SPECTRUM

SHILLONG COLLEGE

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SHILLONG

KNOWLEDGE IS IMMORTAL

PHYSICS DEPARTMENT

SHILLONG COLLEGE

2015

Faculty Members of Physics Department

3rd year B.Sc. Honours

2nd year B.Sc. Honours

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Message From The Principal

At the very outset, I would like to congratulate the Department of Physics, Shillong College for being able to bring out the 3rd edition to their Department magazine, "SPECTRUM". It is indeed a pleasure to learn that they have taken a very good initiative to launch the departmental magazine to highlight the activities of the department and also to provide a platform for the faculty members as well as the students to present their write-ups / articles on the various topics or phenomena related to the subject of Physics. It also facilitates as a great encouragement, particularly for the Science students who would be greatly motivated and also benefitted from this humble exercise. It is encouraging to see that the faculty members of the Physics Department, in their own bit have contributed towards the literary skill development of themselves, in particular, and the student community in general."SPECTRUM" which includes a range of topics from the subject contributed by both the teachers and the students, is indeed a befitting title given to the magazine as it reflects on the wide areas of the various branches of Physics. Physics as we know is a key subject and a very important component of the study of basic Sciences and Technology, and also an inseparable ingredient in any latest developments and recent advances made in Science and Technology. It is therefore a privilege for the students in particular and also for the college in general to learn and understand, to know and to be able to figure out and appreciate the various complexitities and the very many intricate theories and phenomena that are part and parcel of our everyday lives. Physics is considered by the students as difficult subject but by showing their opinions and contributing their articulated writings that will help them to understand and solve their doubts of the subject matter. I do urge upon the other departments of the college to emulate the good thinking and the footsteps of the department and I wish them success and also many more such editions in the future.

Dr. K.D. Ramsiej
Principal
Shillong College

Message From the Vice Principal

It gives me immense pleasure and joy to write about "the Spectrum" - the reflection of Department of Physics, Shillong College, Shillong-3. The Spectrum is a compilation of articles on various aspects of the Science Physics. The articles are contributed by the students and teachers of the Department. While going through the pass two issues of the Spectrum, I found that many of the articles carry significant perception of the students, many hows and whys that ignite spark of inquisitiveness and place the young minds into research and innovations. I suppose the Spectrum is providing ample opportunities to our students of Physics Department to widen the horizon of logical thinking and appropriate reasoning. I wish all success for this Spectrum and urge upon the teachers and students to come forward more intensely and upgrade this Spectrum to its zenith. Once again best wishes for this Spectrum and long live Shillong College.

Dr. M. Dey
Vice Principal
Shillong College

FROM THE DESK OF THE HEAD OF THE DEPARTMENT OF PHYSICS

The department of Physics in Shillong College was established way back in 1963. Ever since its inception, the department of Physics has been on an onward march towards excellence. The faculty members of the department shoulder the responsibility of moulding the character of the students through the teaching learning process. They aim to build a healthy relationship with the students by combining academic excellence with higher values of life. They attempt to promote advanced methods of teaching for the effective dissemination of knowledge to enhance professional skills. The members of the department in their humble effort, sincerely endeavours to encourage and motivate the students and also help in developing the overall personality of the students to achieve success in all their academic pursuits. They have been organizing departmental & inter-college student seminars and Open Quiz competitions on a regular basis for the welfare of the students. The department also takes pride in bringing out the third edition of its departmental magazine **"SPECTRUM"** this year. This magazine is being brought out to bring a qualitative change in teaching-learning process and to provide platform both for the teachers and students to express their scientific intellect. Moreover infusion of scientific temperament among students and teachers is an important task that is essential in this present generation. I take this opportunity to thank the faculty members of the Physics Department Shillong College in the task they had taken for making this magazine possible. My gratitude to the Principal, Dr.K.D.Ramsiej, for his support and guidance given to us. I am also grateful to the students who have contributed in whatever way they could, making it possible for the department to publish this magazine. I wish and pray that the members of the department shall continue to put efforts and elevate the standard of our magazine **"SPECTRUM"** to a higher level in the years to come and I have no doubt that we shall strive together to widen our horizon of learning.

Mrs. E.N.Dkhar
Head Department of Physics
Shillong College

The Physics of Football

By E.N.Dkhar
H.O.D. Physics

Bill Shankly, the former manager of Liverpool football club, once said: "Football is not about life or death. It is more important than that." The event will be over, and all that will remain will be a few repeats on television and the endless speculation about what might have happened. It is this aspect of football that its fans love, and others hate. What if that penalty had gone in? What if the player hadn't been sent off? What if that free kick hadn't bent around the wall and gone in for a goal?

Many fans will remember the free kick taken by the Brazilian Roberto Carlos in a tournament in France. The ball was placed about 30 m from his opponents' goal and slightly to the right. Carlos hit the ball so far to the right that it initially cleared the wall of defenders by at least a meter and made a ball-boy, who stood meters from the goal, duck his head. Then, almost magically, the ball curved to the left and entered the top right-hand corner of the goal - to the amazement of players, the goalkeeper and the media alike. Apparently, Carlos practiced this kick all the time on the training ground. He intuitively knew how to curve the ball by hitting it at a particular velocity and with a particular spin. He probably did not, however, know the physics behind it all. How does all of this explain the free kick taken by Roberto Carlos? Although we cannot be entirely sure, yet, Physics has got probably a fair explanation of what went on. Carlos kicked the ball with the outside of his left foot to make it spin anticlockwise as he looked down onto it. Conditions were dry, so the amount of spin he gave the ball was high, perhaps over 10 revolutions per second. Kicking it with the outside of his foot allowed him to hit the ball hard. The flow of air over the surface of the ball was turbulent, which gave the ball a relatively low amount of drag. Some way along its path - perhaps around the 10 m mark (or at about the position of the wall of defenders) - the ball's velocity dropped such that it entered the laminar flow regime. This substantially increased the drag on the ball, which made it slow down even more. This enabled the sideways Magnus force, which was bending the ball towards the goal, to come even more into effect. Assuming that the amount of spin had not

decayed too much, then the drag coefficient increased. This introduced an even larger sideways force and caused the ball to bend further. Finally, as the ball slowed, the bend became more exaggerated still (possibly due to the increase in the lift coefficient) until it hit the back of the net - much to the delight of the physicists in the crow.

The movement of players was followed using high-speed video at 4500 frames per second, and the impact of the foot on the ball was then studied with finite-element analysis. If you strike the ball straight on with your instep so that the foot hits the ball in line with the ball's center of gravity, then the ball shoots off in a straight line. However, if you kick the ball with the front of your foot and with the angle between your leg and foot at 90° it will curve in flight. In this case, the impact is off-center. This causes the applied force to act as a torque, which therefore gives the ball a spin. The experimental results also showed that the spin picked up by the ball is closely related to the coefficient of friction between the foot and the ball and to the offset distance of the foot from the ball's center of gravity The study of a finite-element model of the impact of the foot on the ball, written with DYTRAN and PATRAN software showed that an increase in the coefficient of friction between the ball and the foot caused the ball to acquire more spin. There was also more spin if the offset position was further from the center of gravity. Two other interesting effects were observed. First, if the offset distance increased, then the foot touched the ball for a shorter time and over a smaller area, which caused both the spin and the velocity of the ball to decrease. There is therefore an optimum place to hit the ball if you want maximum spin: if you hit the ball too close or too far from the center of gravity, it will not acquire any spin at all. The other interesting effect was that even if the coefficient of friction is zero, the ball still gains some spin if you kick it with an offset from its center of gravity. Although in this case there is no peripheral force parallel to the circumference of the ball (since the coefficient of friction is zero), the ball nevertheless deforms towards its center, which causes some force to act around the center of gravity. It is therefore possible to spin a football on a rainy day, although the spin will be much less than if conditions were dry. Of course, the analysis has several limitations. The air outside the ball was ignored, and it was assumed that the air inside the ball behaved according to a compressive, viscous fluid-flow model. Ideally, the air both inside and outside the ball should be included. It was

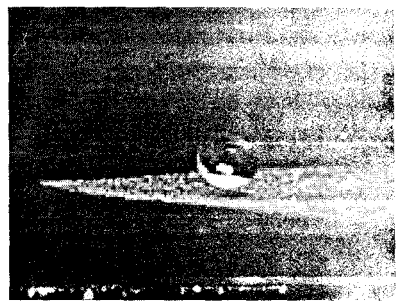
also assumed that the foot was homogeneous, when it is obvious that a real foot is much more complicated than this. Although it would be impossible to create a perfect model that took every factor into account, this model does include the most important features. If you kick the ball hard enough for the airflow over the surface to become turbulent, then the drag force remains small and the ball will really fly. If you want the ball to curve, give it lots of spin by hitting it off-center. This is easier on a dry day than on a wet day, but can still be done regardless of conditions. The ball will curve most when it slows down into the laminar flow regime, so you need to practice to make sure that this transition occurs in the right place - for example, just after the ball has passed a defensive wall. If conditions are wet, you can still get spin, but you would be better off drying the ball (and your boots). Nearly 90 years ago J.J. Thomson gave a lecture at the Royal Institution in London on the dynamics of golf balls. He is quoted as saying the following: "If we could accept the explanations of the behavior of the ball given by many contributors to the very voluminous literature which has collected around the game...I should have to bring before you this evening a new dynamics, and announce that matter, when made up into [golf] balls obeys laws of an entirely different character from those governing its action when in any other conditions." In football, at least, we can be sure that things have moved on.

