $A{:}V \ = \ 96{:}64 \ = \ 1.5$

Surface area of Sphere is $4\pi r^2$ that is $4 \times \pi \times 4 \times 4 = 201$

Volume of Sphere is $4/3 \times \pi \times r^3$ that is $4/3 \times \pi \times 4 \times 4 \times 4 = 268$

Ratio of $A{:}V \ = \ .75$

See that A:V for sphere is always less.

Kaku in his book "Hyperspace" describes that nature always tries to maintain its symmetry in a minimal wastage of energy. Thus a sphere has every symmetry that any other Platonic objects couldn't have like;

- Spherical symmetry
- Rotational Symmetry
- Mirror Symmetry
- Translational Symmetry

Thus sphere has always been a subject of 'conserved symmetry' with a minimum 'energy wastage'. In terms of advanced physics, a geometric sphere can be said as analogous to the occupation of the same true vacuum as the false vacuum tends to reach for maintaining its symmetry.

The shape of the earth is a slightly smashed sphere or the oblate spheroid, simply called as geoid. Geoid comes from the geodesics which are the shortest distances over a convex (positively curved/elliptic) space where any straight line drawn would take the shape of a curve.

21 Androgynous Peripheral Docking and Berthing Mechanism

The Rocket lifting the shuttle consists of 1 Main Liquid Tank, 2 Solid Rocket Boosters along with the orbiter or the shuttle itself. The throttling of the engine is at 100% but when the Max-Q is reached then the dynamic pressure of the rocket is so high due to the relative wind gushing in opposite direction that the throttling is reduced to 65-78% to minimise Max-Q. Then the engine is jettisoned from the External Tank.

After MECO or the Main Engine Cut Off; the External fuel tank is jettisoned and the shuttle dumps the excess hydrogen and oxygen from the feed lines into the space. It follows a spiral trajectory until it starts its main engines into power for the orbital manoeuvre.

After MECO, the shuttle needs to get into a proper orbit. It performs a OMS-1 burn in order to get into a circular orbit. Then it perform a OMS-2 (Orbital Manoeuvre System) burn in order to get into a highly circular orbit. Now, as the shuttle is in a position to achieve its target in a proper interception, the shuttle required its GPC (General Purpose Computer) to make a target Coordinate intersection for perfect allignment of dock port. The Phase angle is computed first, that is the coordinate of the shuttle along with the projection of the shuttles coordinates into the targets orbital plane. Solar illumination is necessary in the background of the stars in the dark to see reflection of the sunlight from the target ISS with respect to sun. The first coelliptic burn is initiated after the sunset as ISS will be gradually visible at the sunrise.

{Coelliptic is a special type of ellipse with 2 semi-axis together}

The shuttle is in a different altitude than the target. Shuttle while moving at a relative high velocity than the target it will perform its height adjustment manoeuvre for reaching the height of the same coplaner plane. It then burned its second coelliptic burn to get in front of the target. The shuttle will make the Terminal Phase Injection in order to get nearer to the target vector. Then the shuttle rotates relative to ISS at a diameter of 200 kilometre. Both shuttle and target are in same velocity of 7.8 Km/Sec and for this the shuttle needed to burn its RCS Jets or Reaction Control Systems Jets in order to a increment of 0.1 Km/Sec velocity. Then the shuttle will move closer to the docking port and the shuttle needs to be stabilised from both the +/- X direction to fire RCS jets for aerobraking in a minimal magnitude.

The Passive ISS docking port has a docking ring, 12 hooks and latches while the active docking port is the external airlock of shuttle with camera and hook engagement ring.

Due to difference in centre of gravity of both, the shuttle continue in pendulum trajectory occuring for half an hour and then it gradually stops. The misalignment is adjusted by shuttle crew with a camera mounted on shuttle airlock docking port. The hook engages, latches tighten and the shuttle docked with ISS.

22 Brachistochrone curve

A baffling problem posed first by Johann Bernoulli in 1696 finally solved using the tools of calculus of variations and optimal control. In solving it, he developed new methods that were refined by Leonhard Euler into what the latter called (in 1766) the calculus of variations. Joseph-Louis Lagrange did further work that resulted in modern infinitesimal calculus. Later Newton solved the problem but never revealed how he came to the conclusion of a cycloid.

The Brachistochrone problem is one that revolves around finding a curve that joins two points A and B that are at different elevations, such that B is not directly below A, so that dropping a marble under the influence of a uniform gravitational field along this path will reach B in the quickest time possible.

