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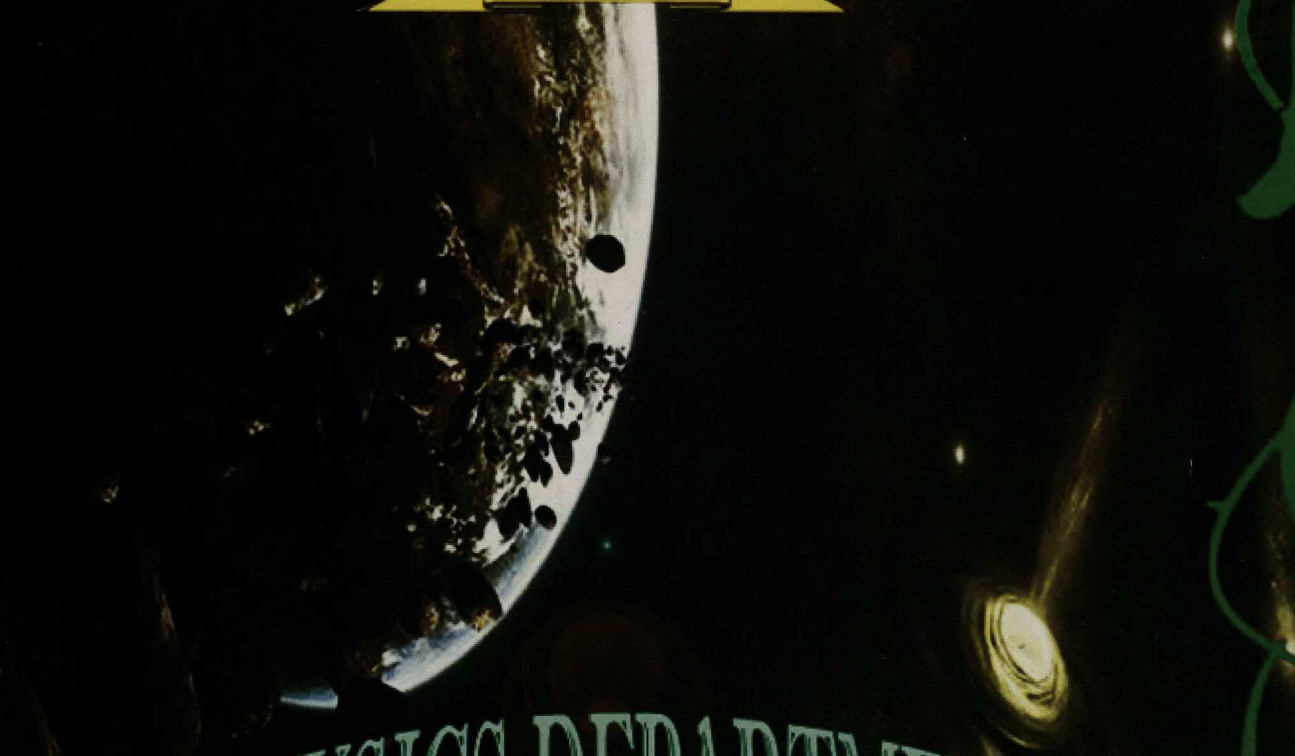

PHYSICS DEPARTMENT

SHILLONG COLLEGE

2009

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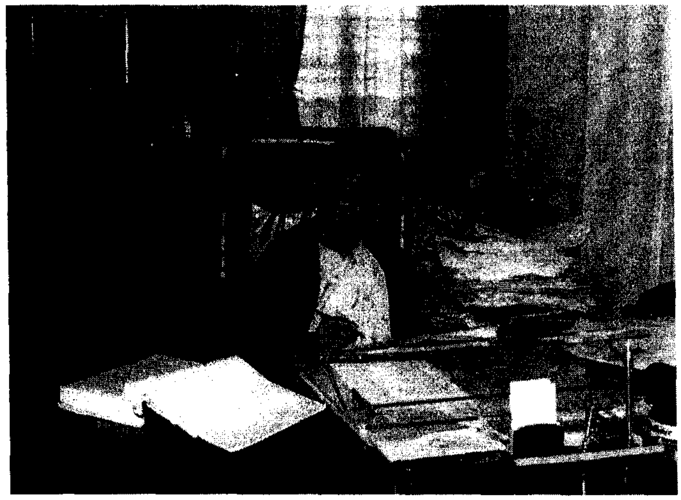
Message From The Principal



I am very pleased to learn that the Department of Physics, Shillong College is bringing out a departmental magazine, to mark the 21st century's largest solar eclipse that took place on July 22, 2009, which was a rare spectacular celestial phenomena. The Department had also organized a one day awareness programme for the students and staff of the college on solar eclipse on 14th July 2009. Shri R. Chatterjee gave a talk on "Sun-Earth: we are truly connected" and Shri S. Lato, Lecturer, of the Department, spoke on "Solar Eclipse". An open quiz was also held with Shri R. Chatterjee as Quiz master. The programme was well organized, and I hope that it has really benefited the students and staff of the College.

I, also watched this exciting event, and getting up early at 5:00 A.M. so as not to miss this spectacle of nature. I really enjoyed witnessing the solar eclipse. Our special thanks to Shri R.D.West, Council of Science, Technology and Environment, Meghalaya for sending us some solar filters to watch the eclipse with caution.

My appreciation to Smt E.N.Dkhar, Head of the Department of Physics and other teachers of the Department, for their well thought of programme.

I wish them all success in their future endeavor.

May God bless you all.

Dated, Shillong

The 20th November 2009

Dr (Mrs) M. P. R Lyngdoh
Principal

Message From The Vice Principal

It gives me immense pleasure to learn that Department of Physics, Shillong College is going to compile a collection of articles written by teachers and students. The articles, as I am told, are those of the interesting presentations made during the awareness programme organized by the department on 14th July 2009, on the occasion of the Total Solar Eclipse of 22nd July 2009. I am confident that this publication is going to make an impact in eliminating myths of superstitions and prejudice that prevails in our society regarding eclipse and similar such astronomical events. Documentation of such historic happenings with scientific explanations would certainly enrich us with broad knowledge and widen our thoughts. I convey my best wishes for the success of the publication.

Dr. Malay Dey
Vice Principal

" Total Solar Eclipse - 22nd July 2009 "

Organized by the Physics Department

Shillong College, Shillong on the 4th of july 2009

From The Desk of the Head of the Department of Physics

Smt Elarina. N. Dkhar

It is indeed a great privilege for the Physics Department, Shillong College, to be able to organize a one day programme on "Total Solar Eclipse" to create awareness amongst the staff and students of the college. On Wednesday, 2009 July 22, a total eclipse of the Sun is visible from within a narrow corridor that traverses half of the Earth. The path of the Moon's umbral shadow begins in India and crosses through Nepal, Bangladesh, Bhutan, Myanmar and China. After leaving mainland Asia, the path crosses Japan's Ryukyu Islands and curves southeast through the Pacific Ocean where the maximum duration of totality reaches 6minutes 39 seconds. A partial eclipse is seen within the much broader path of the Moon's penumbral shadow, which includes most of eastern Asia, Indonesia and the Pacific Ocean. Those who have not visualize it, have missed a great opportunity and will have to wait for 78 long years to catch a rare glimpse of it once again for the next will occur till 2087.So this might be the last opportunity for many of us (I think) in this present generation to be able to view a total solar eclipse and that is why many people have taken the advantage to exploit it especially since it happens in the "YEAR OF ASTRONOMY-2009" as declared by the UNESCO. Indian scientists observed the solar eclipse from an Indian Air Force Plane. The Chinese Government used the opportunity to provide scientific education and to dispel any superstition. Observers in Japan were excited by the prospect of experiencing the first eclipse in 46 years, but found the experience dampened by cloudy skies obscuring the view. In Bangladesh, the people witnessed the longest total solar eclipses of the 21st century defying rain and a heavily overcast sky.

The Physics Dept, Shillong College, is fortunate enough to have been able to organize such a programme within a very short span of time. The good fortune of the faculty with exemplary dedication and commitment made the programme very successful. The Dept is very grateful to the Principal Dr. (Mrs) M.P.R.Lyngdoh, for her consent to the department's proposal to organize the function and also for the financial assistance needed for the programme. The department highly appreciates her motivation and inspiration in making the programme a successful one. The department is also greatly indebted to the State Council of Science and Technology (SCSTE) Govt. of Meghalaya, for providing the solar filters to the department to distribute them to the staff and students of the college for safe viewing of the solar eclipse, and in particular to Mr.R.D.West, Member Secretary SCSTE, Govt. of Meghalaya, who in spite of his heavy scheduled spared his time to grace the function as the chief guest that day. The department also feels a great sense of gratitude to Mr. R. Chatterjee who on request willingly delivered an excellent lecture on the theme "Sun Earth- We are truly connected" and also for conducting an Open Quiz Competition that day. The department wishes to extend their gratitude to the Vice Principal regular courses Dr.M.Dey who had always been there as a constant guide in making the programme a success. The department wishes to thank Mr. S.Lato (a faculty member of the department) for his lecture on the theme "Solar Eclipse", the student volunteers in particular and all those who have helped and contributed during the programme. Most of all, the department express their gratefulness to the VP professional courses Mr.K.D.Roy, colleagues and fellow students who without them the program would have been incomplete. The program was a very informative, benefiting and a successful one in which each one present there that day were highly enlightened.

All such eclipse contributes to enriched mankind's knowledge of science and the universe. For instance, *it was during a total solar eclipse in 1868 in* India that a French Scientist discovered the presence of Helium in the atmosphere.

Aims And Objectives Of The Programme On Total Solar Eclipse-22nd July 2009

The Physics Department, Shillong College organized a one day programme on "Total Solar Eclipse" *on the 4th of july 2009*, to create awareness amongst the staff and students of the college. The main objective is to make them understand what and how a solar eclipse happens and the difference between the different types of eclipses that occur frequently and also to make them aware of the importance of visualizing these rare phenomena of nature and how to take great care of their eyes while visualizing them.

A Solar Eclipse is a fascinating phenomenon in which our Sun, which is normally so reliable, is suddenly stained black by the Moon. Any solar eclipse is an interesting event, but a total solar eclipse is the most spectacular astronomical phenomenon that you'll ever see. During a total solar eclipse, a shadow moves over the Sun for a brief minute or two, and the sky darkens to the same level as on a moonlit night; animals and birds are silent; everything seems to be in suspension. The Sun appears to vanished, but its outer atmosphere – the Corona is visible as a ghostly halo around the black disc of the Moon, with streamers and ribbons of faint light trailing off for millions of miles in the Sun's magnetic field. Looking at the Sun, at any time, is dangerous; and that applies during the partial phases of a solar eclipse, just as it does on any normal day. Hence we have to take precautionary methods to observe these spectacular phenomena at any time.

As we all know that solar eclipses always occur on a New Moon. Now, a new moon happens every month when the Moon is in between the Earth and Sun, so that the near side of the Moon (i.e. the side we can see) is in shadow. Usually the Earth and the Moon aren't lined up right to cause an eclipse; but once in a while, the Sun, Moon and Earth are lined up well enough so that the Moon's shadow falls on the Earth. This is what causes a solar eclipse.

From the Mechanics of Solar Eclipses, the Moon's shadow during a solar eclipse has two parts:

The outer and largest part of the Moon's shadow is known as the penumbra. Any observers in this area see only part of the Sun being covered by the Moon; hence, they see a partial eclipse of the Sun. The penumbra is quite wide, usually a couple of thousand miles or so across as it passes over the Earth.

The smaller inner part of the Moon's shadow is known as the umbra; any observer lucky enough to be in this area see the Sun being completely blocked by the Moon, which is a total eclipse of the Sun. The umbra is very small, perhaps as little as a few miles across; it can be as much as a hundred miles , or (rarely) a couple of hundred. This means that a partial eclipse is usually seen over quite a large area of the Earth; but when a total eclipse occur, it is only visible from a small part of the Earth (whereas its accompanying partial eclipse is seen over a much larger area). However, the shadow isn't simply a "spot" on the Earth; due to the movement or rotation of the Earth and the Moon, the shadow actually races across the Earth's surface at around two thousand miles per hour, causing the Moon's shadow to "write" a long track across the *Earth.*

Eye Safety

During an Eclipse, the first thing to remember about observing is safety. A lunar eclipse is an eclipse of the Moon, is perfectly safe to watch with the naked eye; you're only looking at the moon at night, which is quite safe. A solar eclipse is potentially dangerous, however, because viewing a solar eclipse involves looking at the sun, which can damage your eyesight.