"It is the supreme art of the teacher to awaken joy in creative expression and knowledge"
Albert Einetein

SURFACE TENSION

Sri. S. Lato, Department of Physics

What is Surface Tension??



'In physics, surface tension is a force present within the surface layer of a liquid that causes the layer to behave as an elastic sheet.

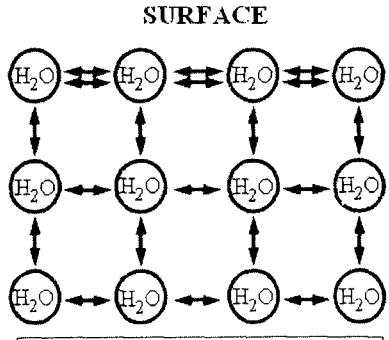
It is the force that supports insects that walk on water, Without most of us never paying attention to it, surface tension is acting all around us, everywhere and all the time, affecting our daily life in a number of ways.

In fact it is surface tension which keeps the billions of cells in our body functional, ensuring the proper organization of their biomolecules, proteins, lipids, and nucleic acids, into membranes and various types of cellular organelles.

Surface tension is a truly fundamental property of water, making it an ideal medium allowing for life as we know it to exist. On a more easily accessible scale, familiar to us all, it is surface tension what makes water drops spherical.

How does it Work??

Surface tension is caused by the attraction between the hydrogen molecules of the liquid (hydrogen bonding). On the surface of the liquid, each particle is pulled in all directions by the other molecules. The molecules that are below the surface keep the ones on top of the water in place (by pulling the molecules on the top towards them). This works because the outward attraction by the hydrogen molecules in the air, which is much less dense than the water, doesn't have any effect on the surface tension because of the density.



Surface tension—molecules at the surface form stronger bonds

In this diagram, the water molecules at the top have stronger bonds with each other than the other particles, this causes the elastic-like sheet to form on the surface.

Commercial importance:-

Chemical industry (paints, inks, coloring ingredients, insecticides)

Automobile manufacturing (surface preparation prior to painting, treatment of glass to prevent water from dewetting, treatment of tires to promote adhesion even on wet or icy roadways)

Glass (anti-stain or anti-frost treatment)

Food (dissolving powders such as milk or cocoa)

Soil science (penetration of liquids into porous rocks)

Construction (waterproofing of concrete, protection of monuments, treatment of greenhouse plastic)

Domestics (spreading of creams, self-drying shampoos)

Practical experiences:-

When dry, your hair is likely to be full and thick, whereas the moment it gets wet, it sticks together in a drab, droopy mass.

Early morning, you can see beads of droplets gracing a spider web. The film of dew that has settled on the threads is unstable and breaks up spontaneously into droplets. (this phenomena has in fact implications for textile fibers, process known as 'oiling')

After stepping out of shower, one dries off by way of evaporation (which can make one feel cold) and by dewetting (the process by which dry areas form spontaneously and expand on one's skin.

If you ever noticed water drops stuck to windshield, you would know that while large droplets roll down the glass, smallest drops remain stuck.

No foam is observed in water until you add some additives. (detergents etc.)

Water spreads on glass, but mercury doesn't stick at all to glass

While food sticks on stainless steel vessels, it doesn't on Teflon vessels.

Surface Tension in Everyday life.

Here are some examples that are in everyday life ... It also plays a role in life sciences.

Rise of sap in plants

Locomotion of insects on the surface of water

Aadhesion of parasites on wet surface (e.g., pyriculariosis of rice, or rice blast)

Wetting of the eye. The cornea is by nature very hydrophobic, yet a normal eye is wet ! Proteins (called mucins), present in tears, turn the surface of the eye hydrophilic, stabilizing the lachrymal film. If one accidentally smears a fatty cream on the eye, it dries up, causing considerable discomfort.

Surface Tension, it only keeps us alive.

I am pretty much certain that the rest of you will think that as well as surface tension being a pretty thing responsible for the frost on the grass in the morning, that after reading this, that surface tension is a necessary thing and a useful thing to have in our world because, you know, it only keeps us alive.

If the world didn't really have surface tension, there also wouldn't be hydrogen bonding; which is what makes liquid, liquid. Water and all other liquids would be gases and because all living creatures need water to survive there would be no life on earth. Even if water was still water we need surface tension in our bodies to keep the billions of cells in our body alive. If surface tension wasn't in our body all the acids, blood, saliva and every other liquid in our body would mix together, in turn, we would die.

Applications of Doppler Effect

Sri. M. Rynjah,
Department of Physics

The Doppler effect has many practical applications, three of which are discussed here.

Astronomy: Perhaps the best known application is in astronomy, where the Doppler shifts of known atomic transition frequencies determine the relative velocities of astronomical objects with respect to us. Such measurements continue to be used today to find the distances of such unusual objects as quasars (objects having incredibly large masses that produce tremendous amounts of radiation). Doppler effect has been used to discover other mundane effects in astronomy, for example the rate of rotation of Venus and the fact that Venus rotates in the opposite direction of earth - the sun rises in the west of Venus. This was determined by observing light reflected from both sides of Venus - on one side it is blueshifted and on the other side it is redshifted, as shown in figure 1. The same technique has been used to determine the rate of rotation of stars.

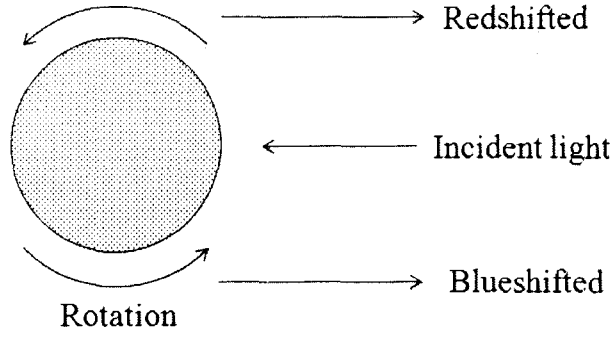


Figure 1

Radar: The Doppler effect is nowhere more important than it is in radar. When an electromagnetic radar signal reflects off of a moving target, the so called echo signal will be shifted in frequency by the Doppler effect. Very small frequency shifted can be determined by examining the beat frequency of the echo signal with a reference signal. The frequency shifted is proportional to the radial component of the target's velocity. Navigation radar is quite complex, and ingenious

techniques have been devised to determine the target position and velocity using multiple radar beams. By using pulsed Doppler radar it is possible to separate moving targets from stationary targets, called clutter.

Doppler radar is also extensively used in meteorology. Vertical motion of air drafts, size and motion of raindrops, motion of thunderstorms, and detailed patterns of wind distribution have been studied with Doppler radar.

X rays and gamma rays emitted from moving atoms and nuclei will have their frequencies shifted to the Doppler effect. Such phenomena tend to broaden radiation frequencies emitted by stationary atoms and nuclei and add to the natural spectral widths observed.

Laser Cooling: In order to perform fundamental measurements in atomic physics, it is useful to limit the effects of thermal motion and to isolate single atoms. A method taking advantage of the Doppler effect can slow down even neutral atoms and eventually isolate them. Atoms emitted from a hot oven will have a spread of velocities around some average value. If these atoms form a beam as shown in figure 2, a laser beam impinging on the atoms from the right can slow them down by transferring momentum.