When Johann Bernoulli asked the problem of the brachistochrone, on June 1696, to the readers of ActaEruditorum, which was one of the first scientific journals of the German-speaking lands of Europe, he received answers from 5 mathematicians: Isaac Newton, Jakob Bernoulli, Gottfried Leibniz, Ehrenfried Walther von Tschirnhaus and Guillaume de *l'Hôpital* each having unique approaches!

The solutions of this problem lead to two conclusions:

- At the onset, the angle must be zero when the particle speed is zero. Hence, the brachistochrone curve is tangent to the vertical at the origin.
- The speed reaches a maximum value when the trajectory becomes horizontal and the angle $\theta = 90°$.

Newton independently solved the problem and arrived the solution, which communicated to the Royal Society on 30 January. This solution, later published anonymously in the Philosophical Transactions, is correct but does not indicate the method by which Newton arrived at his conclusion. Bernoulli, writing to Henri Basnage in March 1697, indicated that even though its author, "by an excess of modesty", had not revealed his name, yet even from the scant details supplied it could be recognised as Newton's work, "as the lion by its claw"! Bernoulli's intention was simply that he could tell the anonymous solution was Newton's, just as it was possible to tell that an animal was a lion given its claw.

The Brachistochrone curve is the same shape as the tautochrone curve; both are cycloids. However, the portion of the cycloid used for each of the two varies. More specifically, the brachistochrone can use up to a complete rotation of the cycloid (at the limit when A and B are at the same level), but always starts at a cusp. Newton gives no indication of how he discovered that the cycloid satisfied his solutions. It may have been by trial and error, or he may have recognised immediately that it implied the curve was the cycloid.

23 Do black holes implode or explode?

Initially they implode but after critical circumference is reached they explode and gets cut off from the universe rather spacetime and travels through hyperspace and rejoins to another universe.

That's what initially believed.

But actually black holes implode and creates a singularity.

They never explode.

Any star with irregular mass distribution, spin, charge, radiation contribute highly and increases exponentially when it becomes a blackhole due to gravity's potential acceleration creating a Roy Kerr singularity.

Moreover, there is teleological evidence that the apparent horizon is the event horizon with absolute horizon as the absolute frame of reference. Any apparent horizon is relative to the in falling persons perspective. Absolute horizon makes the boundary of return & no point return. Black holes do emit radiation and jets due to magnetorotational instability. The Pair-AntiPair of particles if they arises due to quantum vacuum fluctuations near the event horizon, then, they borrow energy and gives back energy, but if in this process the Pair goes inside event horizon, the antipair remains glowing outside the horizon. Moreover the accretion with high in-falling plasma having an unstable orbit interacts with magnetic fields and emit synchrotron radiation. The radiation of photons needs more energy to borrow to balance high gravity. The X-Ray's produced are due to inverse Compton scattering with high energetic rays.

The teleological evidence says that effect occurs earlier than cause as regards to the black hole growth. How? Because the absolute horizon grows in future in anticipation of the in falling radiation to apparent horizon.

There is a static limit and the area between static limit and event horizon is ergosphere. Everything is in a spiral motion. The nearest unstable orbit is the Prograde Photon sphere with spin coincide with black hole. About a distance there is retrograde photon sphere with spin opposite to black hole.

The electrodynamic plasma creates a strong magnetic field and as photons are trapped, they goes in a orbital period and after that radially inside black hole.

A star forms white dwarf due to electron degeneracy pressure which opposes the gravity to collapse. If the star gets more compact then electrons gets attached to the neutrons and radiation pressure attracted by gravity is counteracted with neutron degeneracy pressure. However, if the parent star crosses the Chandrasekhar limit, then, the inward implosion is greater enough for an impact.

The black hole Is unstable to inward perturbations.

Any black hole with high plasma density will eventually have less tidal force. To explain, when two binary stars becomes a black hole, they collided but the mass and radius of the black hole is far greater than that of the addition of 2 binary stars radius. This is because mass is proportional to radius which is related to surface area.

24 Olympus Mons: Largest Volcano in our solar system in Mars

Olympus Mons is an enormous shield volcano on the planet Mars. The volcano has a height of over 21.9 km (13.6 mi or 72,000 ft) as measured by the Mars Orbiter Laser Altimeter (MOLA). Olympus Mons is about two and a half times Mount Everest's height above sea level. It is the largest and highest mountain and volcano of the Solar System, and is associated to the Tharsis Montes, a large volcanic region on Mars.

Being a shield volcano, Olympus Mons has a very gently sloping profile. The average slope on the volcano's flanks is only 5%. Slopes are steepest near the middle part of the flanks and grow shallower toward the base, giving the flanks a concave upward profile. Its flanks are shallower and extend farther from the summit in the northwestern direction than they do to the southeast. The volcano's shape and profile have been likened to a "circus tent" held up by a single pole that is shifted off center.