A solar eclipse can be viewed safely with the naked eye only during the few brief seconds or minutes of a total solar eclipse, when the Sun itself is completely obscured by the Moon. Partial eclipses, Annular eclipses and the partial phases of total eclipses are never safe to watch without taking special precautions. Even when 99% of the Sun's surface is obscured during the partial phases of a total eclipse, the remaining crescent is intensely bright just as intense as at any other time and cannot be viewed safely without eye protection. We must not attempt to observe the partial or annular phases of any eclipse with the naked eye. Failure to use appropriate filtration may result in eye damage or blindness. There is no pain when the retina is being burned and the resulting visual symptoms don't occur until at least several hours after the injury has occurred by which time it is far too late.

Direct viewing

It is never safe to look directly at the Sun except during a total eclipse, a partial eclipse or annular eclipse, even when the Sun is mostly covered, can still cause permanent damage, even though you might not feel any discomfort. Looking at the Sun through any kind of optical aid (binoculars, a telescope, or even a camera's viewfinder) is extremely dangerous, and can cause permanent blindness. Sunglasses don't provide anything like adequate protection, as they don't block the wavelengths of light which are likely to damage your eyes, or reduce the intensity of the visible light sufficiently. Various ad-hoc solar filters such as welder's goggles or using fully exposed and developed black and white negatives are sometimes discussed but unless you know exactly what you are doing can be extremely dangerous and so can't be recommended. Properly designed solar filters made and certified to appropriate national safety standards should be safe. A commonly available type uses aluminized Mylar, in a dual sandwich with the aluminium on the inside. (This means that you are actually looking through a double layer of metal.) However, there exists a risk with using viewing glasses if they aren't in perfect condition. If in doubt, throw them away.

Indirect viewing

Viewing the Sun indirectly, by projecting its image onto a screen, is far safer. You can make a projector with a simple pinhole, or with binoculars or a telescope. However, never look through the projector directly but only look at the image on the screen. Note that a screen refers to a matter surface, such as a white sheet, or a piece of paper, so that the Sun's image can be seen by anyone looking at it from any angle. Looking at a reflection of the Sun in any shiny surface is basically the same as looking directly at the Sun.

Eclipse Lunacy

There has been such hysteria –albeit well-intentioned—stirred up about eye damage, that many people are convinced that it is specifically solar eclipses that cause eye damage; i.e. at any other time of year, looking at the Sun is OK. This is not true. Looking at the Sun at any time for more than a second or two can cause permanent eye damage. Finally, as we often hear some truly daft ideas for eclipse viewing, such as looking through a sheet of Perspex or in a reflection in a bucket full of water. We have no idea where these come from, but these are not safe! If you can see the Sun clearly and brightly in a reflection or via Perspex then it's dangerous.

NEVER ATTEMPT TO LOOK AT THE SUN THROUGH A TELESCOPE, CAMERA, BINOCULARS OR ANYTHING ELSE!

Report Of The Programme

" Total Solar Eclipse 22nd July 2009 ",

Organised By The Physics Department,

Shillong College, On The 14th July 2009

The Physics department Shillong College, Shillong, took the privilege of organizing a one day awareness programme on the 14th July 2009, for the students of the college in particular, and the staff in general, on the topic "Total Solar Eclipse" which is a rare and spectacular celestial phenomenon, and is due to occur on the 22nd July 2009. The department took the initiative of organizing this programme as the whole country looked forward towards observing this phenomenon which will be visible with its totality only over a narrow belt called the '***belt of totality***'. Shillong is not very fortunate to observe the 100% eclipse, but fortunate enough to observe about 98% of the totality, which will be visible from about 5 hr- 29mins – 36 seconds till about 7hr-20mins.

The preparation for the programme started off on a good note with the consent and good gesture of the Principal, and also, with her warm wishes, she graciously agreed to sponsor the said programme. The preparation also saw the active and enthusiastic participation of the staff of the physics department under the leadership of the H.O.D, Smt. E.N. Dkhar. The B.sc (H & P) students and also the class XII (sc) students also actively participated in the preparation for the day.

It was a great honour for the department, that Shri. R.D. West, Member secretary of the State Council of Science, Technology &Environment (SCSTE) gave his assent to grace the programme as the Chief Guest. Shri.R.D. West also agreed to provide about 200 solar filters so that the department can distribute to the staff and students to enable them to have a safe viewing of the eclipse on 22nd July 2009. The department was also very privileged that Shri. R. Chatterjee, Lecturer Jail Road Boys, Secretary Indian Physics Association, Shillong chapter and also an eminent news Anchor and resource person, had given his consent to present a popular talk on that day in which his topic of interest was "Sun-Earth¯ We are truly connected". The department is also greatly indebted to a very own colleague of the department Shri. S. Lato, who volunteered to present another popular talk on the general theme "Total Solar Eclipse".

The inaugural function started at 11:30 a.m with the arrival of the Chief Guest in which Mr. Kitdor Kharbuli, a student of class XII 'Sc' read off the gist of the entire theme of the programme. Then Ms. Steffanie Blah another student of class XII 'Sc', who also anchored the whole function of the day, started off on a welcome note, welcoming the Chief Guest, the Vice Principal Regular courses and the H.O.D physics, to the dais. Unfortunately, the Principal was unable to attend the programme due to her preoccupation. Smt. E.N. Dkhar, H.O.D, physics was then called upon to present the welcome address, after which the V.P Regular courses gave a short speech and then the Chief Guest delivered his address. The Chief Guest in his speech mentioned with great happiness and also congratulated the physics department, Shillong College, for being the first institute to have organized such an awareness programme on this spectacular event. The Chief Guest also took the privilege to motivate and encourage the students to take up the basic sciences¯ Physics, Chemistry etc., for further studies, research works and also as a career. He talked about the dwindling number of students taking up basic sciences for further studies due to emerging new courses which are more market based, have promising and better job prospects, and are more lucrative; he pointed out that the trend is very dangerous as the growth and success of any technology and the whole economy for that matter greatly depends on basic sciences. He therefore exhorted the students, and impressed upon them to take interest and take up the basic sciences for further studies, and also for research purposes.

Immediately after, the inaugural function, Shri. R. Chatterjee was called upon to present his talk. The talk given by the resource person was very resourceful, enlightening and thought provoking. Using power point presentation and streaming videos, he completely caught the attention of the audience and amazed every one present, because, everyone couldn't help but wonder how!!!? something that is happening on the sun, 150 million kilometers away from the earth could affect us one way or the other. It was totally awesome.

The second talk of the day was presented by Shri. S. Lato, a member of the physics department, Shillong College. Shri. S. Lato also used power point presentation and gave the audience a deeper insight into the phenomenon. He also completely mesmerized the audience with his beautiful interpretation of the phenomenon of total solar eclipse, how and when does it occur, and, why we do not see total solar eclipse on every full moon? It was very knowledgeable and everyone, especially the students enjoyed every bit of the presentation.

During these two presentations by the resource persons, the staff and the students present were also given light refreshment to enjoy side by side with the very beautiful presentations. The popular talk by Shri. S. Lato, was then immediately followed by an open quiz in which the department is once again greatly indebted to Shri. R. Chatterjee who readily agreed to help the Department by conducting the open quiz for both the students and the staff. Everyone in the audience participate with enthusiasm in the quiz, in which prizes were handed over on the spot to any participant who gave the correct response. A total of about 47 questions based on astronomy, were put forward to the audience during which they scratch their heads and put their thoughts together to recollect every bit of information that they have learnt and stored in their mental lexicon. It was indeed a very encouraging and wonderful experience to see how everyone actively participated and tried their bit to come up with a correct answer.

After the open quiz, the programme of the day was concluded with a vote of thanks from Shri. A. Dkhar, who is also a member of the physics department. It was all but wonderful to learn that the next total eclipse will be visible from India only until ……**2014.**

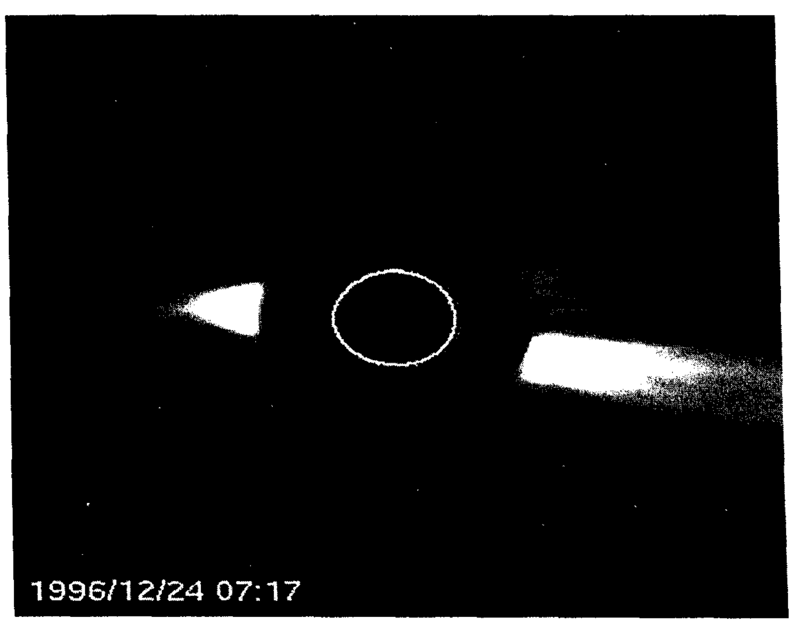
The physics department wishes to convey its heartfelt thanks and gratitude to each and everyone who have worked together and helped to make the function a success. The department would like to thank the student volunteers, who, with selfless dedications have contributed greatly towards the success of the day. The department also thanks the Principal of the college, the Vice Principals ̄ Regular and Professional courses, the staff and all those who have contributed towards the success of the programme.

The Dynamic Sun

Sri Rahul Chatterjee

The Sun is a huge thermonuclear reactor, fusing hydrogen atoms into helium and producing million degree temperatures and intense magnetic fields. Near its surface, the Sun is like a pot of boiling water, with bubbles of hot, electrified gas—actually electrons and protons in a fourth state of matter known as plasma— circulating up from the interior, rising to the surface, and bursting out into space. The steady stream of particles from the Sun is known as the solar wind.

Blowing at 800,000 (12,87,440 km per hr = 357.62 km/s) to 5 million miles per hour (80,46,500 km per hr = 2235.14 km/s), the solar wind carries a million tons of matter into space every second. It's not the mass or speed however, that makes the solar wind potent. In fact, the solar wind would not even ruffle the hair on your head because there are too few particles in the breeze (our air is millions of times denser than the solar wind). Instead, it is the energy stored in the plasma and the magnetic fields associated with that plasma that allow the wind to shape and impact the Earth's protective magnetic shield in space (the magnetosphere). Though less than 1% of the solar wind penetrates the magnetosphere, it's enough to generate millions of amps of electric current in our atmosphere and to cause occasional magnetic storms in the space around Earth.