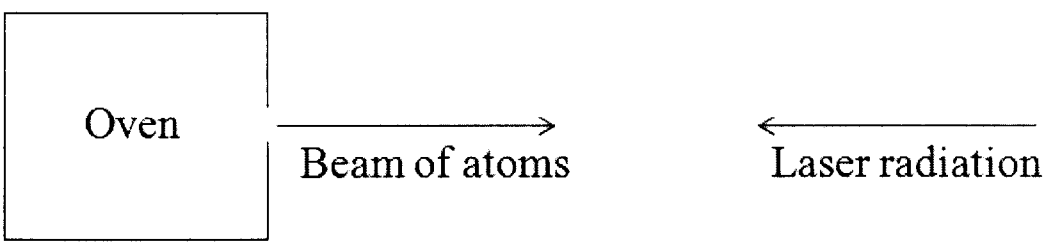


Figure 2

Atoms have characteristic energy levels that allow them to absorb and emit radiation of specific frequencies. Atoms moving with respect to the laser beam will "see" a shift in the laser frequency because of the Doppler effect. For example atoms moving toward the laser beam will encounter a laser with high frequency, and atoms moving away from the laser beam will encounter a laser with low frequency. Even atoms moving in the same direction within the beam of atoms will see slightly different frequencies depending on the velocities of the various atoms. Now, if the frequency of the laser beam is tuned to the precise frequency seen by the faster atoms so that those atoms can be excited by absorbing the radiation, then those faster atoms will be slowed down by absorbing the momentum

of the laser radiation. The slower atom will "see" a laser beam that has been Doppler shifted to the lower frequency than is needed to absorb the radiation, and these atoms are not as likely to absorb the laser radiation. The net effect is that the atoms as a whole are slowed down and their velocity spread is reduced.

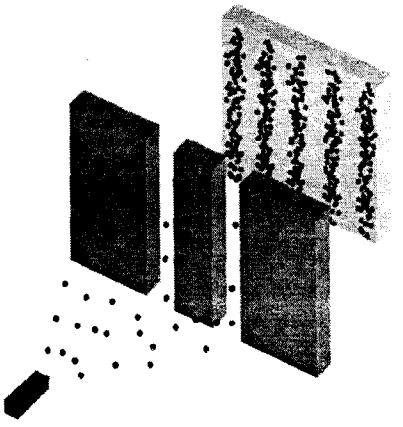
As the atoms slow down, they see that the Doppler shifted frequencies of the laser change, and the atoms no longer absorb the laser radiation. They continue with the same lower velocity and velocity spread. There are two methods to make the deceleration process continue. In one, the frequency of the laser beam is increased to keep the radiation consistent with the Doppler shifted frequency needed to exicite the atoms. In the other method, the laser frequency is kept constant, but carefully shaped magnetic fields are used to vary the frequencies needed to exicite the atoms by changing the excited atomic energy levels. By using six intersecting laser beams coming in at different angles, an "optical molasses" has been created in which the atoms are essentially trapped and the average velocity is zero. In a remarkable series of experiments by various researchers improving on the basic technique, atoms have been cooled to temperatures of 0.5 nK. The 1997 Nobel Prize in physics was awarded to Steven Chu, Claude Cohen Tannoudji, and William Phillips for this technique.

The Spooky Quantum

Sri. A.Dkhar,
Department of Physics

Quantum mechanics (or quantum Physics or quantum theory as it is known among Physicists) deals with the study of particles at the atomic and subatomic levels. The term Quantum mechanics was coined by Max Born in 1924. Though the theory works to provide accurate predictions of phenomena at the subatomic scales, there is no real understanding of why it works, what it really means or what implications it has for our world picture. At best, one can present the central mystery at the heart of quantum mechanics and show how its theoretical structure works to provide real world predictions. Once you decide to go down the rabbit hole, the wonderland of quantum mechanics will keep you enthralled forever.

Spooky, bizarre, weird and mind-boggling are all understatements when it comes to quantum mechanics. Things in the subatomic world of quantum mechanics defy all logic of our macroscopic world. Particles can actually tunnel through walls, appear out of thin air and disappear, stay entangled and choose to behave like waves etc. etc... According to Niels Bohr, the father of the '*Copenhagen interpretation*' of quantum Physics, "Anyone who is not shocked by quantum theory has not understood it". Richard Feynman, one of the founders of quantum field theory remarked, "I think I can safely say that nobody understands quantum theory".



To understand the weirdness of the quantum theory we consider the famous Double-Slit Experiment originally experimented by Thomas Young on the wave nature of light, in what was called the phenomenon of interference. In this experiment, light first diffracts out of one slit, allowing it to spread out and hit two more slits. The light that passes through each of these slits diffracts again, and the wave then hits a detector. Classically, light was always

seen as a wave. If a conventional wave goes through this, an interference pattern will be observed on the screen, as per the principle of superposition of waves, creating bright (constructive interference) and dark (destructive interference) bands. When the experiment was conducted, light indeed produced these interference patterns, which, at that time seemed to conclusively prove that light travelled in waves, causing revitalization in Huygen's wave theory of light, which included an invisible medium, ether, through which the waves are propagating. Several experiments throughout the 1800's, most notably the famed Michelson-Morley experiment, attempted to detect the ether or its effects directly. They however, all failed and a century later Einstein's work on relativity and photoelectric effect results in the ether no longer being necessary to explain the behaviour of light. From here on, the particle theory of light took dominance.

In the early 1900's, the question remained how light - which was now recognised to be in particle-like bundles of quantized energy, called photons - could exhibit the behaviour of waves. So, if light were a bunch of particles, they can somehow interfere with each other, it would seem. With the technology that was there at that time, it was possible to decrease the emission rate of light low enough that only one photon was being sent out at a time, so this seems to be a logical step. When the experiment was performed the results were surprising, it matched Young's version identically - alternating bright and dark bands, seemingly resulting from wave interference. This result both confirms and bewilders the wave theory. In this case, photons are being emitted individually. There is literally no way for interference to take place, because each photon can only go through a single slit at a time. But the wave interference is observed. How is this possible? The attempt to answer this question led to many intriguing interpretations and explanations of quantum mechanics, from the Copenhagen interpretation to the Many-worlds interpretation.

When the same experiment was conducted with a detector, placed behind the slits, which can tell whether or not the photon passes through one slit; then if we know that the photon passes through one slit then it cannot pass through the other slit to interfere with itself. Surprisingly, it turns out that when the detector is added, the bands disappear!! It appears the act of measuring which slit is used by the photon removed the wave element completely. At this point, the photon acted exactly as is expected of a particle to behave. The very uncertainty in its position is related, somehow, to the manifestation of wave effects.

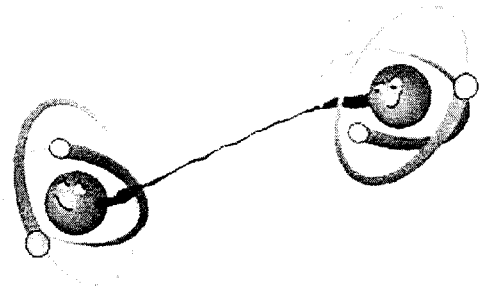
Then things got stranger. Over the years, the experiment has been conducted in a number of different ways, with things that are pretty sure to be particles. In 1961, Claus Jonsson performed the experiment with electrons, and it conformed to Young's experiment, creating interference pattern on the observation screen. Jonsson's version of the experiment was voted, "the most beautiful experiment" by *Physics World* readers in 2002. In 1974, the technology enables the experiment to be performed by releasing a single electron at time. Again the interference patterns showed up. But when a detector is placed at a slit, the pattern once again disappears. The experiment was again performed in 1989 by a Japanese team that was able to use much more refined equipment yielding, yet again, the same results.

The experiment has been performed with photons, electrons, and atoms, and each time the same result becomes obvious - something about measuring the position of the particle at the slit removes the wave behaviour. Many theories came into existence to explain the observed results, but much of it still remains, but a conjecture.

The Copenhagen interpretation of quantum mechanics was the earliest interpretation, championed by Niels Bohr himself.For the better part of the last century, the most accepted explanation for why the same quantum particle may behave in different ways was the ***Copenhagen interpretation***. Although it's getting a run for its money from the Many-Worlds interpretation lately, many quantum physicists still assume the Copenhagen interpretation is correct. The Copenhagen interpretation was first posed by physicist Niels Bohr in 1920. It says that a quantum particle doesn't exist in one state or another, but in all of its possible states at once. It's only when we observe its state that a quantum particle is essentially forced to choose one probability, and that's the state that we observe. Since it may be forced into a different observable state each time, this explains why a quantum particle behaves erratically.This state of existing in all possible states at once is called an object's ***coherent superposition.*** The total of all possible states in which an object can exist — for example, in a wave or particle form for photons that travel in both directions at once — makes up the object's ***wave function.*** When we observe an object, the superposition collapses and the object is forced into one of the states of its wave function.

Bohr's Copenhagen interpretation of quantum mechanics was theoretically proven by what has become a famous thought experiment involving a cat and a box. It's called Schrödinger's cat experiment, and it was first introduced by the Viennese physicist Erwin Schrödinger in 1935.