The composition of Olympus Mons is approximately 44% silicates, 17.5% iron oxides (which give the planet its red coloration), 7% aluminum, 6% magnesium, 6% calcium, and particularly high proportions of sulfur dioxide with 7%. These results point to the surface being largely composed of basalts and other mafic rocks, which would have erupted as low viscosity lava flows and hence lead to the low gradients on the surface of the planet.

Olympus Mons is the youngest of the large volcanoes on Mars, having formed during Mars's Hesperian Period with eruptions continuing well into the Amazonian. It had been known to astronomers since the late 19th century as the albedo feature Nix Olympica (Latin for "Olympic Snow"). Its mountainous nature was suspected well before space probes confirmed its identity as a mountain.

The volcano is located In Mars' western hemisphere, with the center at 18°39′N 226°12′E, just off the northwestern edge of the Tharsis bulge. The western portion of the volcano lies in the Amazonis quadrangle (MC-8) and the central and eastern portions in the adjoining Tharsis quadrangle (MC-9).

25 Kruskal coordinates

The best way to think about black holes is to switch to another set of coordinates:

Here sets of points r=const where r > 1 (outside the black hole, here its radius Sch^R = 1) are hyperbolas on the right, event horizon is the line r=1 and places r = const inside the black hole (r < 1) are hyperbolas above. Singularity r = 0 is the hyperbola on top. All events with t=const line up on lines going through the center. In this diagram an observer hovering at constant height above the black hole moves up and right along r=const hyperbola, never crossing the horizon (diagonal line). An in-falling observer here moves straight up, gradually decreasing his r, first crossing more and more t=const lines (this makes him look slowed down for external observer), actually crossing all these t > 0 lines, i.e. for every

moment t in external observer's history there is a point on the in-falling observer's path towards the horizon and it's below the diagonal line, i.e. for external observer the falling one will never reach the horizon.

In case of a rotating black hole we must switch from the Schwarzschild to Kerr metric which is more complicated. Schwarzschild metric is its corner case where rotation speed is zero. If we increase rotation speed then we notice that from the r=0 point, the singularity, a second event horizon starts to move outwards, while the original horizon starts to move inwards. We can say that Schwarzschild solution had outer horizon at Sch® = 2GM/c² and inner horizon at r=0. As rotation speed increases they move towards each other and meet at r = GM/c². If we keep increasing rotation speed and make these horizons meet, they disappear and we now have a naked singularity. So what is that inner horizon? It's similar to the outer one in that regard that it also swaps signs for 'dr' and 'dt' coefficients, which means inside the inner horizon. Time is time again and space is space.

GM/c^2 is the Schwarzschild radius.

26 The Missile Equation

Equation stands out to be,

$$\Gamma = \theta + \psi + \Omega$$

Gamma = Theta + Psi + Omega

Derivation,

$$\Gamma = \theta + \psi/2 + \psi/2 + \Omega$$

This is the equation of a Intercontinental Ballistic Missile. The mechanics are same as that of a rocket engine but there is a nuclear weapon attached to its nose or payload. The missile when fires from Earth leaves the earths atmosphere by a certain angle called "Theta (θ) and then rises above at a certain altitude of 100 kilometre which is represented by Psi/2 (ψ/2) which then reaches the burnout stage that is the end of the fuel. Now after that the missile takes a parabolic shape of a projectile trajectory of 45 degree and makes a downward angle of the same as before Psi/2 (ψ/2) and then makes a re-entry into the earths atmosphere and mages an angle of Omega (Ω) before hitting its target.

A missile with a 100 kilometre burnout stage can achieve a maximum trajectory of 8000 kilometre which can cause the impact by hitting the ground. The missile must be accurate to .1 degree of accuracy or else its impact region will vary with a 10 kilometre radius from the desired location.

27 A Probability, A Mountain and A Valley

A hypothetical condition before the Big Bang has been considered without any resemblance to Ekpyrotic cosmology.

Consider there is a huge mountain. Very tall. And at the peak of that mountain stands a 'state'. A state with 1 among millions and millions of probabilities. If the probability approaches to 1 from fractions then it can be $1/10^5$ or $2/10^7$ or $8/10^9$ or $223/10^{999}$ or any fractions. Anything is a probability and there is only one state with only 1 probability is standing at the top of the tall mountain. The mountain is very slippery. And the top of the mountain had space for only 1 state of only 1 probability to occupy and stand.

Each Probability represents a multiverse. And our state is just our universe.

All of these are before Big Bang.