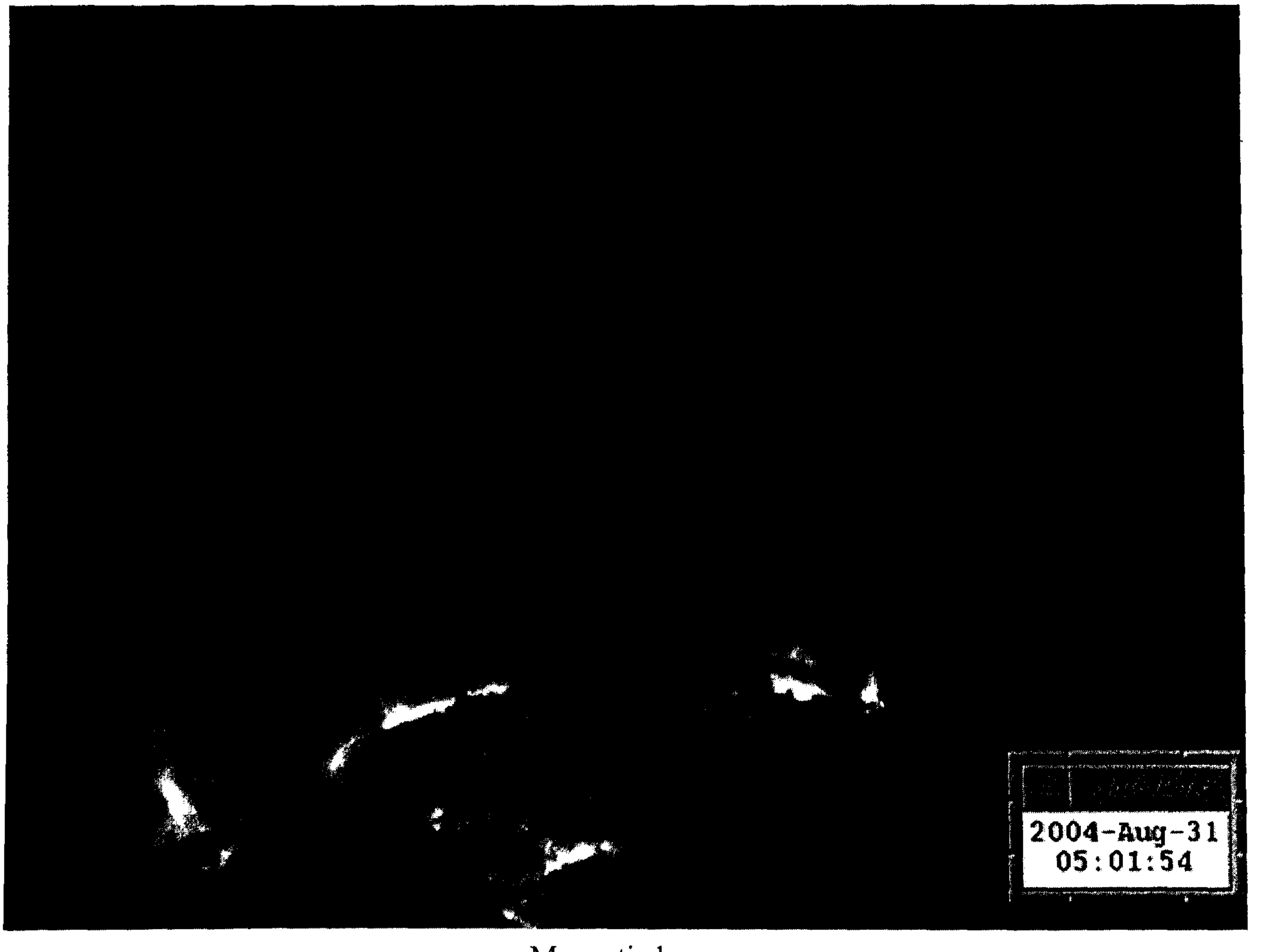
CME

If the character of the solar wind is like that of the winds on Earth—mild, steady, and global—then sunspots and solar flares are like lightning and tornadoes—potent, but only over a small area. Sunspots are dark splotches on the Sun caused by the appearance of cooler (3000 degrees Celsius) areas amidst the roiling gases on the surface (6000 degrees C). These areas are cooler because much of their energy is tied up in intense magnetic fields that are 1000 times stronger than the magnetic field of Earth.

On the other hand, solar flares appear as explosive bright spots on the surface of the Sun. Flares occur when magnetic energy built up in the solar atmosphere near a sunspot is suddenly released in a burst equivalent to ten million volcanic eruptions. Radiation—including radio waves, X rays, and gamma rays—and charged particles may strike the Earth following a solar flare (though most of the particles are deflected by Earth's magnetic field). The strongest flares occur just several times per year, while weaker flares are relatively common, with as many as a dozen a day during the Sun's most active periods.

One of the most important solar events from Earth's perspective is the coronal mass ejection (CME), the solar equivalent of a hurricane. A CME is the eruption of a huge bubble of plasma from the Sun's outer atmosphere, or corona. The corona is the gaseous region above the surface that extends millions of miles into space. Thin and faint compared to the Sun' surface, the corona is only visible to the naked eye during a total solar eclipse. Temperatures in this region exceed one million degrees Celsius, 200 times hotter than the surface of the Sun.

How the corona can be so much hotter than the surface remains a mystery to scientists, but most suspect that it has to do with the complicated magnetic fields that burst from the interior and extend above the surface in great arches and loops. The buildup and interaction of these magnetic loops—which can stretch over, under, and around each other—seems to supply the energy to heat the corona and produce the violent explosion of a CME.



Magnetic loops

A typical CME can carry more than 10 billion tons of plasma into the solar system, a mass equal to that of 100,000 battleships. The energy in the bubble of solar plasma packs a punch comparable to that of a hundred hurricanes combined. Just hours after blowing into space, a CME cloud can grow to dimensions exceeding those of the Sun itself, often as wide as 30 million miles across. As it ploughs into the solar wind, a CME can create a shock wave that accelerates particles to dangerously high energies and speeds. Behind that shock wave, the CME cloud flies through the solar system bombarding planets, asteroids, and other objects with radiation and plasma. If a CME erupts on the side of the Sun facing Earth, and if our orbit intersects the path of that cloud, the results can be spectacular and sometimes hazardous.

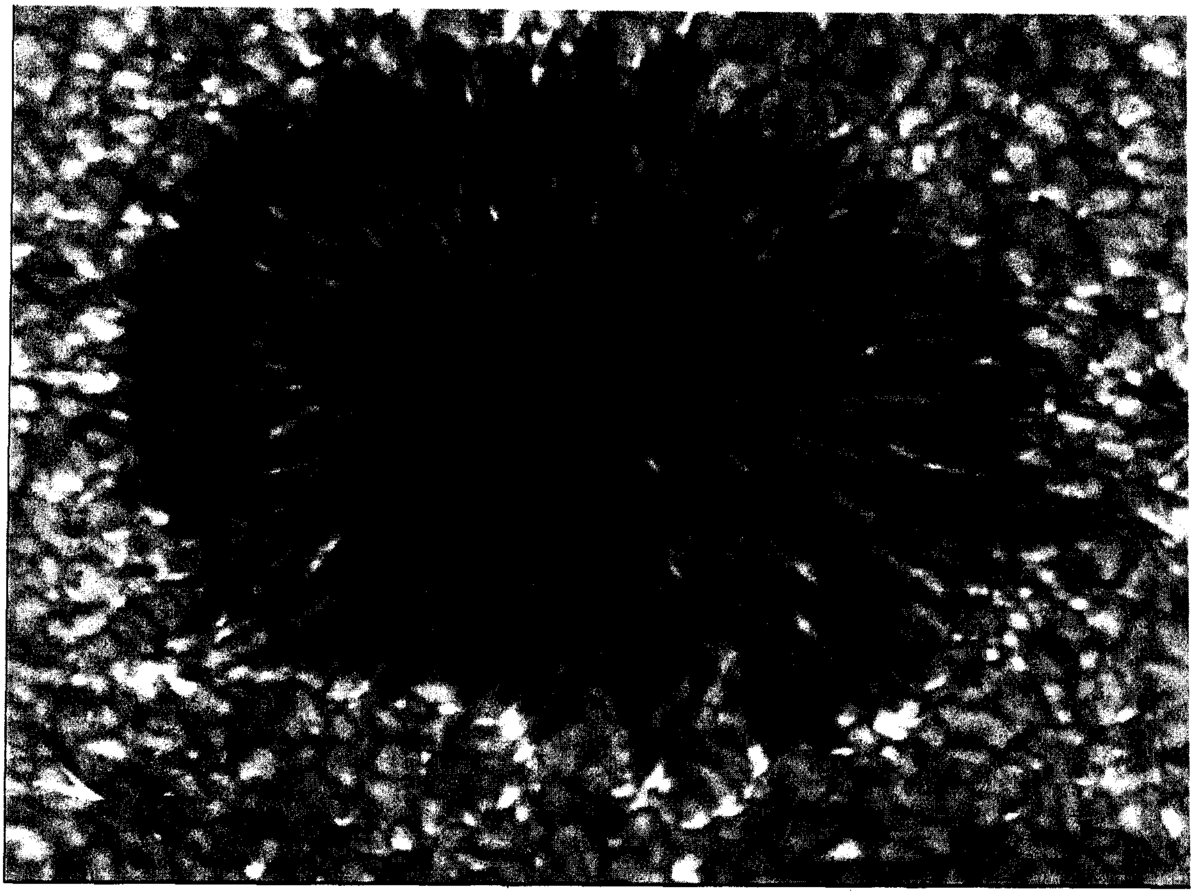
Coronal mass ejections occur at a rate of a few times a week to several times per day, depending on how active the Sun may be. And because of the size of the plasma clouds they produce, the odds say Earth is going to get hit by a CME from time to time. Fortunately, our planet is protected from the harmful effects of the radiation and hot plasma by our atmosphere and by an invisible magnetic shell known as the magnetosphere. Produced as a result of Earth's own magnetic field, the magnetosphere shields us from most of the Sun's plasma by deflecting it into space. But some energetic particles do enter the magnetosphere from time to time, funneling in near the North and South Poles, where the magnetic field is weakest and the magnetosphere is partially open to space. The rain of plasma into our magnetosphere can induce magnetic storms, alter Earth's magnetic field as measured on the ground, and produce the phenomena known as auroras.

Auroras are a visible sign of the magnetic mayhem in our atmosphere, but beyond that, the human eye can't detect much of what we call space weather. That's because most of the material flowing from Sun to Earth is too small, too diffuse, or too dim—when measured against the background of space or the brightness of the Sun—to register in the visible portion of the spectrum. For instance, since the corona is only visible to the naked eye during an eclipse, scientists must use an occulting disk—which blocks out the light from the solar surface to create an artificial eclipse—to detect what the Sun is spitting into space. In order to see the invisible, space physicists rely on telescopes that detect visible light, ultraviolet light, gamma rays, and X rays. They use receivers and transmitters that detect the radio shock waves created when a CME crashes into the solar wind (the equivalent of a sonic boom in space). They employ particle detectors to count ions and electrons, magnetometers to record changes in magnetic fields, and cameras to observe the auroral patterns over the whole Earth.

Aside from bright auroras, there are other less benevolent effects of the connection between Sun and Earth. In fact, bright auroras are merely a visible sign that the balance of electrical and magnetic energy in Earth's magnetosphere has been upset. With the average CME dumping about 1500 Gigawatts of electricity into the atmosphere (double the power generating capacity of the entire United States), big changes can occur in our space. Those changes can wreak havoc on a world that has come to depend on satellites, electrical power, and radio communication—all of which are affected by electric and magnetic forces.

For the satellites dancing in and out of the radiation belts and the solar wind, CMEs and magnetic storms can be perilous. For instance, a series of flares and coronal mass ejections in March 1989 produced a potent magnetic storm. After the particles and energy from the Sun bombarded the Earth, more than 1500 satellites slowed down or dropped several miles of altitude in their orbits due to increased drag.

But atmospheric drag isn't the only effect CMEs can have on satellites. When excited and accelerated by a storm, high energy electrons can degrade the solar panels used to power satellites and can upset and even shut off computers on a spacecraft. The increased flow of electricity in Earth's space also can cause electrical charge build up on the surface of a spacecraft. That charge can eventually be released as a damaging spark (a spark not unlike the one you get when you touch metal or a friend after you drag your feet on a carpet). In 1994, two Canadian satellites were shut down when each was electrically shocked during magnetic storms; as a result, telephone service across Canada was disrupted for months. Similarly, in January 1997, an American satellite went dead just hours after a CME struck the magnetosphere. The loss of that satellite disrupted television signals, telephone calls, and part of a U.S. earthquake monitoring network.



Sun spot

Magnetic storms also play havoc with radio signals, which are bounced off Earth's ionosphere (the outermost layer of our atmosphere, made up mostly of plasma) as a sort of natural relay station. In the extreme, magnetic storms can completely wipe out radio communication around Earth's North and South Poles for hours to days.

On the ground, magnetic storms can affect the strength of Earth's magnetic fields. Changes in magnetic fields can produce surges in power lines and strong electrical currents in gas and oil pipelines. The extra current can cause pipelines to corrode and deteriorate faster than they would naturally; in power lines, the extra electricity can burn out transformers and cause brownouts and blackouts. During the March 1989 storm, a transformer burned up at a power plant in New Jersey, and a whole system was blown out at a power station in Quebec, leaving 6 million people without electricity for hours, some for months.

Since so much modern information is relayed by satellites and other advanced technology—from automated teller machines and broadcast signals to the Global Positioning System and disaster warning systems—CMEs pose a natural and technological hazard to life on Earth.