In his theoretical experiment, -Schrödinger put his cat in a box, along with a bit of radioactive material and a Geiger counter — a device for detecting radiation. The Geiger counter was designed so that when it sensed the decay of the radioactive material, it triggered a hammer which was poised to break a flask containing hydrocyanic acid, which, when released, would kill the cat.To eliminate any certainty regarding the cat's fate, the experiment was to take place within an hour, long enough so that some of the radioactive material could possibly decay, but short enough so that it was also possible none would.In Schrödinger's experiment, the cat was sealed in the box. During its stay there, the cat came to exist in an unknowable state. Since it could not be observed, it could not be said whether the cat was alive or dead. It existed instead in the state of both life and death. It's sort of like quantum physics' answer to the old Zen question: If a tree falls in the woods and no one is around to hear it, does it make a sound?



One of weirdest or wildest predictions of quantum mechanics is "Quantum Entanglement". Entanglement is a term used in quantum theory to describe the way that particles of energy/matter can become *correlated* to predictably interact with each other regardless of how far apart they are.In quantum physics, entangled particles remain connected so that actions performed on one affect the other, even when separated by great distances. The phenomenon annoyed Albert Einstein so much that he called it "spooky action at a distance." Quantum entanglement, one of the odder aspects of quantum theory, links the properties of particles even when they are separated by large distances of over billions of light years apart. When a property of one of a pair of entangled particles is measured, the other "immediately" settles down into a state compatible with that measurement. So how fast is "immediately"? According to research by Prof. Juan Yin and colleagues at the University of Science and

Technology of China in Shanghai, the *lower limit* to the speed associated with entanglement dynamics - or "spooky action at a distance" - is at least 10,000 times faster than light!!!

Particles, such as photons, electrons, or qubits (for quantum bits) that have interacted with each other retain a type of connection and can be entangled with each other in pairs, in the process known as correlation. Knowing the spin state of one entangled particle - whether the direction of the spin is up or down - allows one to know that the spin of its mate is in the opposite direction. Even more amazing is the knowledge that, due to the phenomenon of superposition, the measured particle has no single spin direction before being measured, but is simultaneously in both a spin-up and spin-down state. The spin state of the particle being measured is decided at the time of measurement and communicated to the correlated particle, which simultaneously assumes the opposite spin direction to that of the measured particle. Quantum entanglement allows qubits that are separated by incredible distances to interact with each other immediately, in a communication that is not limited to the speed of light. No matter how great the distance between the correlated particles, they will remain entangled as long as they are isolated.

Entanglement is a real phenomenonwhich has been demonstrated repeatedly through experimentation. The mechanism behind it cannot, as yet, be fully explained by any theory. One proposed theory suggests that all particles on earth were once compacted tightly together and, as a consequence, maintain a connectedness. Much current research is focusing on how to harness the potential of entanglement in developing systems for quantum cryptography and quantum computing, and even the possibility of,***human teleportation***!! .....**Spooky!!**.....**isn't it?**

Corruption in Scientific Community

Sri. L. Khongiang,
Department of Physics

Corruption is no longer confined to English language, because a person, who is illiterate and does not even know what English is, knows what this word "corruption" means. The word is so rich in meaning that it almost fits itself in all spheres of life. As I try to define this word on my own while typing this article I realized that my mind is always towards finding its definition in the internet. But at that time the internet connection is not available and I asked my friend who owns a computer store as to why there is no connection in my desktop despite many attempts I have made to connect to the internet. He plainly said one or two files in your computer is/are corrupted. Then I thought to myself, why should I define this word, everyone knows what it means. But I do not want to ask from my friend what he means by or understand from the word corrupted in his own way. I rather asked him, why is the file corrupted when my computer is not having an emotion or mind of its own? He said a "virus" causes some files to be corrupted. I thought corruption is associated only to human beings who have emotions, mind, intelligence; greed and "money' is the "virus" in this case, but now I realized from this answer that whether you have or you do not have those qualities you will be prone to being corrupt. I further asked him if he can help me to rectify the problem to which he said we have to repair or remove the affected files and new ones must be installed, that too it depends to what extent the virus has affected the files, otherwise the whole system has to be formatted.

I am a man of science and I am proud of who I am because people in the whole world have unshakable faith on Science. Science is taken as Absolute Truth. Many articles in newspapers started with "Scientist confirmed..., or A study finds that.....etc." without going into the credentials of who the scientist(s) is/are, showing that the reporter completely accepted what his so called scientist has said or may be the journalist is scientifically illiterate to separate true science from junk science. The scientific process assumes the highest standard of honesty from the participants. But the participants in all Scientific Processes are people like you and me with all the mentioned qualities.

Then, is it not possible that there will be corruption in Science? Why Not? Politics is a good game that everyone wants to take part, but the players (politicians) are otherwise. Science is truth, but some scientists are otherwise. All good ideas start out well enough but, sometimes after gaining wide spread acceptance, they inevitably become corrupted. The purpose of science is to discover the true nature of the Universe and to convey that knowledge truthfully to the people everywhere. Any scientific activity that deviates from this purpose is corruption in Science. If this is the basis of all meanings of corruption in science, then I may say that, corruption in science beyond tolerance.

Corruption in science started at the very early stage. My student is asked to perform an experiment to find the value of acceleration due to gravity in our college, though he got the result to be 9.73 ms^{-2}, but he thought that the value is wrong as he had studied the value of g on the surface of the earth is 9.8 ms^{-2}, hence he tried to manipulate some readings in the graph so that the result comes out to be exactly 9.8 ms^{-2}. My student is not reporting what he obtained from his scientific observations, he misleads the scientific community. The reason is best known to him. This is the first corruption case as I would classify it. My direct experience on how we tend to be scientifically corrupted is with my fellow Physicists, for we both are aware of the bad effects of uranium mining, but I am teacher and he is a researcher who have the same knowledge about those harmful effects on human lives of that mining activities. Later he was employed by an agency which is in favour of uranium mining and this scientist will not talk any more about the harmful effects of mining but rather talk about and popularize the benefits of uranium and all questions about the bad effects is suppressed by the all the talks about the benefits from it. Is he not denying the other part of the truth? Is this not another form of corruption? I understand that this scientist is being censored; he has to speak only what the press officer(s) of the company wants him to talk.

A well-known and very popular corruption in science deals with a pesticide, DDT (dichloro-diphenyl-tricloroethane). A Scientist and writer, Rachel Carson, in the year 1962 in a book *Silent Spring* highlighted the dangers of DDT. Her credibility as a scientist is questioned and was derided as "hysterical". It took ten years for the Environment Protection Agency to issue a "cancellation order" for

DDT in 1972.When it was banned in the USA, the pesticide industry funded research on the impact of DDT on Environment and human life. Then a headline was issued on a popular daily newspaper that millions of lives are lost due to a ban on DDT; the reason slated here is the increase in the population of mosquitoes and hence increase cases of malaria. Some scientists even wrote that in order to save science and mankind, we should fight to bring back DDT.

To add more, The Tobacco Institute founded a faux journal Reports on Tobacco and Health research in 1960 to spread uncertainty about the link between Smoking and Lung Cancer. Research work like "Inhalation Tests Fail to Cause Lung Cancer; Virus Suggested" was published in the Journal. The Journal is circulated to many Lung Specialists. In a similar note, the recent blanket ban on coal mining activities in the state of Meghalaya will definitely compel the coal barons to fund an independent research project as to why there is chaos in the state. The outcome of the project is predictable and shall be accepted by certain agencies of the government.

Politicizing science is another form of corruption in science: The government is an end product of result of politics; the political conglomeration is controlled by people with a lot of money to invest. If the government (which is nothing but a political party) feels that certain agency is funding a project that would yield results that is in bad taste with its sponsors, it will try to withdraw funding to such an agency. This is an indirect abuse on science.

Corruption in science among academicians is quite less as compared to those in health and environmental sciences. There is quality in the works of the academician till recently, but I am afraid that with the implementation of API scores for career advancement of the academicians, we would rather stick to quantity of scoring points than how to score those points with quality works. One of my colleagues bluntly pointed out that this is like a system of Publish-Or-Perish. Self-discipline is a part of scientific publication systems. Peer Review is a process that decides whether your work gets published in an academic journal. But only a group of few individuals will decide for the publication of those papers, and if the group is not acquainted with the work, the process becomes slow and gets postponed and many more papers will pile up. As there is pressure from the funding

agency for the work to be published and get recognition, the researchers cannot wait for too long and opted for other journals even if they have to pay (or bribe) for their work to get published. Since the work is not properly refereed by qualified and competent persons, it is likely that that some flaws will go undetected. This is another case of Corruption in Scientific Publication systems. As an example, a study by University of Illinois came out with the report that hurricanes with *female* names are more destructive than those with *male* monikers. This was reported in Proceedings of the National Academy of Sciences, which was later disagreed by many as the name of the hurricane has nothing to do with its severity.