If we took the State as S* then it is natural that this S* is imaginary as (S* × $\boldsymbol{i}$). Now what are the elements of this imaginary state (S* × $\boldsymbol{i}$). They are very constants of nature but with an imaginary $\boldsymbol{i}$ multiplicative factor with it. Like imaginary gravity, imaginary speed of light, imaginary time, imaginary dimensions and other constants of nature. So, basically (S* × $\boldsymbol{i}$) is a huge imaginary state.

Now why its imaginary rather than real ?

Because Big Bang hasent yet happened and nothing or no universal constants exists as of now in reality. Hence, all are imaginary.

Now, as the mountain is steep, the state's rolls down and hit the valley. While hitting the valley a large explosion occurs which is Big Bang and this explosion separates the $\boldsymbol{i}$ from (S* × $\boldsymbol{i}$) leaving only S* which is real. So, after the big bang explosion everything or every constants of nature becomes real.

Where did the $\boldsymbol{i}$ goes to?

Well, it got attached to some tiny real domains of spacetime further down the valley and that particular real domain still exists as an imaginary domain. And one of the element of this imaginary domain is the imaginary dimensions.

Therefore, if we conclude the set of dimensions as $\mathbb{N}$ then $\mathbb{N} = \{D,\bar{D}\}$ where D is real dimensions and $\bar{D}$ =D$\boldsymbol{i}$ is complex dimensions.

This complex dimensions are still there in a small patch of space in the valley and if one can find out this tiny complex domain then one can resolve not only the mysteries of time but the mysteries of everything thereby forming the Theory of Everything from Pre-Big Bang Epoch conditions.

This indicates a transformation of Imaginary higgs to real higgs field thereby making up the potential of spontaneous symmetry breaking when the 'state' hits the valley.

{*As of now no evidence of dimensions as regards to its IR or UV nature has been ascertained, however, we would be very wrong if we confuse this with the analogy of IR or UV Brane. The spontaneous symmetry breaking over a scaler potential of Higgs happens during the transition phase where the particles falls from 'false vacuum to true vacuum' with Tachyons below the VeV without* 10^{40} *Joules/Cm³ of energy*}

28 Acoustic Levitation – Sound to levitate objects against gravity

Sound is usually taken as a transverse wave with the wave propagation at right angles to the wave amplitude. A sound is a simple vibration in air molecules & can only be heard when there is air present in the atmosphere. Imagine an example: How a bell rings in a temple? Push the bell, the bell gets forced to the opposite side thereby compressing the gas molecules of air and creates a region of high pressure which will produce a non-linear high sound. On the other side, the pressure is low or the wave is rarefaction: A region of low pressure where the sound waves are linear & hence the sound is less. The bell then moves backwards again creating a high pressure compression zone & makes the sound. The rarefaction is on the opposite side.

This principle is used to levitate objects like solid or liquid bubbles in air against the pull of gravity. There are two parts in this mechanism: The lowest part is called the transducer & the highest part is called the reflector. An intense sound of 150 Decibel is needed – So, the ultrasonic sound of high pitch is ejected from the transducer and it strikes the reflector.

Remember the law of reflection – The angle of incidence is equal to the angle of reflection. The sound waves reflect to & fro from the transducer to the reflector & again backwards. There creates two portions: The portion of compression & rarefaction. Interference occurs between them.

Compression with compression gets amplified. Rarefaction with rarefaction gets non-amplified. Rarefaction with compression gets neutralised.

There forms a region in the sound wave called node : A region of low pressure. Anti-Node : A region of high pressure.

The reflection and interference between the non-linear sound wave produces a standing sound wave. This standing wave from the upward creates a downward pressure & from the downward creates an upward pressure. It is this standing waves which creates a region of acoustic radiation pressure. A region where the gravity pull is neutralised by the standing wave. In gravity environment the particles get stuck in the acoustic radiation pressure zone & remain floating in space because of the increasing pressure from upwards & decreasing pressure from downwards. But in Space, where there is microgravity the particles stuck at the node : A region of minimum pressure. The particles may be liquid provided the surface tension of the liquid due to gravity must withhold the acoustic radiation pressure or else the water bubble will get flattened like a donut & bursts away. Air behaves like a fluid except that there is no fluid but gases & the molecules move faster & as sound is the movement of molecules in air by pressure, so, levitation is done by controlling &stabilising the pressurised environments of standing waves of sound.

29 Computing the energy of the Bohr model of hydrogen atom

Bohr Radius – Of Hydrogen Atom

$\Delta X * \Delta P > \hbar$

$\Delta P > \hbar / \Delta x$

This is uncertainty principle. Consider the electrons bounded in an atom at a distance of ‘a’.

Then $\Delta P > \hbar / a$

Or, $P > \hbar/a$ (Here P is the momentum)

$P^2/2m$ is kinetic energy.