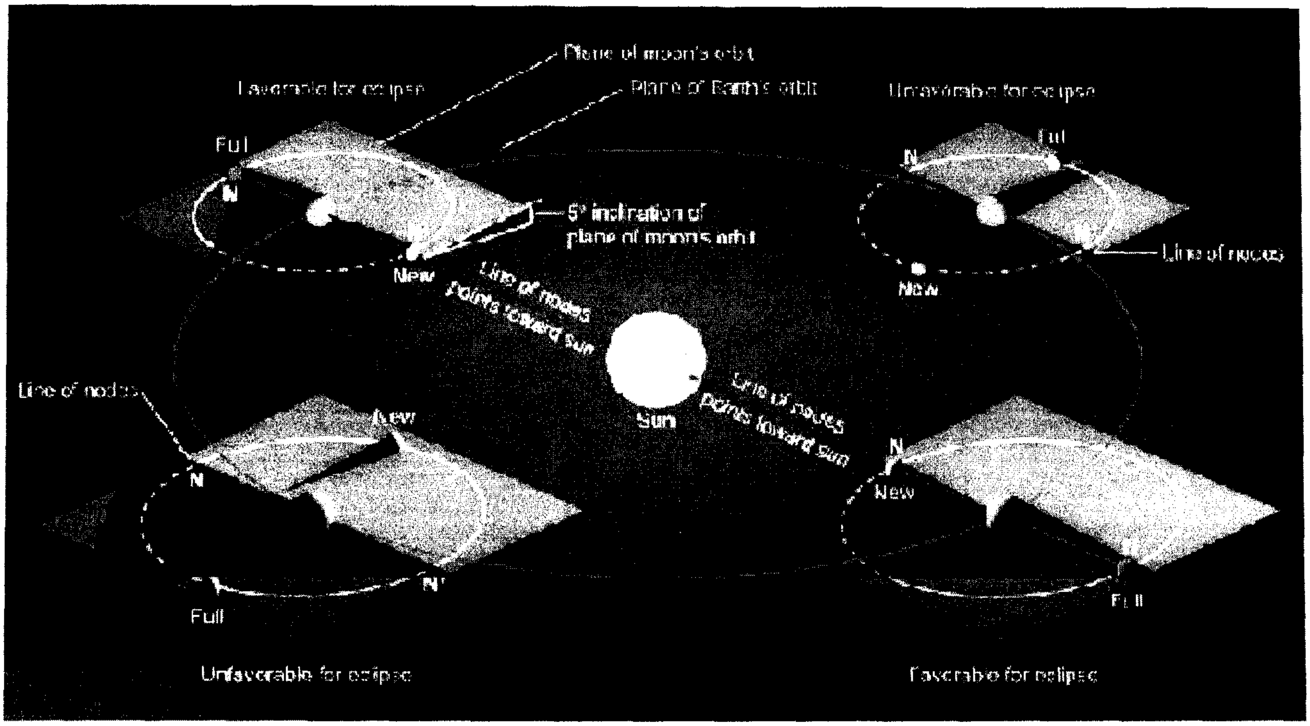
Longest Celestial Hide And Seek Of The Century

Sri Snarmon Lato

On 22 July 2009, we shall have an opportunity to witness one of the grandest spectacles the nature can offer the total eclipse of the Sun when the Moon would completely cover the disc of the Sun. It is an event so rare that most people do not get an opportunity to witness it even once in their lifetime. On an average, a total solar eclipse may occur at a particular place on the Earth only once in about 360years. In addition, such eclipses are notorious in having their tracks of totality very narrow and passing over relatively inaccessible regions of the globe. But, the path of totality of the on 22 July 2009 would pass through a large numbers of cities and densely populated regions. It will also be the *longest* solar eclipse of the century, with totality lasting for 6 minutes and 39 seconds at maximum along its path making it the longest until 2132. Under the most favourable conditions, however, the totality can last for a maximum of 7½ minutes.

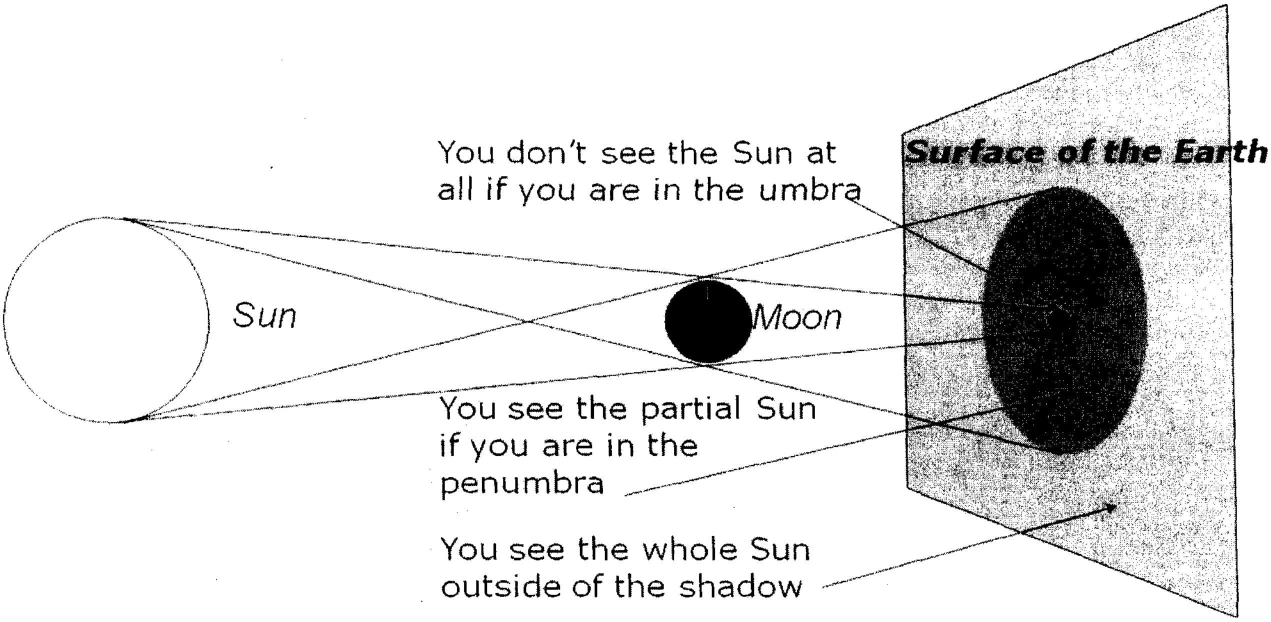
How do the eclipses of the Sun take place, anyway? An eclipse of the Sun takes place when the Moon comes between the Earth and the Sun so that the Moon's shadow sweeps over the face of the Earth. This can occur on the new Moon day (though not on *every* new Moon day due to the inclination of the Moons orbit). This shadow consists of two parts: the umbra, or the total shadow, a cone into which no direct sunlight penetrates; and the penumbra, or partial shadow, which is caused by light reaching from only a part of the Sun's disc. To an observer within the umbra, the Sun's disc appears completely covered by the disc of the Moon. Such an eclipse is called the *total* solar eclipse. To an observer within the penumbra, however, the Moon's disc appears projected against t the Sun's discs so as to overlap it partly. The eclipse is then *partial* to the observer. The umbral cone being narrow at the distance of the Earth, the total solar eclipse is observed only over a narrow strip of land or sea over which it passes. The partial solar eclipse, however, can be seen from a large number of places covered by the penumbra.

By a remarkable coincidence, the sizes and the distances of the Sun and the Moon are such that they appear very nearly the same angular size from the Earth. However, their apparent sizes depend on their distances from the Earth. This happens because the Earth revolves in an elliptical orbit around the Sun and the Moon too revolves in an elliptical orbit around the Earth. When the Sun is closest to the Earth, and Moon the farthest, the apparent disc of the Moon is smaller than that of the Sun. The Moon passing over the Sun's disc cannot cover it completely, but leave the rim of the Sun visible. Such an eclipse is called *annular*. In India, we shall have an opportunity witness annular eclipse of the Sun on 15 January 2010 that would be visible in southern parts of the country. Sometimes the Earth misses the umbra but only intercepts the penumbra. Under such circumstances, only *partial* solar eclipse is observed anywhere on the Earth. Moon's disc then does not pass across the centre of the Sun. Incidentally; partial eclipses of the Sun are more frequent than total or the annular eclipses.

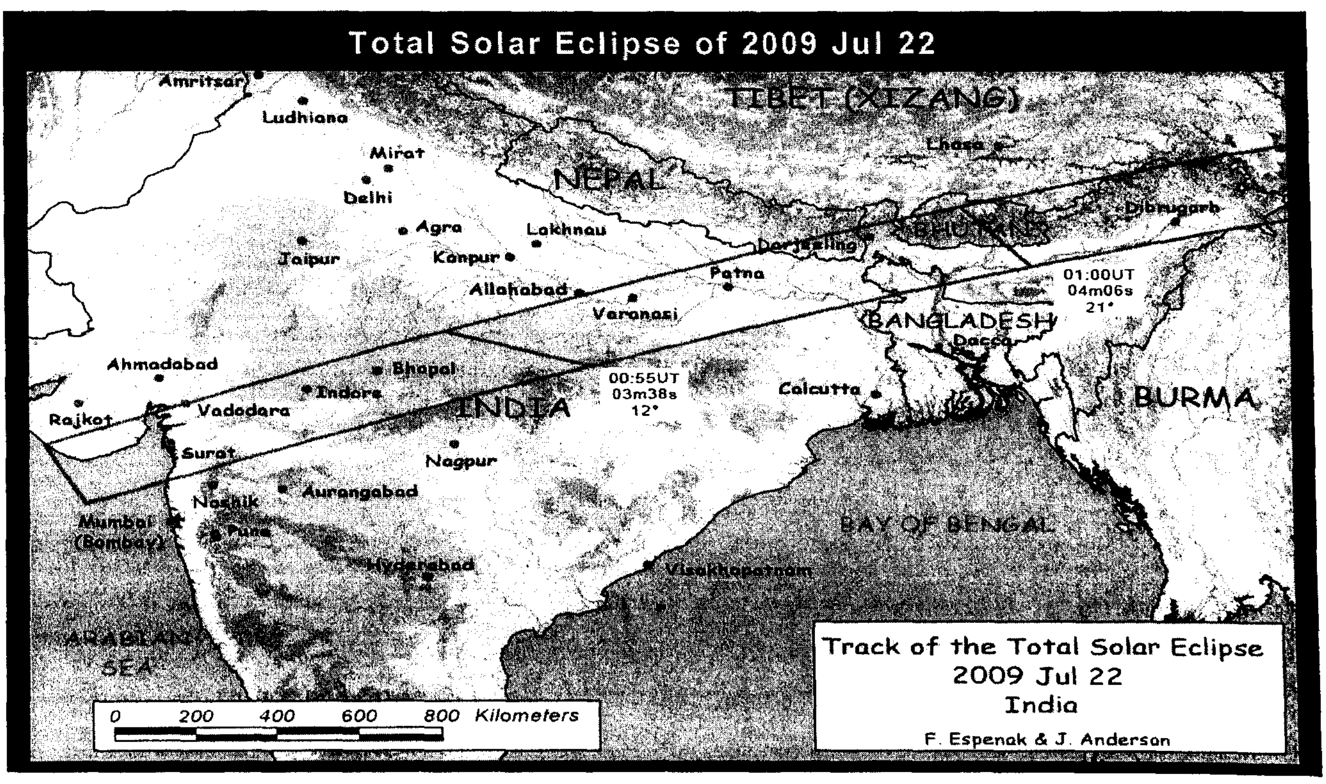


Why is a total solar eclipse so grand a spectacle? An hour before the totality, there is almost no change in the conditions where a person may be stationed. About twenty minutes before totality, there is a sizeable decrease in the intensity of light. Some three minutes before, the sky darkens considerably. Only a narrow crescent of the Sun can be seen. If you are on a hilltop, and if the eclipse takes place in the afternoon, you may see the umbral shadow of the Moon approaching from the western horizon at a speed of about 800 metres per second (or about 2.5 times the speed of sound). About one minute before the totality, ripples of dark and bright bands, called 'shadow bands', appear to move over a white plain surface. The intensity of light quickly drops in the next few seconds, and this is when the real drama begins. The sunlight shining through the valleys of the Moon, called the Baily's beads, give the appearance of a beaded necklace. And the final flash of light from the Moon's valleys produces a brilliant flare known as the 'diamond ring. Soon after the diamond ring vanishes, the chromosphere or lower atmosphere of the Sun that lies just above the visible photosphere blazes into view, indicating that the totality has just begun. One could then see red or orange jets of fire shooting to millions of kilometres above the surface of the Sun, called prominences. The Sun is now completely hidden behind the Moon and the magnificent pearly white corona flashes into view. Corona is the Sun's outer atmosphere consisting of hot sparse gases that extends to millions of kilometres. It is generally quite feeble, its brightness being comparable to that of the Moon and hence not visible ordinarily due to the glare of the photosphere. The shape of the corona varies with the 11 -year solar cycle giving it a different look during every total solar eclipse (depending on whether the number of sunspots is maximum or minimum). And, before you realise what has happened the entire sequence repeats in the reverse order! Strange things happen in nature in these few moments of totality and few minutes before and after totality! The sunlight is greatly reduced and planets and bright stars become visible to the naked eye. Many plants that close up during night close up during the phase of totality. Plants that give agreeable fragrance during night do so during the totality. Birds get confused. The owls and the bats come out. Fowls sit down where they are, and the cock may crow after totality! Pigeons may go to roost before totality and may come out again after totality is over! Surely, one needs to live through the experience of the total eclipse of the Sun. There is no way it could be explained. It is worth travelling any distance to observe a total solar eclipse.