The inappropriate influence of companies with financial stakes in the outcome of any work leads to anti-science. Corporations that stand to lose from the results of independent scientific inquiry have gone to great lengths to manipulate and control science and scientists. They go up to the extent to tell a scientist that the results should be like the way they want it to be and if the result is contradicting, there will no funding and the project is terminated then and there only. Even when a scientist has done an independent research, they will try to suppress the work and exert their influence so that no journals would publish his work.

Corrupted Science that shapes public perception and opinions is influencing the government and exploit judicial pathways. Policy-makers seek concrete steps and hard facts before bringing in any form of Law in the state. If the very system, once believed to be the ultimate authority (i.e. Science) is corrupted then the whole system will fall. This is very dangerous as it leads to scientifically-manufactured disasters. Corporations, non-profit organizations, academic institutions, scientific societies and the media, all have critical roles in reducing abuses of science.

FEW FASCINATING FACTS ABOUT THE INVENTIONS THAT CHANGED THE WORLD

Sri. K. Nongbri,
Department of Physics

True inventions are almost always uncomplicated there is no such things as complicated invention. Though there are complicated machines, however the basic ideas and devices that make up complex mechanism are usually fairly simple. All the smoothly functioning machines of the modern civilization have developed from the smart, clever, simple inventions and discoveries that slowly accumulated over centuries of human history. Combining several simple, but basic inventions and discoveries can result in a complicated machine such as trains and the automobile, which could never have come about without wheel. Even if they are simple in concept, they can be express simple. Einstein's famous equation "$E=mc^2$", although the result of years of intense work, expresses the whole field of atomic energy. And what could be plainer than a wheel spinning axle? These are simple and basics ideas, yet they show the directness and purposefulness of man inventive mind.

1. **Who invented paper?**
   A Courtier name Tsai - Lun, from Lei - yang in China, was the inventor of paper (not papyrus) approximately 105 A, However, the word paper is derived from the name of the reedy plant papyrus, which grows abundantly along the Nile River in Egypt. Paper is made of pulped cellulose fibers like wood, cotton or flax, papyrus is made from the sliced sections of the flower stem of the papyrus plant, pressed together and dried

2. **Who invented Photostat?**
   In 1937, an American law student Chester Carlson invented a copying machine process based on electrostatic energy called Xerography. Xerography became commercially available in 1950 by the Xerox Corporation. The word 'Xerography' comes from the Greek for 'dry writing'.

3. **Who invented the radio?**
   Radio owes its development to two other inventions the telegraph, and the telephone. In fact, all three technologies are

closely related. Few radio broadcasts travel through air exclusively, while many are sent over telephone wires. In 1860s, James Clerk Maxwell, a Scottish physicist, predicted the existence of radio waves, and in 1886 Heinrich Rudolph Hertz, a German physicist, demonstrated that rapid variations of electric current could be projected into space in the form of radio waves, similar to those of light and heat. Guglielmo Marconi, an Italian inventor proved the feasibility of radio communication. He sent, and received his radio signal in Italy in 1895. By 1899, he flashed the wireless signal across the English Channel, and two days later received the letter 'S". Telegraphed from England to Newfoundland. This was the first successful transatlantic radio-telegraphed message in 1902. Nikola Tesla is now credited with having invented the modern radio, the Supreme Court of the US overturned Marconi's patent in 1943 in favor of Tesla.

4. Who invented the Transistor?

The Transistor is an influential invention that changed the course of history for computers. The first generation of computers used vacuum tubes; the second generation of computers used Transistors; the third generation of computers used integrated circuits and the fourth generation of computers used microprocessors. John Bardeen, William Shockley and Walter Brattain, scientists at Bell Telephone Laboratories in Murray Hill, New Jersey, were researching the behavior of crystals (Germanium) as semi- conductors in an attempt to replace vacuum tubes as mechanical relays in telecommunications. The vacuum tube, used to amplify music and voice, made long- distance calling practical, but the tubes consumed power, created heat and burned out rapidly, requiring high maintenance. The team's research was about to come to a fruitless end when last attempts to try a purer substance as contact point lead to the invention of the 'point -contact' transistor amplifier. John Bardeen and Walter Brattain took out a patent for their transistor. In 1956, the team received the Nobel Prize in Physics for the invention of Transistor.

5. Who invented cell phone?

Cellular telephone is a type of short - wave analog or digital telecommunication in which a subscriber has a wireless connection from a mobile telephone to a relatively nearby transmitter. The transmitter's span of coverage is called a cell. As cellular telephone user moves from one cell or area of coverage to another, the telephone is effectively passed on to the local cell transmitter. Cell phones can now be used to transmit SMS messages, emails, and hear music and many more.

Dr. Martin Cooper, a former general manager for the systems division at Motorola, is considered the inventor of the first modern portable handset. Cooper made the first cell on a portable cell phone in April 1973. He made the call to his rival, Joel Engel, Bell Labs head research. Bell Laboratories introduced the idea of cellular communication in 1947 with the police car technology. However, Motorola was the first to incorporate the technology into a portable device that was designed for use outside an automobile.

6. **Who invented the computer mouse?**

Douglas Engelbart changed the way computers worked, from specialized machinery that only a trained scientist could use, to a user- friendly tool that almost anyone can use. He invented, and contributed to several interactive, user-friendly devices including the computer 'mouse', which revolutionized the way we use computer. The first computer mouse was invented in 1963-64 as part of an experiment to find better ways to "point and click" on a computer display screen. Due to space restrictions, the first mouse had only one button and was carved out of wood. Engelbart received a patent for the wooden shell with two metal wheels in 1970, describing it the patent application as an 'X-Y position indicator for a display system". The device was nicknamed the mouse because the end tail came out at the end".

7. **Who invented dynamite?**

Alfred Nobel, Swedish industrialist, engineer, and inventor, built bridges and buildings in Stockholm. His construction work inspired him to research new methods of blasting rock. In 1863, Alfred Nobel invented the Nobel patent detonator or blasting cap for detonating nitroglycerine and dynamite. The Nobel patent detonator used a strong shock rather than heat combustion to ignite the explosives. In 1865, the Nobel Company built the first factory that made nitroglycerine and later dynamite. One advantage of dynamite over nitroglycerine was that it could be cylinder-shaped for insertion into drilling holes used for mining.

8. **Who made guns first?**

The first commercially successful revolver was invented by Samuel Colt in 1835. The first practical repeating rifle was invented by Benjamin Tyler Henry in 1860. The machine gun was invented by James Puckle, an English man in 1718.

9. **How were computer printers created?**

In 1953, Remington - Rand developed the first high-speed printer for use on the Univac computer. In 1938, Chester Carlson invented a dry printing process called electro photography commonly called Xerox, the foundation technology for laser printers to come. The original laser printer called EAS was developed at Xerox Palo Alto Research Center in California, USA, and completed by November, 1971. Xerox Engineer, Gary Stark weather adapted Xerox copier technology, adding a laser beam to it to come up with the laser printer. In 1992 Hewlett-Packard released the popular Laser Jet 4, the first 600 by 600 dots per inch resolution laser printer.

10. **Who invented the calculator?**

William Seward Burroughs invented the first practical addingand listing machine. He was awarded a patent application for his calculating machine in 1888. In 1886, Burroughs and several St. Louis businessmen formed the Arithmometer Company of America to market the machine. The first machine, however, required a special knack pulling the handle to execute the calculation correctly. In 1893, Burroughs received a patent for an improves calculating machine, which incorporated an oil-filled 'dashpots', a hydraulic governor. This device enables the machine to operate properly, regardless of the manner in which the handle might be pulled.

FAST FACTS ABOUT INVENTIONS AND INVENTORS

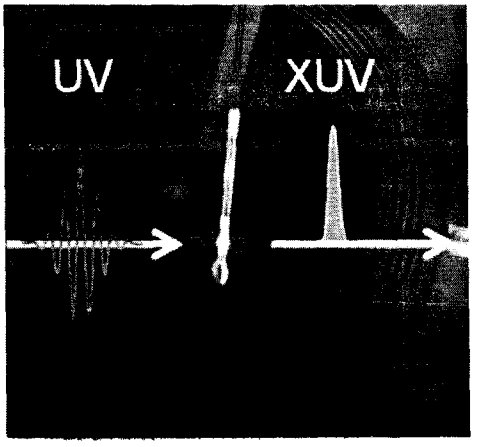
- In 1894, Lord Kelvin predicted that radio had no future; he also predicted that heavier-than-air flying machines were impossible.
- The word "sneaker" was coined by Henry McKinney, an advertising agent for N.W. Ayer & Son.
- Charles Macintosh invented the waterproof coat, the Mackintosh, in 1823.
- Air-filled tyres were used on bicycles before they were used on motorcars.
- The paperclip was invented by Norwegian Johann Vaaler.
- Music was sent down a telephone line for the first time in 1876, the year the phone was invented.
- Optical fiber was invented in 1966 by two British scientists called Charles Kao and George Hockham working for the British company Standard Telecommunication.
- Joseph Niepce developed the world's first photographic image in 1827.
- The videophone was invented by Bell Laboratories in 1927.
- The very first projection of an image on a screen was made by a German priest. In 1646, Athanasius Kircher used a candle or

oil lamp to project hand-painted images onto a white screen. Modern projectors emit more than a thousand Lumens!