Then the uncertainty relation reduces to $\hbar^2/2ma^2$

Potential energy is $-e^2/a$ (-e as because the charge of electrons are in a bounded state)

$E = \hbar^2/2ma^2 - e^2/a \longrightarrow EQ(1)$

$\partial E/\partial a = - \hbar^2/ma^3 + e^2/a^2$

Setting the limit $\partial E/\partial a \longrightarrow 0$

$\hbar^2/ma^3 = e^2/a^2$
$\hbar^2/ma = e^2$
$\hbar^2 = e^2ma$
$a= \hbar^2/e^2m$ = .538 * 10^-10 Meter or .538 Å

Substituting “a” in EQ(1) we get the electron mass about -13.6 Electron Volts.

Thus: $-e^2/\hbar^2/e^2m = -e^4m/\hbar^2 = 13.6$ E.V

30 Tachyon – By Prof. E.C.G Sudarshan

What does this hypothetical particle actually teaches us?

In one sentence:

"*A body having negative mass can only travel faster than the speed of the light & it can warp space positively unlike that of sun & planets & hence remain free to accelerate & absent from the effects of gravity*".

How can a body be simultaneously at rest & motion at the same time? Well, its quite simple. A standing body has positive rest & zero motion. On the other hand a moving body has zero rest & positive motion. So, rest & motion are unified by principle of combination.

Now, think of a body having at rest has positive rest mass. That means the body has positive potential energy (PE) but zero kinetic energy (KE). Now the body starts moving, It has zero rest mass, that means it has zero PE & positive KE. Now where does this KE come from? Simple, the PE got converted into KE.

Now the body is moving, chasing the speed of light – Suppose light speed is 100 Km/sec. The body is moving at 99.999 Km/sec. That's the maximum a body can move because "A body having positive mass can never cross the speed of light"… why? As, It's moving at a very high speed the KE is increasing & got converted to mass by $E^2=m^2c^4+p^2c^2$ and the mass of the body is increasing. So, the more the KE, the more the mass. Ultimately the mass becomes infinity and an infinite KE is needed to cross the light which again requires an infinite velocity: So, the body will lag behind & never able to cross the speed of light.

Now, why the body has mass? There is an invisible field pervading the whole of universe called the HIGGS field. A body made up of nucleons & electrons can easily interact with the field and get its mass. This increases the intrinsic mass of the body from zero to infinity.

Now, what happens when the body has negative mass: Say -10 Kg. Then: The mass will increase to -9 Kg, -8 kg, -7 kg, -6 kg….. But before reaching the positive mass it will easily cross the speed of light.

Now, as a positively mass body made a negative curvature in space and hence it follows Newtons first law. "A body in rest or a body in motion will tend to remain in a state of rest or motion until & unless effected by an external unbalanced force". So, gravity is the external force which slows down the body. But what happens when the reverse occurs? The negatively mass body will make a positive curvature in space & hence will slide on with a tremendous speed: It doesn't gain energy but it looses its energy and hence can follow the speed of light & even can attain the superluminal speeds.

This negatively mass body is known as TACHYONS. In string theory. Which can cross the speed of light. But what about neutrino? Well its speed is 99.99% the speed of light but it has positive mass & hence can never cross the speed of light.
VeV of Tachyon < 0 '& don't fall in Higg's field'

31 Spacecraft systems engineering and de Laval nozzle

A rocket engine consists of 4 parts;

The first Part.

The Fuel Tank and Pump:

There are two separate fuel tanks one for the propellant & one for the oxidiser. The oxidiser burns the propellant upon being ignited. A propellant is usually a kerosene or a much more stabilised one that is Monomethylhydrazine (MMH) which is a volatile hydrazine chemical with the chemical formula $CH_3(NH)NH_2$. And Oxidiser is liquid oxygen. Both the propellant and oxidiser are liquid. They are in two separate tanks. There is a pump which pumps the mixture into a separate chamber for ignition. The pump maintains the pressure flow & makes the flow ideal.

The Second Part.

The mixing Chamber and The combustion Chamber:

In the mixing chamber the propellant &oxidiser is mixed and the mixing then goes through a pipe to the combustion chamber where they are ignited by a electric spark. If liquid nitrogen is used then the typical formulae of the reaction is;

$$N_2O_2 + 0_2 + Heat \longrightarrow H_2O + Combustion\ Excess\ heat$$

H_2O produced gets evaporated by the amount of heat generated. This heat results in the thrust which is used to levitate the rocket upward into space.

The Third Part.