Total Solar Eclipse



Why do the scientists eagerly wait for this event? The Sun is the nearest star we can study in minute details, and a total solar eclipse gives us the opportunity to study the atmosphere of the Sun - like stars. Further, the corona can be studied in minute details only during such rare events. Indeed, the element helium was discovered on the surface of t he Sun during an expedition on 17 August 1868 in the tobacco fields of Guntur, Andhra Pradesh, by the French astronomer Janssen. This is where the solar physics was born ? in the tobacco fields of Guntur! Helium was discovered on Earth only in 1895! It was during the total solar eclipse of 29 May



1919 that the General Theory of Relativity of Einstein was first tested by observing the deflection of light coming from a distant star by the gravitational field of the Sun. On 22 July 2009, when an exceptionally long total eclipse of the Sun would take place, the path of the Moon's umbral shadow would begin in the Gulf of Khambhat (Cambay), India, and cross through Nepal, Bangladesh, Bhutan, Burma, and China. The umbra of the moon's shadow will first touch the Earth off the western coast of India at sunrise at 6.23 a.m. at a speed of about 18 kilometres per second. Within seconds, the coastal city of Surat (Gujarat) will experience darkness for 3minutes and 17 seconds. The Sun would be only 3° above the eastern horizon. The altitude of the Sun, however, would rapidly increase as the umbra rushes eastward. Vadodara in Gujarat will be on the northern limit of totality and will experience darkness for one minute and 19 seconds. The shadow will then reach Indore, which will experience totality for 3 minutes and 13 seconds. The altitude of the Sun here is merely 6° above the horizon. Although Bhopal lies 40 km north of the central line, it would experience totality for 3 minutes and 12 seconds. Varanasi and Patna both lie within the shadow's path. The track of the umbral shadow will then sweep over Darjeeling, Shiliguri, Gangtok, Thimphu (Bhutan), Dibrugarh and Itanagar. It would take only about13 minutes for the umbral shadow to cross India. The shadow then enters northern Myanmar and then China and Japan. After leaving mainland Asia, the path crosses Japan's Ryukyu Islands and curves southeast through the Pacific Ocean where the maximum duration of totality reaches 6 minutes 39 seconds. Here the speed of the umbral shadow would be only about 800 metres per second.

How could one safely watch a solar eclipse? First thing to remember is to never watch the Sun eclipsed or uneclipsed with naked eye. It could permanently damage the retina and the vision. For direct viewing of the partial phase of the eclipse, use only tested safe solar filters, or the dark arc welder's glass No. 14.Vigyan Prasar provides safe solar filters in its astronomy activity kits, or even separately for this purpose. Sun's image could be projected onto a wall or a whitepaper using a small telescope to observe the progress of the eclipse. Safest way of course would be to project the image of the Sun on a shaded wall through a pinhole. The intensity of the uneclipsed portion of the Sun, even when it becomes a thin crescent, remains high enough to cause permanent or partial blindness. Surely, during the phase of totality, one does not require any filters. Preferably, an experienced person should accompany eclipse watchers to announce the beginning and the end of the totality.

What are the prospects of watching the oncoming eclipse from India? It would commence early morning with sunrise when the Sun's altitude would be very low. Next, the event takes place at the height of the south -west monsoon! But, for many of us, this would be the only opportunity in our lifetime to watch this awesome celestial drama. After 1898, India witnessed total solar eclipses on 20 February 1980, 24 October 1995, and 11 August 1999.

The World of Nanotechnology

Smt Elarina. N. Dkhar

Nanotechnology refers to technologies in which matter is manipulated on the atomic and molecular scale to create novel materials and processes. Nano means small (10^{-9} nm) but of high potency, and emerging with large applications piercing through all the discipline of knowledge, leading to industrial and technological growth. So small, in fact, that a nano-sized structure needs to be magnified over 10 million times before we can easily appreciate its fine detail with the naked eye. At the nano scale, matter functions differently from both the individual atomic and macroscopic scales. For many scientists, it is nothing startlingly new; after all they have been working at the nanoscale for decades, through electron microscopy, scanning probe microscopies or simply growing and analysing thin films. For most other groups, however, nanotechnology means something far more ambitious, miniature submarines in the bloodstream, little cogs and gears made out of atoms, space elevators made of nanotubes, and the colonization of space. It is no wonder people often muddle up nanotechnology with science fiction. Nanotechnology is a multidisciplinary science that has its roots in fields such as colloidal science, device physics and supramolecular chemistry. It pulls theories and conceptions from disciplines not only comprising engineering and physics but also chemistry, biology, mathematics and computer science to completely new approaches based upon **molecular self-assembly,** from developing **new materials** with dimensions on the nanoscale to investigating whether we can **directly control matter on the atomic scale**. Moreover, it is being proclaimed as the next big technological revolution.

On December 29, 1959, the influential American Physicist Richard Feynman presented a classic talk to the American Physical Society entitled "There's plenty of room at the bottom: An invition to enter a new field of Physics". He asked "why cannot we write the entire 24 volumes of the Encyclopedia Brittanica on the head of a pin?" and introduced the concept of Nanotechnology. In its traditional sense, means building things from the bottom up, with atomic precision. His speech had inspired many researchers. Eric Drexler later on popularized the word Nanotechnology in the 80's when he start talking about building machines on the scale of molecules, a few nanometers wide- motors, robot arms, and even whole computer, far smaller than a cell. Due to the popularity and media exposure of the term nanotechnology, the words picotechnology and femtotechnology have been coined in analogy to it, although these are only used rarely and informally.

Molecular manufacturing involves the manipulation of individual atoms (working from the bottom up); and ultra-miniaturization results in smaller and smaller devices (building from the top down). The "bottom-up" i s **an** approach in which arrangement of smaller components are made into more complex assemblies. Materials and devices are built from molecular components which assemble themselves chemically by principles of molecular recognition. These techniques include chemical synthesis, self-assembly and positional assembly. Another variation of the bottom up approach is Molecular Beam Epitaxy or MBE which is also widely used to make samples and devices for the newly emerging field of spintronics.The other is the "top down" approach which seeks to create smaller devices by using larger ones to direct their assembly. The nano-objects are constructed from larger entities without atomic-level control. Areas of physics such as **nanoelectronics, nanomechanics and nanophotonics** have evolved during the last few decades to provide a basic scientific foundation of nanotechnology.

There are several tools and techniques to study nanotechnology. The Atomic Force Microscope (AFM) and the Scanning Tunneling Microscope (STM) are two early versions of scanning probes that launched nanotechnology. They can be used to look at surfaces and to move atoms around. Using different tips for these microscopes, they can be used for carving out structures on surfaces and to help guide self-assembling structures. They are also used for characterization and synthesis of nanomaterials. Other types of scanning probe microscopy, are SAM that made it possible to see structures at the nanoscale. The tip of a scanning probe can also be used to manipulate nanostructures (a process called positional assembly). Various techniques like optical lithography, X-ray lithography dip pen nanolithography, electron beam lithography or nanoimprint lithography were also developed. Lithography is a top-down fabrication technique where a bulk material is reduced in size to nanoscale pattern. Another group of nanotechnological techniques include those used for fabrication of carbon nanotubes, nanowires, semiconductor such as deep ultraviolet lithography, electron beam lithography, focused ion beam machining, nanoimprint lithography, atomic layer deposition, molecular vapor deposition, and further including molecular self-assembly techniques such as those employing di-block copolymers. However, all of these techniques preceded the nanotech era, and are extensions in the development of scientific advancements rather than techniques which were devised with the sole purpose of creating nanotechnology and which were results of nanotechnology research.

Some of the products in the market already benefiting from nanotechnology are: **Sunscreens** which use nanosized zinc oxide or titanium oxide particles to absorb and reflect UV rays. This makes lotions transparent and smooth as opposed to sticky and white which will therefore make it more appealing to the consumer. **Self cleaning windows** are coated with a material which has unique chemical properties. When the sun shines on these windows, a chemical reaction is triggered which breaks down dirt. Rain, instead of forming droplets, will spread evenly over the panel and wash away the broken down dirt. The thickness of this layer is controlled at the nanoscale. **Stain repellent fabrics** are made by immersing rolls of woven cotton fabric in liquids zinc oxide nanoparticles containing trillions of nanotech fibres. The cotton is then dried in an oven, binding the tiny fibres to the cotton threads. The cotton appears to be unchanged but is, in fact, impermeable to liquid. It gives better protection from UV radiation. Engineers discovered that adding Aluminium silicate nanoparticle to scratch resistant polymer coating made the coating more effective. Scratch-resistant coating is common from cars to eyeglass lenses. **Bouncy tennis balls** are coated in nanosized material. A molecular barrier is formed by the tiny particles that trap air molecules making the balls extra bouncy. In 2002, the tennis racket company Babolat introduced the VS Nanotube Power racket. They made the racket out of carbon nanotube-infused graphite, meaning the racket was very light, yet many times stronger than steel. **Antimicrobial bandages** was developed using nanoparticles of silver. Silver ions block microbe's cellular respiration and kill them. **Interface and colloid science** has given rise to many materials which may be useful in nanotechnology, such as **carbon nanotubes** and other **fullerenes,** and various **nanoparticles** and **nanorods.** Progress has been made in using these materials for medical applications **Nanoscale materials** are sometimes used in **solar cells** which combats the cost of traditional **Silicon** solar cells Development of applications incorporating semiconductor nanoparticles to be used in the next generation of products, such as display technology, lighting, solar cells and biological imaging.

New products incorporating nanotechnology are coming out every day. Wrinkle-resistant fabrics, deep-penetrating cosmetics, liquid crystal displays (LCD) and other conveniences using nanotechnology are on the market. Before long, we'll see dozens of other products that take advantage of nanotechnology ranging from **Intel microprocessors** to **bio-nanobatteries, capacitors** only a few nanometers thick. Over 600 companies are currently active in nanotechnology, from small venture capital backed start-ups to some of the world's largest corporations such as IBM and Samsung. The U.S. national foundation has predicted that the global market for nanotechnologies will reach $ 1 trillion or more within 20 years. While this is exciting, it's only the tip of the iceberg as far as how nanotechnology may impact us in the future. Even more significantly, there are companies applying nanotechnology to a variety of products we can already buy, such as automobile parts, clothing and ski wax. Nanotechnology is already all around us if you know where to look.

THE FUTURE OF NANOTECHNOLOGY: Machines called **replicators** can produce practically any physical object, from weapons to a steaming cup of tea. Long considered to be exclusively the product of science fiction, today some people believe replicators are a very real possibility. They call it **molecular manufacturing**, and if it ever does become a reality, it could drastically change the world.

Atoms and molecules stick together because they have complementary shapes that lock together, or charges that attract. As millions of these atoms are pieced together by nanomachines, a specific product will begin to take shape. The goal of molecular manufacturing is to manipulate atoms individually and place them in a pattern to produce a desired structure. The first step would be to develop nanoscopic machines, called **assemblers**, that scientists can program to manipulate **atoms** and molecules at will. Assemblers and replicators could work together to automatically construct products, and could eventually replace all traditional labor methods. This could vastly decrease manufacturing costs, thereby making consumer goods plentiful, cheaper and stronger. Eventually, we could be able to replicate anything, including **diamonds,** water and food. Famine could be eradicated by machines that fabricate foods to feed the hungry.

Nanotechnology may have its biggest impact on the medical industry. Patients will drink fluids containing **nanorobots** programmed to attack and reconstruct the molecular structure of **cancer** cells and **viruses**. It is theorized that man-made nanomachines could repair damage to the human body that is currently untreatable.There's even speculation that nanorobots could slow or reverse the aging process, and life expectancy could increase significantly. Nanorobots could also be programmed to perform delicate surgeries — such **nanosurgeons** could work at a level a thousand times more precise than the sharpest scalpel By working on such a small scale, a nanorobot could operate without leaving the scars that conventional surgery does. Additionally, nanorobots could change your physical appearance. They could be programmed to perform cosmetic surgery, rearranging your atoms to change your ears, nose, eye color or any other physical feature you wish to alter.