- The first neon sign was made in 1923 for a Packard dealership.
- The first vending machine was invented by Hero of Alexandria in the first century. When a coin was dropped into a slot, its weight would pull a cork out of a spigot and the machine would dispense a trickle of *holy* water.
- The can opener was invented 48 years after cans were introduced.
- The hair perm was invented in 1906 by Karl Ludwig Nessler of Germany.
- Leonardo da Vinci never built the inventions he designed.
- Traffic lights were used before the advent of the motorcar.
- The Monopoly game was invented by Charles Darrow in 1933. He sold the rights to George Parker in 1935, then aged 58. Parker invented more than 100 games, including Pit, Rook, Flinch, Risk and Clue.
- One hour before Alexander Graham Bell registered his patent for the telephone in 1876, Elisha Gray patented his design. After years of litigation, the patent went to Bell.
- Thomas Edison filed 1,093 patents, including those for the light bulb, electric railways and the movie camera. When he died in 1931, he held 34 patents for the telephone, 141 for batteries, 150 for the telegraph and 389 patents for electric light and power.
- The first fax process was patented in 1843.
- Count Alessandro Volta invented the first battery in the 18th century.
- During the 1860s, George Leclanche developed the dry-cell battery, the basis for modern batteries.
- In 1894 Thomas Edison and W K L Dickson introduced the first film camera.
- In 1895 French brothers Auguste and Louis Lumiere demonstrated a projector system in Paris. In 1907 they screened the first public movie.
- The first electronic mail, or "email", was sent in 1972 by Ray Tomlinson. It was also his idea to use the @ sign to separate the name of the user from the name of the computer.
- Queen Elizabeth of Britain sent her first email in 1976.
- In 1889, Kansas undertaker Almon B. Strowger wanted to prevent telephone operators from advising his rivals of the death of local citizens. So he invented the automatic exchange.

A Bright light for ultrafast snapshots of materials

Bakeley lab reachers have developed a way to produce high - repetition rate xuv light for obtaining rapid, sharp images of a materials electronic structure.



If we want to understand, how novel phases emerge in correlated materials, including high-temperature superconductivity and nanoscale electronic order, we can obtained completely new viewpoint by taking 'snapshot' of under lying rapid electronic interaction . one way to do this is by delivering pulses of extreamly short wavelength uv-light to a material and deriving information base on the energy and direction of travel of the emitted electrons. However, generating pulses extreme UV(XUV) light with the required properties for such application is difficult to achieve.

Now research have developed a way of producing an efficient, high-repetition rate XUV source for use in obtaining rapid, sharp images of electronic structure.

Like taking a photo on a bright day as opposed to dim twilight, if we have a bright laser source, we can cut down the measurement noise and take excellent data because a lot of photons, has to be worked with. But there a catch : for experiments such photo emission, the light has to be disturbed across as many pulses as possible.

To avoid unwanted blurring of the measure spectra :

Angle-resolved photoemission spectroscopy, or ARPES is a key technique that makes use of the photoelectric effect for studying condensed matter materials. by analyzing the emitted electron , it provided direct information about a material's electronic structure in energy and momentum space. But standard detectors used for static measurements are about 10 trillion times slower than the timescale on which electrons interacts with each other. To access such microscopic timescale requires a deficient measurement technique base on extremely short pulses of light, on the order of 10 to 100 femto-seconds (1fs is 10-15s).

Importantly, the photon energy of light also needs to overcome the work function of the material with shorter wavelength allowing for a more comprehensive view of electronic structure across energy and momentum. thus, time resolved ARPES requires overcoming two challenges generally short wavelength XUV light, and pulsing it at rapid intervals with a small number of photon per impulse to minimize blurring from electron-electron interaction that occur after photo emission.

It is very difficult to generate XUV light in the first play. This is made possible by a process called high-harmonic generation, where the atom expose to extremely strong laser field with peak intensity of 100 tera-watts or more. An electron can then tunnel out of the atom and return having picked up a lot of energy that , subsequently it can lose by emitting an XUV photon. now an important results is that we achief very efficient high-harmonic conversion into the XUV, despite operating at high repetition rates whose the driving laser power has to be divided among many pulses. The scheme first convert infrared pulses from an amplifier femto-second laser into the UV, then gain back orders of magnitude in efficiency through subsequence high-harmonic conversion. At the high rate of 50,00 pulses /sec, the corresponding weak UV driving pulses have to be focoused tightly into the thin column of krypton gas where high-harmonic generation occurs. However, this intermediate step yield a more than 100 fold boost of XUV. Conversion efficiency, compared to the driving the process directly with the infrared laser.

The berkeley lab study demonstrated an exception ally bring XUV source flux, with the strangest harmonic line occurring at a wavelength of 56nm (photon energy 4 22eV) and exceeding 1013 photons/sec. by accompanying their experiments with numerical calculations. The observed efficiency boost through a combination of favorable electron dynamics in the intense UV laser field, together with a near optimal coherent build up of XUV light across the gas. In addition to flux enhancement, the setup also delivers other benefits.

Full size image :

In a new from bakeley lab, UV light is used to efficiently generated XUV light at high repetition rates. narrowband, isolated XUV harmonics around 22eV are obtained, ideal for time-resolved ARPES studies of materials.

High harmonic source generate a series of line with different XUV wavelength. where spectra from different line will get entangled. In contracts our scheme isolated a single XUV harmonic using only thin metal filter, resulting in a very compact beamline. the harmonic has an energy width of 72meV, corresponding to only 0.3% of the photon energy.

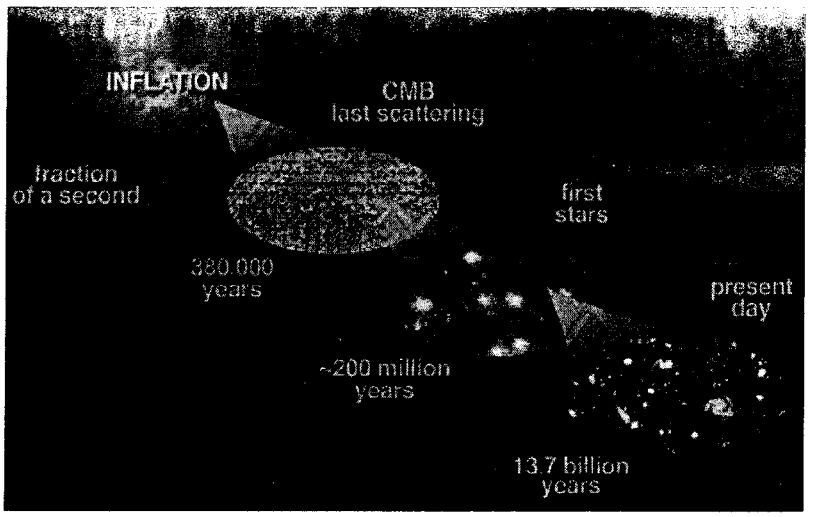
That extremely narrow for high harmonic allows us to take sharp images of the electronic structure in materials.

With this bright, high repetition - rate XUV sources, researchers now have the opportunity to gain new insights into the physics of correlated materials by tracking ther rapid , fundamental interaction across large swatchs of energy and beyond that , there femto-second XUV pulses represent a powerful tool for other application such a short - wavelength metrology, co-insidence and time-of-light spectroscopy of molecules and nanoscale imaging.

By Purningstar shabong
3rd BSc Physics Honours

Big Bang Theory - The Premise

The Big Bang theory is an effort to explain what happened at the very beginning of our universe. Discoveries in astronomy and physics have shown beyond a reasonable doubt that our universe did in fact have a beginning. Prior to that moment there was nothing; during and after that moment there was something: our universe. The big bang theory is an effort to explain what happened during and after that moment.



According to the standard theory, our universe sprang into existence as "singularity" around 13.7 billion years ago. What is a "singularity" and where does it come from? Well, to be honest, we don't know for sure. Singularities are zones which defy our current understanding of physics. They are thought to exist at the core of "black holes." Black holes are areas of intense gravitational pressure. The pressure is thought to be so intense that finite matter is actually squished into infinite density (a mathematical concept which truly boggles the mind). These zones of infinite density are called "singularities." Our universe is thought to have begun as an infinitesimally small, infinitely hot, infinitely dense, something - a singularity. Where did it come from? We don't know. Why did it appear? We don't know.