The Nozzle:

A de Laval nozzle is used which is a tube that is pinched in the middle, making a carefully balanced, asymmetric hourglass shape. It is used to accelerate a hot, pressurized gas passing through it to a higher supersonic speed in the axial direction, by converting the heat energy of the flow into kinetic energy. The nozzle should be ideally expanded with a half angle divergence of 60° & half angle convergence of 15° which is needed for the fluid dynamics as because the heat flow will reach supersonic speed with a maximum thrust.

Rocket works on the principle of conservation of momentum & the thrust must be isentropic & adiabatic. The principle of the second law of thermodynamics hold as because the Enthalpy in addition to the entropy must be conserved with a trade off for total kinetic energy of the thrust vector. The fuel when ignited and starts to burn then it's volume gets increased and the pressure becomes 200 times more than the ambient pressure as because due to the pressure gradient the high pressure will tend to flow towards low pressure which will thereby produce a thrust impulse in the order of pressure impulse that will kick the rocket upwards.

The Fourth and The Final Part.

The Cooling Pipes:

Liquid hydrogen when cooled at about -253° C then they become cryogenic and helps in Cooling the surrounding impact zone. The nozzle is surrounded by a coiling of the cooling pipes through which liquid hydrogen runs and this helps the nozzle to keep cold and prevents it from melting as the temperature runs around 175° C – 250° C. Cooling pipe also is used in the maintaining of the heat of the overall rocket nozzle as it equates the cold with the propellant heat thereby causing the rocket to be steady during the flight time.

32 Information Theory

Information theory which is of significant importance in classical & quantum mechanics regarding the "principle of conservation of information" was found in 328 BC …. But how did this happened accidentally?

Previously it's been thought that Information theory is not at all related to Black holes. But later Bekenstein and Hawking discovered black hole entropy where black hole thermodynamics and information are tightly related. Moreover the maximum bits of information possible in this universe has a limit and that is 10^{78}.

Along with this beautiful relation:

$$Entropy \propto Uncertainity \propto Disorder \propto Randomness \propto Heat(Energy) \propto 1/information \propto 1/area$$

Entropy is the logarithm of the maximum possible arrangements. Or Entropy is the measure of the possible arrangements that provides a meaningful criterion. Entropy is the hidden information.

And if 1 bit of information is added to Black hole then its Schwarzschild Radius will increase $(10^{-35})^2$ that is 10^{-70} Square meter which is the Planks Area.

Information wallpapers the black hole horizon as the hologram in the AdS_5 spacetime giving birth to AdS/CFT equivalence.

Once upon a time in the ancient world, there exists a large library containing works by the greatest thinkers and writers of antiquity, including Homer, Plato, Socrates and many more, the Library of Alexandria, northern Egypt, is popularly believed to have been destroyed in a huge fire around 2000 years ago and its volumous works lost.

But somehow it's said that …. Although not sure but with a probability, it's heard that Plato once said, even if the library got destroyed then also all of the information contained in the books of the library wouldn't get destroyed as all of those information's were actually on the outside of the walls of the library rather than inside in the books…. Therefore, even if all the books are burnt in the inside, the information would be remained over the outside walls of the library.

This indeed sound quite philosophical but it has a deeper meaning discovered almost 2500 years later.

But how?

Imagine that there is a great library of $(500\ ft)^3$ containing say 10^{110} bits of information. That's huge right. But as per the information-entropy concept entropy is related to each bit of information in a Plank Area not volume. So, the inner world of the library is a volume. But the outer walls of the library is the area. So, the maximum possible bits of information presented in its outer surface wall is 10^{78} (This has been proved by mathematics). Then how can a library of $(500\ ft)^3$ containing 10^{110} bits of information projected outside as 10^{78}. Well, its inner information based on the volume has been projected as a hologram in the outer walls (or surface area) with a maximum possibility of 10^{78} bits with 1 bit in $(1\ Plank\ Length)^3$ volume.

That's the maximum limit. The same way information is presented as a hologram in $AdS\ spacetime$.

33 What exactly is a WAVERIDER and how it works?

Some WAVERIDERS are also called as (THSV) or TRANSATMOSPHERIC HYPERSONIC SCRAMJET VEHICLE

Scramjet stands for supersonic combustion Ramjet engine which operates at Mach 3 and makes the speed boost upto Mach 20. It's an air breathing engine. Meaning the initial rocket engines are required to achieve Mach 3 and then after stage separation, the SCRAMJET will work. The Plane has a wedge shape body with no such clearly distinguishing wing surface as it's meant for hypersonic Run.

The Important properties are as follows:

- Thick shock layer with boundary detachment.
- Entropy layers due to viscous interaction as Nitric oxide turns Ionic and Oxygen, Nitrogen disassociation occurs due to high heat.