Nanotechnology has the potential to have a positive effect on the environment. For instance, scientists could program airborne nanorobots to rebuild the thinning ozone layer. Nanorobots could remove contaminants from water sources and clean up oil spills. Manufacturing materials using the **bottom-up method** of nanotechnology also creates less pollution than conventional manufacturing processes. Our dependence on non-renewable resources would diminish with nanotechnology. Cutting down trees, mining coal or **drilling for oil** may no longer be necessary — nanomachines could produce those resources. Many nanotechnology experts feel that these applications are well outside the realm of possibility, at least for the foreseeable future. They caution that the more exotic applications are only theoretical. Some worry that nanotechnology will end up like **virtual reality** — in other words, the hype surrounding nanotechnology will continue to build until the limitations of the field become public knowledge, and then interest (and funding) will quickly dissipate.

NANOTECHNOLOGY CHALLENGES, RISKS AND ETHICS: The most immediate challenge in nanotechnology is that we need to learn more about materials and their properties at the nanoscale. There's a concern that some nanoparticles could be toxic. Some doctors worry that the nanoparticles are so small, that they could easily cross the **blood-brain barrier**, a membrane that protects the brain from harmful chemicals in the bloodstream. If we plan on using nanoparticles to coat everything from our clothing to our highways, we need to be sure that they won't poison us. Nanotechnology may also allow us to create more powerful weapons, both lethal and non-lethal.

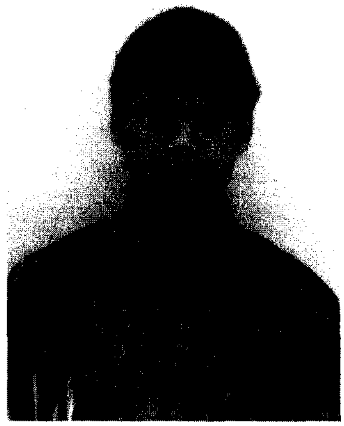
In theory, medical nanotechnology could make us smarter, stronger and give us other abilities ranging from rapid healing to night vision. Shrinking machines down to the size where they can be inserted into the human body in order to detect and repair diseased cells is a popular idea of the benefits of nanotechnology, and one that even comes close to reality. Many companies are already in clinical trials for drug delivery mechanisms based on nanotechnology, but unfortunately none of them involve miniature submarines. It turns out that there is a whole range of more efficient ways that nanotechnology can enable better drug delivery without resorting to the use of nanomachines. Should we pursue such goals? Could we continue to call ourselves human, or would we become transhuman — the next step on man's evolutionary path? Since almost every technology starts off as very expensive, would this mean we'd create two races of people — a wealthy race of modified humans and a poorer population of unaltered people? We don't have answers to these questions, but several organizations are urging nanoscientists to consider these implications now, before it becomes too late. If molecular manufacturing becomes a reality, how will that impact the world's economy and manufacturing jobs? If you can create anything using a replicator, what happens to currency? Would we move to a completely electronic economy? Would we even need money?

CONCLUSION: The wide application of nanotechnology also proves how much important nanotechnology is for us and our world. Today may it be engineering researches, or huge construction or medical science, nanotechnology and its application plays an important role in all these fields. Though being new, it has captured for itself a huge attention, and is gradually becoming more and more popular. Today, it is one of the high priority subjects in India. It shares this space and position with Biotechnology. This is the reason that worldwide more and more people are attracted towards this course. Nanotechnology is at a very early stage in our attempts to understand the world around us, and will provide inspiration and drive for many generations of scientists.

There has been much debate on the future implications of nanotechnology as it has the potential to create many new materials and devices with a wide range of applications like in medicine, electronics and energy production. Because of the far-ranging claims that have been made about potential applications of nanotechnology, a number of serious concerns have been raised about what effects these will have on our society if realized, and what action if any is appropriate to mitigate these risks. The Center for Responsible Nanotechnology suggests that new developments could result, among other things; in untraceable weapons of mass destruction, networked cameras for use by the government, and weapons developments fast enough to destabilize arms races. One area of concern is the effect that industrial-scale manufacturing and use of nanomaterials would have on human health and the environment, as suggested by nanotoxicology research groups.

What is new about nanotechnology is our ability to not only see, and manipulate matter on the nanoscale, but our understanding of atomic scale interactions. Like any other branch of science, is primarily concerned with understanding how nature works. Nature has the ability to design highly energy efficient systems that operate precisely and without waste, fix only that which needs fixing, do only that which needs doing, and no more. We do not although know but maybe one day our understanding of nanoscale phenomena may allow us to replicate at least part of what nature accomplishes with ease.

THE Space-time Diagram - A Brief Introduction



Sri Meban. J. S. Rynjah

The Greeks recognized that the distance between two points on a 2-dimensional plane can be calculated by using the Pythagorean theorem. As shown in the figure (1), the space interval 'd' in a two dimensional plane is obtained from the relation $d^2 = x^2 + y^2$. After the Greeks, the 17th century French Philosopher René Descartes generalized this theorem to a 3-dimensional world (the world where we live), and the equation $d^2 = x^2 + y^2 + z^2$ gives the distance, or the space interval between two points in a 3-dimensional space (figure (2)).Then Einstein generalized the space and time into a 4-dimensional space-time. One might expect in this case that the space-time interval 'd' will be given by $d^2 = x^2 + y^2 + z^2 + t^2$, but as usual in relativity one's common sense is incorrect. In fact, in relativity, the distance between two points in a 4-dimensional space-time is $d^2 = |t^2 - (\text{space})^2|$, where the space here is meant to stand for the three normal dimension x, y and z and the negative sign is an indication of the bizarre property that space-time has. This space-time interval 'd' defined in this way is in fact invariant. All observers will always agree on this interval between two points in space-time. To make things simple, I shall draw a space-time diagram with

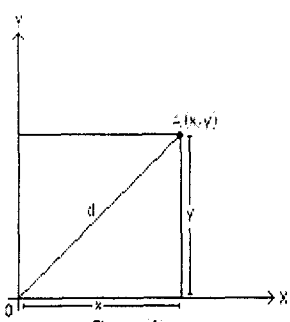


Figure (1)

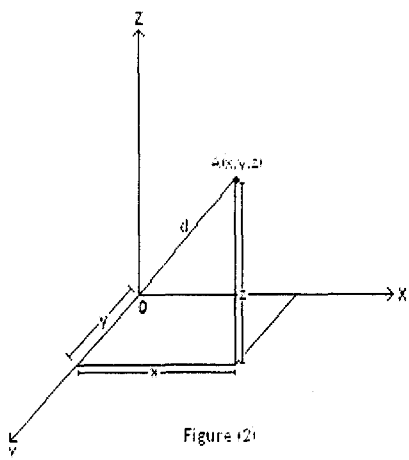


Figure (2)

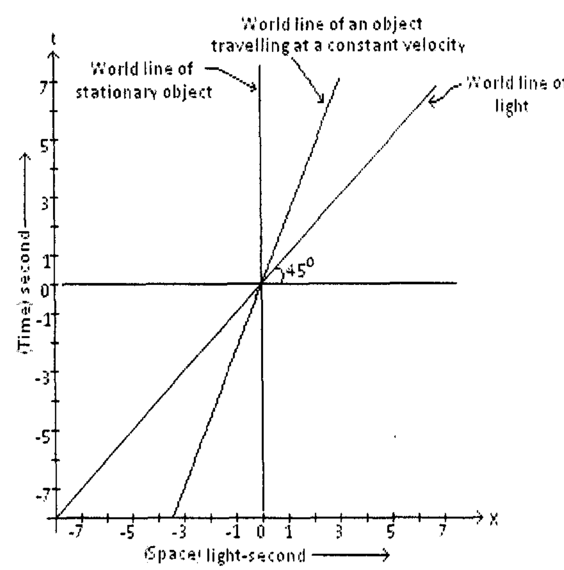


Figure (3)

space on one axis (usually the x axis) and the time on the other. The time axis is labelled in seconds, a space axis in light-seconds, or the time axis in years and the space axis in light-years, when dealing with universe (figure (3)).

An object sitting still in a space-time diagram is represented by a straight vertical line, because time is certainly passing for that object but is not moving anywhere in space. This line is called a world line. An object travelling from one point to another at a constant speed in a space-time diagram looks like a tilted world line. If we have a light signal, the distance travelled by light in 1 second is 1light-second, 2 second is 2 light-second and so on. So light will be represented by a line making an angle of 45° to the time axis or the space axis (figure (3)).

Drawing the two diagonal lines from two given locations form what we called light-cone because they look like a cone. The light-cone divides the diagram into a time-like region containing an absolute past and an absolute future and a space-like region which is at present unreachable by the observer at the point where the light cross, and contain relative past and relative future (figure (4)).

So far I have considered the one space dimension plus the one time dimension (1+1) case. The space-time diagram for 2+1 case is shown in the figure (5), and the space-time diagram for 3+1 case!! "I'm sorry, I cannot draw the 4-dimensional diagram because...I am a 3-dimensional being".

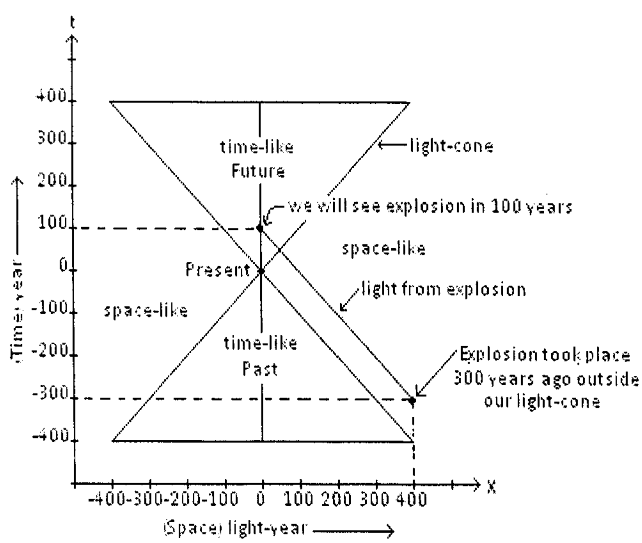


Figure (4)

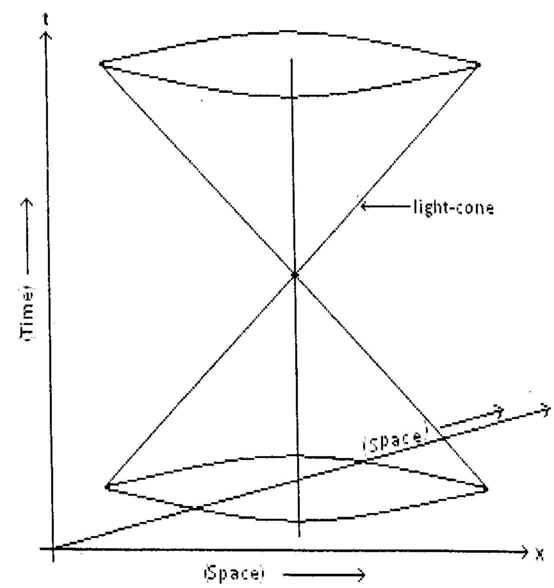


Figure (5)

If an event happened outside the light-cone, it is neither in the past nor in the future or rather it could be both in the pass or in the future. A star which is 400 light-years away, and is exploded 300 years ago outside the light cone, will be discovered only until 100 years from now as shown in the figure (4).

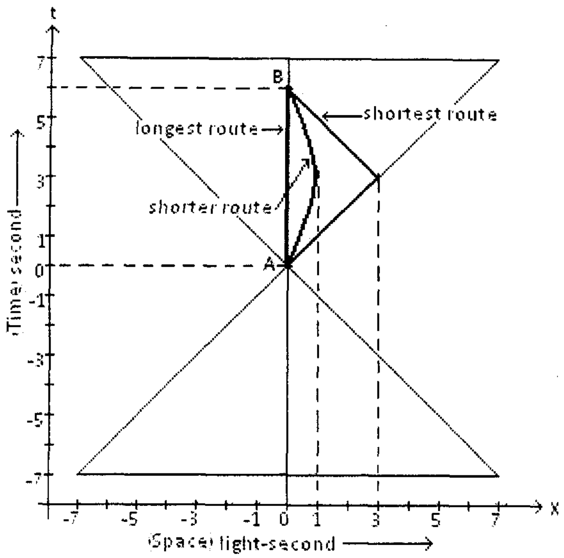


Figure (6)

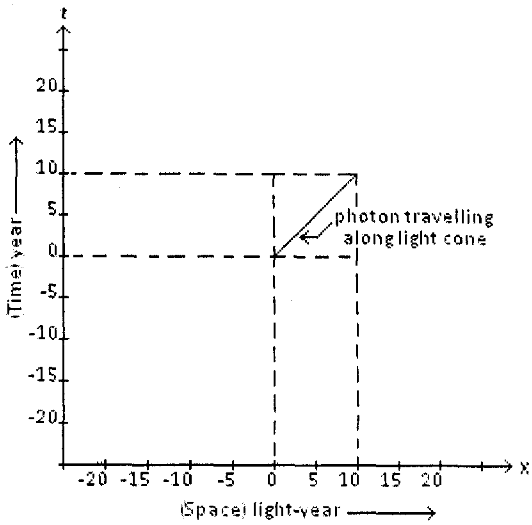


Figure (7)

The invariant space-time interval 'd' reveals interesting aspects of the diagram and of reality.