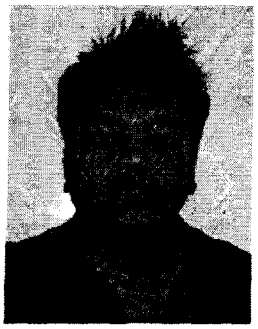
After its initial appearance, it apparently inflated (the "Big Bang"), expanded and cooled, going from very, very small and very, very hot, to the size and temperature of our current universe. It continues to expand and cool to this day and we are inside of it: incredible creatures living on a unique planet, circling a beautiful star clustered together with several hundred billion other stars in a galaxy soaring through the cosmos, all of which is inside of an expanding universe that began as an infinitesimal singularity which appeared out of nowhere for reasons unknown. This is the Big Bang theory.

Big Bang Theory - Common Misconceptions

There are many misconceptions surrounding the Big Bang theory. For example, we tend to imagine a giant explosion. Experts however say that there was no explosion; there was (and continues to be) an expansion. Rather than imagining a balloon popping and releasing its contents, imagine a balloon expanding: an infinitesimally small balloon expanding to the size of our current universe.

Another misconception is that we tend to image the singularity as a little fireball appearing somewhere in space. According to the many experts however, space didn't exist prior to the Big Bang. time and space had a finite beginning that corresponded to the origin of matter and energy." The singularity didn't appear *in* space; rather, space began inside of the singularity. Prior to the singularity, *nothing* existed, not space, time, matter, or energy - nothing. So where and in what did the singularity appear if not in space? We don't know. We don't know where it came from, why it's here, or even where it is. All we really know is that we are inside of it and at one time it didn't exist and neither did we. if the universe is keep on expands as time goes, does time also expands(increase) with the universe? will it(universe and time) come to an end? what make the universe expand?

By Kersom Pohduna
3rd yr BSc. Hons (Physics)



Guiding Light

Alone at midnight, when I'm upset,
Comes out from nowhere with his ugly face.
Yes, ugly and sober he is but...
Everything he is, perfect man I've ever found.
Dependant on him and his guidance,
And on his absence we are nothing;
Hopeless, choiceless , meaningless and faithless.
Still and will remember him forever
And his words: Knowledge is power.
Here I stand and shed my tears because of my failure
Remembering what he had told and which I often ignored.
Quarrelled thousand times and even tried to stay away,
And here comes my smiling face with silence for being stupid.
The life he has lived may not have produced;
Millions of dollars, a fancy car or a beautiful house,
But what he has given to me is much more valuable
Than all those of material things or a sack of golds.
My conscience says, " He is better than everyone else."
And it keeps on asking me " Are all fathers the same? "
Everything he is, perfect man I've ever found.
I live with him and will always...
May God shower blessings upon him!!
He is everything and he is my father : THE MAN

Soyam Ajay Singh,
3rd B.Sc (Hons) Physics

Interesting Facts

1. A spider eats about 2000 insects a year ! (So spiders are good to have around the home)

2. Giraffes and humans have the same number of teeth!

3. The moon is about 400 times smaller the sun.

4. Antarctica is the only continent where butterflies have not been found

5. The world's oldest pet goldfish lived to be 43 years old!

6. Trees and tusks of walruses both have rings that help determine their ages

7. Wood frog has natural antifreeze in its body so it doesn't die when its freezes

8. In the year 1450 Johannes Gutenberg puts his printing machine into action. The first book he prints is the Bible.

9. American astronaut Alan Shepard was the first person to hit a golf ball on the moon's surface!

10. The gates of Paradise is a novel consisting of 40,000 words written in two sentences!

11. Saros is called the period of 18 year and 11.3 days, after which the earth, the moon and the sun return to the same relative positions.

12. Mercury is the planet which has the longest day and the shortest year in the solar system.

13. Sirius is the brighter star in the sky.

By Peaceful Huwa
3rd yr BSc. Hons (Physics)

JOKES

Volume of a cow

A mathematician, an engineer and a physicist set around the table discussing how to measure the volume of a cow. The mathematician suggested the use of geometry and symmetry relationship of a cow, but his idea was rejected on the ground of being too much time consuming.

The engineer suggested placing the cow into the pool of water and measuring the change in the height of water but his idea was rejected on the ground of impracticality

" It's easy", said the physicist. "We'll make an assumption that the cow is the sphere, calculate the volume and then blow it up to the actual size" .

By Doublebless
3rd BSc Physics Honours

Little Buds has Strong Stem

My name is Daiohiphi Lapasam, student of shillong college since 2014 and I'm studying 2nd year BSc in Physics Honours. I'm interesting to do research mostly in the field of Mathematics & Physics which lead me tension and busy every time and my dreams always distop my sleeping if I cannot complete my solution. Here the words of Dr.APJ Abdul Kalam is coming true in my life (*People always Dreams while sleeping .According to me, Dreams which does not let me sleep)*

Here I want to express and describe the details of my interesting work in research field "*Gravitational effects of Relativity Theory*"

Gravitational Effects of Relativity Theory

The Gravitational force effect in the velocity of the photons,it seem that the Gravitational force is decrease with the increase of the velocity of the photons. But in the case, if we consider that velocity of speed of light is constant that is *c* then the gravitational force varies only when the wavelength varies. According to the equation:-

$$F = \frac{GM}{CR^2}\left(\frac{h}{\lambda}\right)$$ *[Where **G**=gravitational constant& **h**=Planck's constant]*

*[**M**=mass of object & **ë**=wavelength]*
*[**R**=distant of the two object]*
*[**C**=speed of light]*

The relative gravitational force effect only when an objects or particles is in the motion otherwise it remain only rest gravitational force.

The relative gravitational force with the effect of the relative mass-force of the objects, it seem that when the velocity (v) of the particles it tends to c i.e.$v=c$ then the gravitational force tends to infinity i.e., $v'!$".But when the velocity v is decrease the gravitational force is increase. When the velocity is zero $v=0$ then the gravitational force remain conserved with the rest mass of particle.

$$\mathbf{F} = \frac{GM}{R^2}\frac{m_0}{\sqrt{1-\frac{v^2}{c^2}}}$$ *[m_0=mass of other objects]*

$$[\sqrt{1-\frac{v^2}{c^2}} = \text{Relativity value}]$$

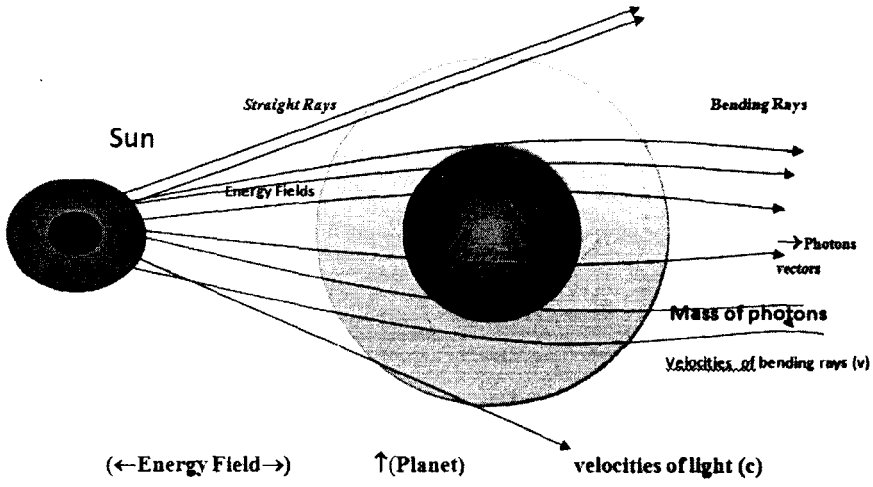
$$F = \frac{GM}{R^2}\frac{m_0}{\sqrt{\frac{c^2-v^2}{c^2}}}$$

$$F = \frac{GM}{R^2}\frac{m_0 c}{\sqrt{c^2-v^2}}$$

Electromagnetic wave when propagate in the field of the energy with the high frequency then only it can form a pulse mass like photons form the mass when only the electromagnetic wave propagate inside the space-energy then it produce a pulse-mass which is when remain stationary it does released only energy no mass at all.

Similarly if it propagate a mechanical wave of particles inside energy field with high frequency then only it form a mass as well as when particles move then it form a wave and vice versa

⇒ Gravitational force is more when only the objects move with a velocity (v) otherwise it remains conserved with the rest mass of the particles.