- Temperature is greater than 2000 Kelvin and the shock layers are thin which applies the Newtonian Sine Squared law.
- The kinetic energy is very high and doubles the total pressure which means the plane is basically riding on a shockwave.
- Due to thin shock layers, the pressure and temperature, the total pressure compared to static pressure and density changes a lot which makes a sudden transition from laminar to turbulent flow.
- The Lift/Drag ratio is optimum at lower angle of attack like 3-5 degrees.
- The Lift Coefficient is maximum at approx. 55 degree angle of attack.
- The Reynold's number is inversely proportional to the flow.
- The mean free path and the Knudson Number along with nose cross section are greater than 10 which makes the flow separation.
- The scramjet intake the Mach 3 air and after forming and passing over of numerous bow shocks, it gradually increase in pressure and the temperature is to high to combust the fuels and the high speed viscous flow is exited through the converging-diverging Nozzle which is Hypersonic at around Mach 12.
- Blunt nose is preferred over cone nose as the bow shock will get aligned properly.
- The inner boundary layer is inviscus but outer boundary layer is not isentropic. The change in density, pressure and temperature makes the vehicle loose the kinetic energy which gets added to the total energy which makes the thermodynamic quantities prominent.
- The Plane usually maneuver for 5 to 10 minutes in space.

Gay-Lussac's law is necessary for a SCRAMJET run as due to repeated oblique shock waves inside the flow engine the pressure of a given mass of gas (here it's air as it's an air breathing engine) varies directly with the absolute temperature of the gas when the volume is kept constant.

34 Kármán limit

Outer space is not completely empty rather a hard vacuum containing a low density of particles, predominantly a plasma of hydrogen and helium as well as electromagnetic radiation, magnetic fields, neutrinos, dust and cosmic rays. The baseline temperature, as set by the background radiation from the Big Bang, is 2.7 kelvins (K) (−270.45 °C; −454.81 °F). Plasma with a number density of less than one hydrogen atom in m^3 and a temperature of millions of kelvins in the space between galaxies accounts for most of the baryonic (ordinary) matter in outer space. In most galaxies, observations provide evidence that 90% of the mass comes from dark matter.

The Kármán line Is at 100 km above sea level and conventionally used as the start of outer space.

Outer space has effectively no friction containing a few hydrogen atoms in m^3. The mean free path of a photon is about 10^{23} km, or 10 billion light years.

The Earth's atmospheric pressure drops to about 0.032 Pa at 100 kilometers' (62 miles) of altitude.

The vacuum space radiation is not in thermodynamic equilibrium. There are premoidal photons cosmic microwave background radiation (CMB) with temperature around 3 K (−270 °C; −454 °F).

The space particles have energies ranging from about 10^6 eV (electron Volts) up to an extreme 10^{20} eV of ultra-high-energy cosmic rays. The peak flux of cosmic rays occurs at energies of about 10^9 eV, with approximately 87% protons, 12% helium nuclei and 1% heavier nuclei.

Geospace **–** The region of outer space near Earth. Geospace includes the upper region of the atmosphere and the magnetosphere. The inner boundary is the ionosphere. Geospace is populated by electrically charged particles at very low densities.

Interplanetary Space **–** The space around the Sun and planets of the Solar System, dominated by the interplanetary medium, which extends out to the heliopause where the influence of the galactic environment starts to dominate over the magnetic field and particle flux from the Sun. This wind has a particle density of 5–10 protons/cm³ and is moving at a velocity of 350–400 km/s (780,000–890,000 mph). Van Allen radiation belt is present here. The average density is around 10^6 particles per m³, but cold molecular clouds can hold 10^8–10^{12} per m³. A number of molecules exist in interstellar space, as tiny as 0.1 μm dust particles. The region is of within 100 parsecs of the Sun which nearly coincides with the Local Bubble with temperatures of up to 7,000 K and radii of 0.5–5 Parsec.

Intergalactic Space **–** The physical space between galaxies. Studies of the large scale distribution of galaxies show that the Universe has a bubble-like structure, with clusters and groups of galaxies lying along filaments that occupy about a tenth of the total space. Surrounding and stretching between galaxies, there is a rarefied plasma (rarer or less dense plasma) that is organized in a galactic filamentary structure with a typical length of 163 to 261 million light years.

35 Torque Vs. Moment of Momentum and Satellite mechanics

A satellite in orbit has different types of drag. From the microgravity of Earth to that of centrifugal force of earths rotation & even from the high gravity of Sun. Equatorial bulge of Earth is 42.72 Km which attracts the satellite more while it revolves round the earth than the poles causing nutation or conical vibration dragging the satellite from its orbit.