(1) The longest space-time interval between points A and B shown in figure (6), on a stationary world line is a straight line that connect the points A and B because

$d^2 = (\text{time})^2 - (\text{space})^2 = (6)^2 - (0)^2 = 36$ or $d = 6$

(2) The shorter interval would be obtained by travelling away from the location and then returning again (figure (6))

$d^2 = (\text{time})^2 - (\text{space})^2 = (6)^2 - (1+1)^2 = 36 - 4 = 32$ or $d = 5.65$

(3) Shortest interval is obtained by travelling away from the location at the speed of light and then returning again at the same speed as shown in figure (6)

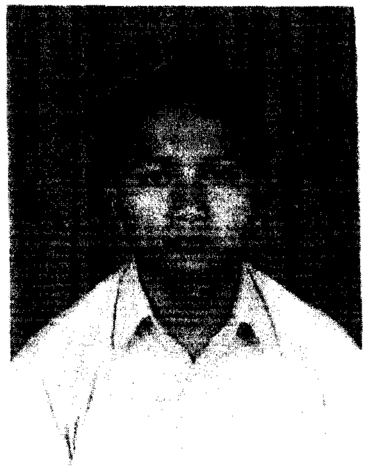
$d^2 = (\text{time})^2 - (\text{space})^2 = (6)^2 - (3+3)^2 = 36 - 36 = 0$ or $d = 0$

So we have seen that the shortest interval in a space-time diagram is not a straight line, but it is a curve line. This property of the space-time gives rise to the famous twin paradox. Again the space-time interval experience by a photon moving from A to B as shown in figure (7) is zero because

$d^2 = (\text{time})^2 - (\text{space})^2 = (10)^2 - (10)^2 = 0$ or $d = 0$

Hence light does not experience space-time or time does not exist for a photon. The photons that come to us from far beyond our solar system has no time lapse for them at all. It can also be shown that no body can travel faster than the speed of light, by using the space-time diagram. Even though the theory of relativity does not forbid faster-than-light travel.

Nanotechnology



Sri Aiborlang Dkhar

On Dec 29, 1959, at the California Institute of Technology, Nobel laureate Richard P. Feynman gave a talk at the annual meeting of the American Physical Society that has become one of the twentieth century's classic science lectures, titled: "There's Plenty of Room at the Bottom". Feynman, in his lecture presented a vision, a theoretical capability of extreme miniaturization several years before the word 'chip' became part of the lexicon. He talked about the possibility of manipulating and controlling things on a small scale. Extrapolating from known physical laws, he envisioned a technology using the ultimate toolbox of nature, building nanoobjects atom by atom or molecule by molecule. In his famous lecture, Feynman said, "I want to build a million tiny factories, models of each other, which are manufacturing simultaneously...... The principles of Physics, as far as I can see, do not speak against the possibility of maneuvering things atom by atom. It is not an attempt to violate any laws; it is something, in principle, that can be done; but in practice, it has not been done because we are too big".

The word nanotechnology was popularized by K. Eric Drexler in the 1980's. Drexler was talking about building machines on the scale of molecules, a few nanometer or one billionth of a metre wide— motors, robot arms, and even whole computers, far smaller than a cell. As nanotechnology became an accepted concept, the meaning of the word shifted to encompass the simpler kinds of nanometer-scale technology. Much of the work being done today that carries the name 'nanotechnology' is not nanotechnology in the original meaning of the word. In its original sense , 'nanotechnology' refers to the projected ability to construct items from bottom up, with atomic precision inside personal nanofactories (PNs), using techniques and tools being developed today to make complete, high performance products. Today devices with minimum feature sizes less than 100 nanometer (nm) are considered to be products of nanotechnology. Nanotechnology encompasses the production and application of physical, chemical, and biological system at scales ranging from individual atoms or molecules to sub-micron dimensions, as well as integration of the resulting nanostructures into larger systems. Ultimately, nanotechnology will enable control of matter at the nano-scale. Shortly after this envisioned molecular machinery is created, it will result in a manufacturing revolution, probably causing severe disruption. It also has serious economic, social, environmental, and military implications.

Billions of years ago, molecules began organizing themselves into the complex structures that could support life. Photosynthesis harnesses solar energy that could support plant life. Molecular ensembles are present in plants, which include light harvesting molecules, such as chlorophyll, arranged within the cells on the nanometer to micrometer scale. These structures capture light energy, and convert it into chemical energy that drives the biochemical machinery of plant cells. The flagella rotate at over 10,000 rpm. This is an example of a biological molecular machine. The flagella motor is driven by the proton flow caused by electrochemical potential differences across its membrane. The molecular processes of life, particularly the activity of proteins (enzymes) and the self organizing behavior of many biological molecules have greatly inspired nanotechnology, and molecular motors (i.e. protein complexes) could be considered as the result of nature's nanotechnology.

So, what is a personal nanofactory? It is a proposed compact molecular manufacturing system possibly small enough to sit on a desktop, which could build a diverse selection of large-scale molecularly precise diamondoid products. Diamondoid materials include pure diamond or any stiff covalent solid that is similar to diamond in strength, chemical inertness, or other important material properties, and possesses a dense three-dimensional network of bonds. The nanofactory is potentially a high quality, extremely low cost, and very flexible manufacturing system. To build a personal nanofactory, one needs to start with a working fabricator, a nanoscale device that can combine individual molecules into useful shapes. A fabricator could build a very small nanofactory, which then could build another one twice as big, and so on. Within a period of few weeks, one would have a tabletop model. Products made by a personal nanofactory will be assembled from nanoblocks, which will be fabricated within the nanofactory. Computer aided design (CAD) programs will make it possible to create state-of-the-art products simply by specifying a pattern of pre-designed nanoblocks.

The principal output of the first commercial nanofactory will be macroscale quantities of molecularly precise diamondoid products. These products may include nanocomputers, medical nanorobots, and products having diverse aerospace and defense applications, devices for cheap energy production and environmental remediation, and a cornucopia of new and improved consumer products. The nanofactory is a molecular assembly that will make it possible the creation of fundamentally novel products having the intricate complexity currently found only in biological systems, but operating with greater speed, power, reliability, and most importantly, entirely under human control. Molecular manufacturing has the potential of being very inexpensive, extremely and efficient. Nanofactories will be constructed form diamondoid components of the same sort that it can itself manufacture. While molecular manufacturing systems made from DNA, other biopolymers, or even biological organisms are possible, such systems would be unable to build products that approach the remarkable strength, stiffness, temperature range, lightness, electrical, optical and other properties that can be achieved with diamondoid materials.

Nanotechnology is sometimes referred to as general purpose technology. That's because in its advanced form it will have significant impact on almost all industries and all areas of society. It will offer better built, longer lasting, cleaner, safer, and smarter products for homes, for communications, for medicine, for transportation, for agriculture, and for industry in general. But as a general purpose-technology, it will be of dual use, meaning it will have many commercial uses and it will also have many military uses¯ making far more powerful weapons and tools of surveillance. Thus we may have, lifesaving medical robots or untraceable weapons of mass destruction; networked computers for everyone in the world or networked cameras so governments can watch our every move; trillions of dollars of abundance or a vicious scramble to own everything; rapid invention of wondrous products or weapons development fast enough to destabilize any arms race. Hence nanotechnology represents not only wonderful benefits for humanity, but also grave risks.

Nanotechnology will not only allow making high-quality products at very low cost, but it will also allow making new nanofactories at the same low cost and at the same rapid speed. This unique (outside of biology, i.e.) ability to reproduce its own means of production is why this technology is also said to be an exponential technology. It represents a manufacturing system that will be able to make more manufacturing systems¯ factories that can build factories¯ rapidly, cheaply and cleanly. The means of production will be able to reproduce exponentially, so in just a few weeks a few nanofactories conceivably could become billions. It is a revolutionary, transformative, powerful, and potentially very dangerous or beneficial- technology.

The very first and obvious question that one may therefore ask is¯ Is nanotechnology **good** or **bad**? Nanotechnology offers great potential for benefit to humankind, but also brings severe dangers. While it is appropriate to examine carefully the risks and possible toxicity of nanoparticles and other products of nanoscale technology, the greatest hazards are posed by malicious or unwise use of molecular manufacturing.

The other equally important and tough questions that need to be answered and addressed are:

- Who will own this technology?
- Will it be heavily restricted, or widely applicable?
- What will it do to the gap between the rich and the poor?
- How can dangerous weapons be controlled, and perilous arms race be prevented?

Many of such questions have not yet been answered. If these questions are not answered with proper deliberation, answers will evolve independently and will take everyone by surprise; the surprise most likely will be very unpleasant.

Radon – A Cancer-causing Radioactive Gas

Sri Longkhraw Khongiang

Biological effects of radiations are due to ionization of the tissues, etc through which the radiations pass. The severity of the damage caused to the tissues depends upon specific ionization of the radiation. Since α-particles have higher specific ionization; they can cause more harm compare to β-particles or γ -radiations once the radiation penetrated inside the tissue. A body exposed to external sources of radiations is unaffected unless the radiation reaches the sensitive tissues (lymphoid tissue, bone marrow, reproductive organs, lungs, liver, etc.). When exposed to three types of radiations (α, β and γ), γ-radiations cause maximum damage since they are highly penetrating radiations.

The three types of radiations are produced naturally from radioactive substances. Not that a particular isotope emits simultaneously all the three types of radiations, but a particular isotope emits a particular radiation. The amount of radiation depends on the decay constant (or half-life), which is the characteristics of the isotope. Moreover, the decay process or emission process is a probabilistic phenomenon. There is no way by which one can tell which atom will disintegrate at a particular time. But in a given sample of radioactive substance, half of the amount of the substance gets disintegrated in a given period of time (called the half-life). For example, though the half-life of uranium-238 is 4.5 billion years, it does not mean that only after 4.5 billion years a particular atom will disintegrate, but it might happen that the atom disintegrate immediately or it might not disintegrate at all. On the other hand, if 100 grams of uranium-238 is present, then after 4.5 billion years the amount of uranium-238 remaining is always 50 grams.

An α-particle cannot penetrate the skin of human being. If a person is exposed to alpha radiations only, he or she is unaffected as they cannot penetrate the skin. Similarly, beta rays lose their power of ionization after traversing a distance of 50 cm in atmospheric air. But yet people are so scared of these radiations. I am not scared of the radiations but I am scare of the source that produces them. How these radiations are produced is a well-established facts accepted by all and the effect of these radiations on biological specimens is also accepted by all. But how the radiations can contaminate the environment, to what extent they can cause the damage, people differ. If alpha, beta and gamma rays loses their power to ionize after traversing certain distances through atmospheric air then what harm can it do if a person stays at 1 km from the source of the radiations. There something more than the Penetrating power of a radiation which is more dangerous. One can see from the various decay-series (the step-by-step production) of radioactive substances by releasing radiations (fig.1, 2 & 3), that in all these decay-series, a chemically inert gas (called Radon gas) is produced. Radon has a short half-life ranging from 4 seconds to 4 days (approximately). Radon is a gas just like pure air- odourless, colourless and tasteless. Just like one does not feel anything upon inhaling pure air, so also one will not realize the moment he or she inhale this gas. Once inhaled, it reaches the delicate organs of the body. Radon-222 is a member of the radioactive decay chain of uranium-238. Radon-220 is formed in the decay chain of thorium-232. Radon-222 decays in a sequence of radionuclides called radon decay products, radon daughters, or radon progeny. The primary routes of potential human exposure to radon are inhalation and ingestion. As clear from the decay schemes (fig.1, 2 & 3), radon (radon-222, radon-220, radon-219) is an α-emitter; its daughter products being radioactive solid with high surface adherence easily stick to dust particles. So wherever they stick, that dust or materials become radioactive. Human beings or organisms which inhale these dust particles are directly inhaling high ionizing α-particles. Once radon gas is inhaled inside the body, the tissue or organ is continuously under bombardment of α-particles since each daughter product is radioactive with relatively short half-lives.