1. Bending Rays effected due to Gravitational force of Planet to the moving Photons
2. Straight Rays are not effects by the Gravitational force, but the mass and velocity of Photons remain constant inside the Energy field i.e. $c = 3\times10^8 m/s$

By Daiohiphi Lapasam
2nd year BSc (H) Physics

Origin of Species - Natural Selection

Natural selection is a natural process which acts to preserve and accumulate minor advantageous variations within living systems. Suppose a member of a species were to develop a functional advantage (a reptile grew wings and learned to fly: an obvious advantage his earth-bound relatives couldn't enjoy); its offspring would inherit that advantage and pass it on to future offspring. Natural selection would act to preserve the advantageous trait. Essentially, natural selection is the naturalistic equivalent to domestic breeding. Over the centuries, human breeders have produced dramatic changes within domestic animal populations simply by selecting individuals to breed. They have been able to accentuate desirable traits (given the trait is already present in the creature's genetic code) and even suppress undesirable traits gradually over time. The difference between domestic breeding and natural selection is this: rather than human breeders making the selections, nature itself is the selector. Since natural selection can and does produce slight variations within animal populations it should therefore be able to explain all of the variety we observe in biology. He concluded that since natural selection explains variety, all life must somehow be related, everything ultimately having evolved from some sort of common ancestor. "It is a truly wonderful fact-the wonder of which we are apt to overlook from familiarity-that all animals and all plants throughout all time and space should be related to each other. Well, this whole idea of the birds and bananas, the fish and the flowers, all being related, and life evolving from non-life.

By Nandari Marbaniang
3rd yr BSc. Hons (Physics)

For those who cannot remember the value of some simple trigonometry angles

Trick to remember some of the trigonometry angles . . .

(1) To obtain the angle of sin(30), cos (30),tan (30), sin (60), cos (60), tan(60) ...

(a) Draw a figure in the form of a right triangle and assign the value of perpendicular = 1, base = "-3 and hypotenuse = 2 as in the fig (A)

(b) For a 30 degree use fig (A)

(c) For a 60 degree use the second fig (B)

(d) For a second fig i,e fig(B) , just rotate the fig (A) by 90 degree

(e) We know sin = perpendicular / hypotenuse cos = base/ hypotenuse and tan = perpendicular/base. Since cosec, sec and cot is the reciprocal of sin, cos and tan, we can obtain the value easily after we have got the value of sin, cos and tan.

(f) Now look at the figure and put the value of perpendicular, hypotenuse and base in (e) then the value will be as in the table below

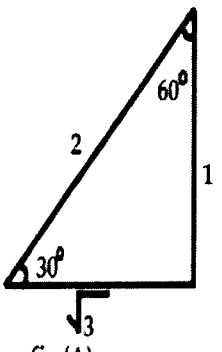


fig (A)

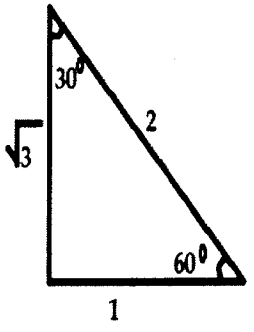


fig (B)

Table for 30 and 60 degree:

function	angle	value	Angle	value
sin	30	1/2	60	√3/2
cos	30	√3/2	60	1/2
tan	30	1/√3	60	√3
cosec	30	2	60	2/√3
sec	30	2/√3	60	2
cot	30	√3	60	1/√3

(2) To obtain the value of sin (45) , cos (45) , tan (45)

(a) For a 45 degree angles use the fig (C) below

(b) here put the value of perpendicular = 1, hypotenuse = "2 and base = 1

(c) Again do as in 1(e), then the value will be as in the table below

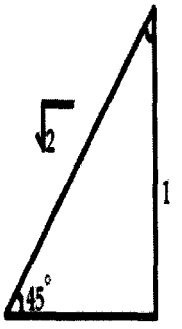


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fig (C)

Table for 45 degree :

function	angle	Value
sin	45	$1/\sqrt{2}$
cos	45	$1/\sqrt{2}$
tan	45	1
cosec	45	$\sqrt{2}$
sec	45	$\sqrt{2}$
cot	45	1

(3) For 0 and 90 degree

(a) Here put the perpendicular = 0 , hypotenuse = 1, and base = 1

(b) Same here we have to do as in 1(e)

(c) For 90 degree , turn fig(D) by 90 degree left then follows as in 1(e)

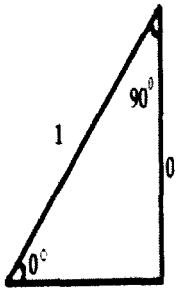

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fig (D)

Table for 0 and 90 degree

function	degree	value	degree	value
Sin	0	0	90	1
Cos	0	1	90	0
Tan	0	0	90	undefine
Cosec	0	undefine	90	1
Sec	0	1	90	undefine
cot	0	undefine	90	0

By S. kurkalang
3rd BSc Physics Honours

If Newton didn't, what about mass energy equivalence? Is Einstein's wrong?

Mr. Banshanborlang Kharumnuid
(BSc. II Phys. Hon.)

Just after the declaration of M.Sc result (2014), I visited my Class XII teacher, to wish him for his success. I want to ask him to give me a party, instead he showed me the news item which appeared on Monday, SEPTEMBER 22ND, 2014, captioned "Newton didn't give Second Law of Motion: Research Paper, and forced me to read. After seeing and reading this news, he explained to me his ideas and understanding.

Many young and enthusiastic students like me are confused, and we discussed many times, whether F=ma be credited to Euler or Newton? I have been waiting for some clarification especially from the College Physics professor, to throw light on this subject, so as not to mislead me and the future generation.

I am also interested to know more but my little knowledge on the subject, I decided one day again, I will approach my teacher who is planning to continue research for clarification. At that time, I learnt from him that he will be presenting his first research paper: *"Random waste disposal as the cause of anthropogenic climate change and its remedies", on the 24 -07-2015, at the National Seminar on "Climatic Aberrations" Organised by Department of Chemistry in collaboration with Department of Botany Sankardev College, Shillong.*

He ask me to be present on that day and promised me that he will discuss more on this subject, with his teachers. Few days after this seminar, I again visited and found him doing mathematics. After few minutes, he then discuss about Newton with some detailed calculation and show it to me. He suddenly said: **'if Newton didn't, what about mass energy equivalence?'**

You as a young BSc. Phys. students and myself a young MSc. Phys. degree holder, I feel that I am not in a position to comment on it, and I have not seen any clarification with justification on this write up. In this news item it mentioned: *"In Sir Isaac Newton's time (1642-1727), the terms 'acceleration' and 'second derivative' did not exist, so he could not have deduced F = ma, the Second Law of Motion. This has been unscientifically credited to Newton, says a research paper".* This clarification to you is not to confront the authority of the researcher, but my stand on the subject, at the little level which I have gathered knowledge and information from different books and papers and above all from my very own teacher. After listening to his lecture this is what my teacher share:

If Newton's Law is printed wrongly, {(say) $F = \frac{dp}{dt} = \frac{dF}{dt}$, for k=1}, we consider it a mistake in our state, why do you want to know whether Newton did or didn't give Second Law of Motion (F=ma)? It hardly matters.

For your personal understanding, there is no doubt that Leonhard Euler (pronounced "Oiler") 1707-1783, was the most prolific writer in the history of mathematics. He found result in virtually every branch of pure & applied mathematics. Although German was his native language, he wrote mostly in Latin and occasionally in French. His amazing productivity did not decline even when (1766), he became totally blind. When he died he left so many unpublished manuscript that the St. Petersburg Academy was still publishing his work in its proceedings almost half a century later. The French academician Francois Arago once commented that Euler could calculate without effort "just as men breathe, as eagles sustain themselves in the air."

Again, the variation of mass with velocity, to me clearly shows the existence of God theoretically, because if a body moves with the velocity of light, it shall posses infinite mass i.e infinite energy also infinite power, which only God posses (see Holy Book Gen. 1:1).

Know that, the first verification of the increase in mass with velocity came from the work of Kaufmann in 1906 and of Bucherer in 1909. While studying the ß rays emanating from radioactive materials, they found that the velocities were comparable to the velocity of light and also that their masses were found to be related to their velocities.

Accelators are used to accelerate the various charged particles of matter to very high velocities. It has been found that electron and protons accelerated in these machine to the velocities closed to the velocity of light aquire increased masses, exactly as predicted. The increase of mass with velocity has now been tested in particle accelators.

Do you think Einstein is insane? when he quip "God does not play dice with the universe".
In the derivation of mass energy equivalence (no second order derivative) Force is defined as the rate of change of momentum

i.e, $F = \frac{d(mv)}{dt}$ ——————— Newton's Second law of motion

According to the theory of relativity, both mass and velocity are variable.

Therefore $F = \frac{d(mv)}{dt} = m\frac{dv}{dt} + v\frac{dm}{dt}$ leads to famous $E=mc^2$ which is Einstein's mass energy relation.

I believe that this write up will enlighten the minds of all of us students and readers and enrich the knowledge of young scientific minds. The writer will appreciate further more clarification.

SPACE