Celestial mechanics is used for trajectory corrections –

Acceleration is the second order derivative of distance w.r.t time;

$$F = m * r''$$

Where ‘r’ is the distance w.r.t time (t).

Third order derivative of acceleration is a jerk;

$$A = r'''$$

This causes imbalance in the momentum of the satellite.

Momentum has two parts;

Linear momentum expressed as a product between the mass & distance in its second order derivation with (t).

$$L = m * r''$$

Now when the momentum has a moment in its centre then it’s an angular momentum expressed as the cross product of distance vector along with velocity vector which is changing.

$$\Omega = |r| \times |\dot{r}| \, Cos\, \theta$$

The angular momentum when expressed in radial mass velocity equation stated;

$$\Omega = m * r^2 * \theta'(t)$$

Here Θ is in its first order derivation with time. And it can be expressed as the $\theta = \omega * r$.

When the angular momentum is in its (Z) axis then the moment of inertia is maximum along the (Z) +Ve -Ve Part by (I)zz… Where (I) is inertia.

Angular momentum is null in (I)xx and (I)yy Axis.

So, angular momentum is the inertia of all axis with respect to Time. Here 'H' is used as the rotational momentum;

$$H = \{(I)xx + (I)yy + (I)zz\}T$$

Satellites have a momentum bias. The moment of momentum which helps them to stabilise in its current position. But still there are many perturbative drag forces which disrupts their momentum. So, in general when a satellite rotates along its (Z) axis then the (X,Y) axis is relatively fixed without any moment of momentum. Due to small nutation a jerk will produce and cause the satellite to imbalance causing the inertia to gather along its (I)xx (I)yy (I)zz axis which if disturbed will cause a momentum between any such axis described as a cross product of the distance vector from its centre along with the velocity vector from its centre. This in turn will produce a torque in opposite direction which will cause the satellite to drag down;

$$\Omega = |r| \times |\dot{r}| \, Cos\, \theta = -T \, (Torque)$$

Sometimes a hybrid of despun satellite is used whose one surface remains in a ball bearing position with the other surface such that the rotational momentum on one surface will cancels out the torque in the other surface and the satellite got a momentum bias on one side along with a non-momentum bias on the other side as;

$$\Omega = m * r^2 * \theta'(t) \; on \; (I)zz = (I)stationary\{xx, yy\}$$

Sometimes thrusters or small rockets are used for path correction where a thruster fired in one side should be neutralised by the momentum imparted by the thruster on the other side in order to maintain rotational bias stability.

36 Thermodynamics, Bekenstein Entropy, Hawking Radiation

Black hole emits electromagnetic radiation and gravitational radiation because both first & second law of thermodynamics are proportional to black hole. The entropy is proportional to the horizon which is proportional to its mass. The temperature is proportional to gravitation which is inverse the mass. That means more the radiation, less the mass.

Black hole shrinks by radiating particles.

A black holes entropy is given by,

$$(1/4Log_e 10) * Surface\ Area/G\hbar/c^3$$

$$G\hbar/c^3 = 2.6 * 10^{-66}\ Cm^2$$

$$And\ all\ this\ equal\ to\ Log\ 10^{79}\ (If\ the\ BH\ is\ of\ 10\ solar\ masses\ or\ 11000\ Km^2).$$

But how can a BH irrespective of empty contains so much entropy? The answer is we determine the black hole by its spin, charge and mass. The event horizon spins and this spins accelerates the vacuum surrounded to it. The Gravitational & Electromagnetic Vacuum fluctuations are accelerated by the spinning horizon. This in turn gives them rotational energy. The vacuum is always chaotic due to maintaining a zero energy balance. Sometimes virtual particles absorb energy and makes a negative energy gradient which in turn is compensated by a highly positive energized particles. If this particles are energized then they will be real particles and this real particles will be either a pair or an Antipair. If any such Pair or Antipair got ejected outwards as a real particledue to positive energy then it is the radiation. The counterpart of the Pair is absorbed inside the Black hole by strong tidal forces. The vacuum fluctuations of real particles are triggered by the tidal effect of BH horizon and some fall back into black hole while others radiate. BH radiate and shrinks…. However the smaller the BH is, the greater the amount of radiation. The radiation gives a negative push to the horizon which lowers its

spin a bit. The spin ultimately shrinkens as the BH evaporate and then it becomes a non spinning BH. Black hole is governed by classical physics but virtual particles by quantum physics.

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Conflict of Interest: Authors of this paper declare that they have no conflicting interests or competing interests in course of this work.

Reference: These topics are very common to the physics and engineering students and are not from any such suitable references that needs to be cited here, rather these are to be found in almost everywhere in net, in books, in lectures or in Wikipedia. Still, some related references to the authors work are cited here.

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