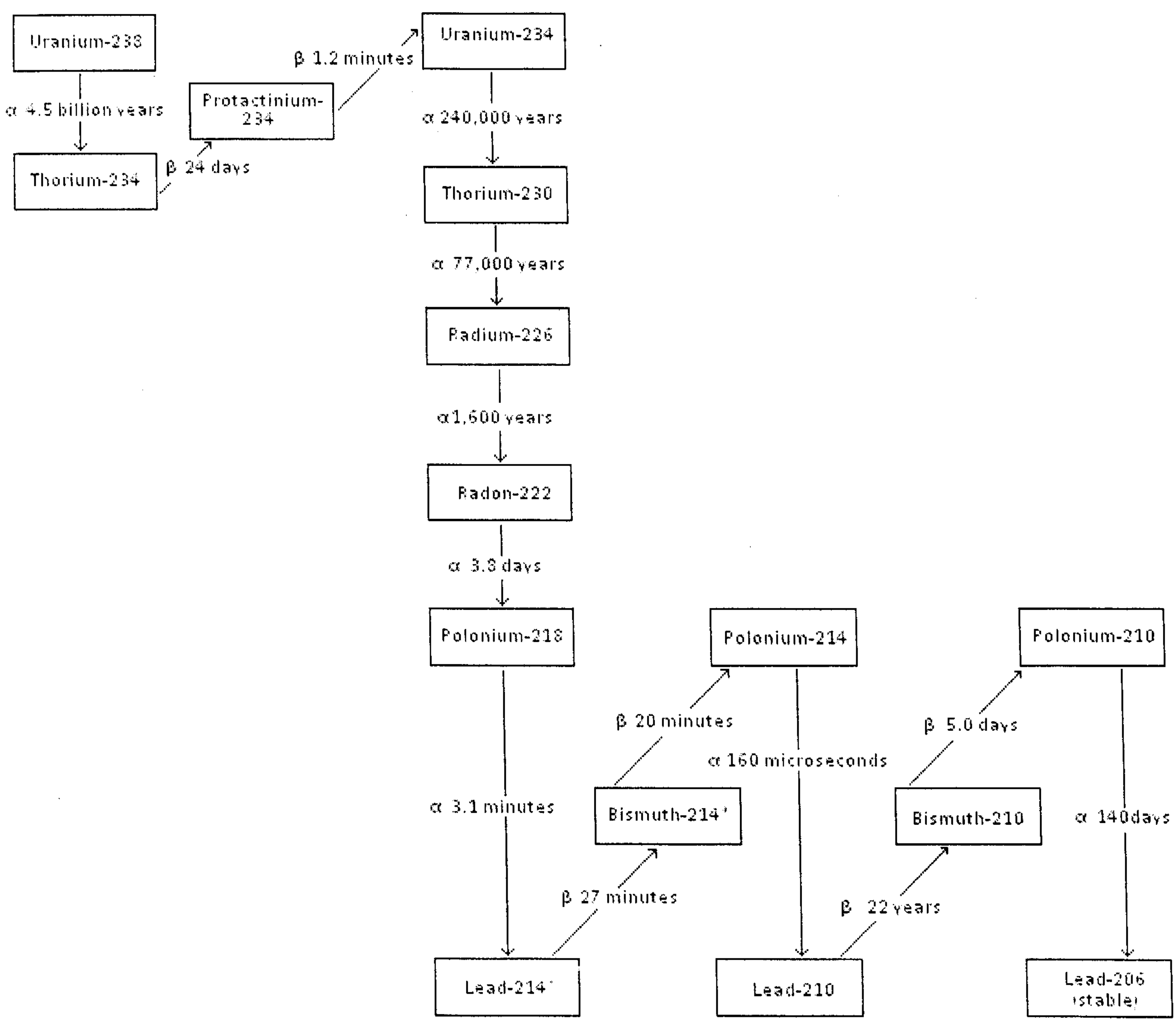


FIGURE 1: Natural Decay Series: Uranium-238

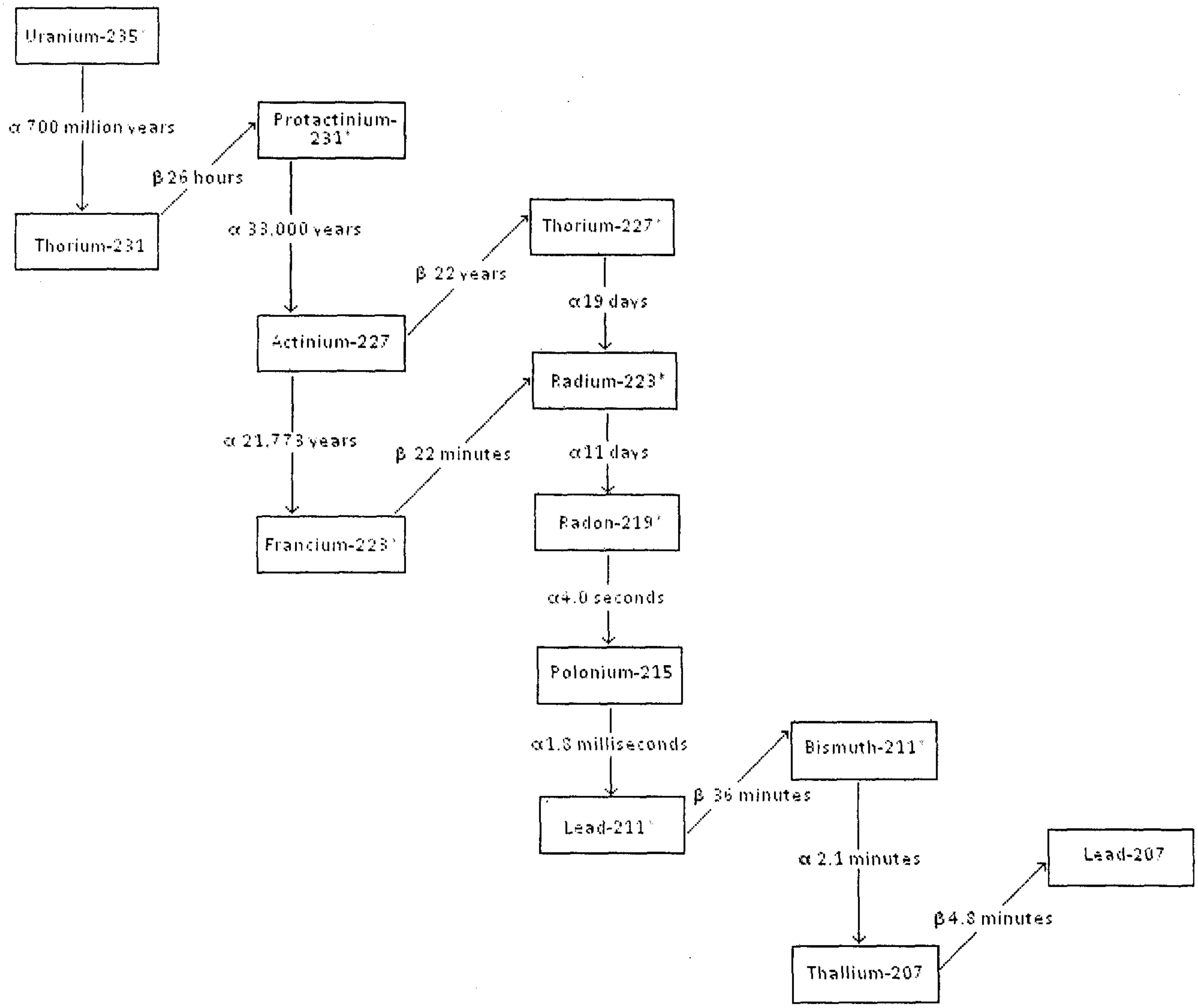


FIGURE 2: Natural Decay Series: Uranium-235

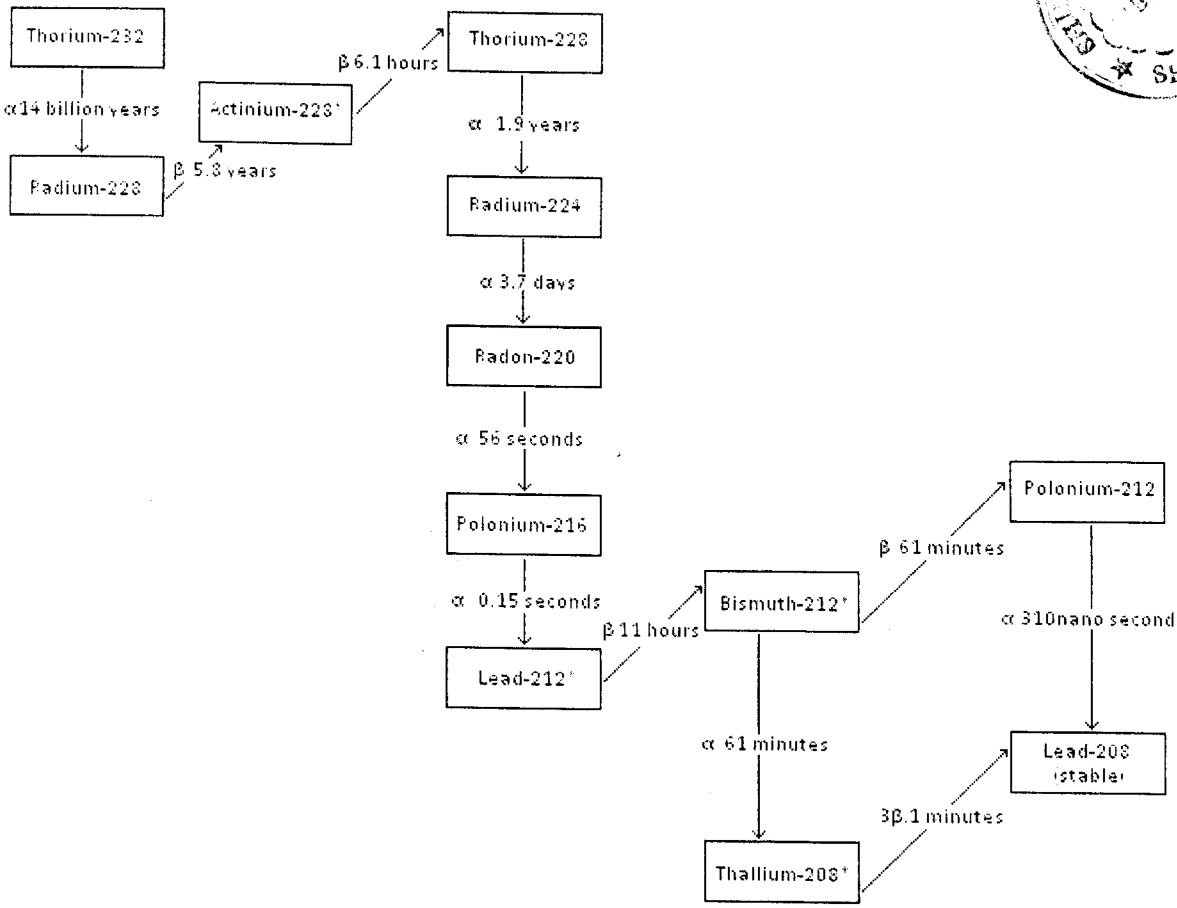


FIGURE 3: Natural Decay Series: Thorium-232

Journey To The Sun

For more than four hundred years, astronomers have studied the Sun from afar. Now NASA has decided to go there. "We are going to visit a living, breathing star for the first time," says program scientist Lika Guhathakurta of NASA Headquarters. "This is an unexplored region of the solar system and the possibilities for discovery are off the charts."

The name of mission is Solar Probe+ (pronounced "Solar Probe plus"). It's a heat resistant spacecraft design to plunge deep into the Sun's atmosphere where it can sample solar winds and magnetism first hand. Launch could happen as early as 2015. By the time the mission ends of years later, planners of the mission believe Solar probe+ will solve two great mysteries of astrophysics and make many new discoveries along the way.

The probe is still in its early named as "pre-phase A" at NASA headquarters, says Guhathakurta. The spacecraft will be designed and built in Johns Hopkin's Applied Physics Lab (APL) for NASA. APL already has experience sending probes toward the Sun. APL's messenger spacecraft completed its first flyby of the planet Mercury in January 2008 and many of the same heat-resistant technologies will fortify solar probe+. The mission is called solar probe+ because it builds on earlier 2005 APL design Solar Probe.

At closest approach, Solar Probe+ will be 7 million Km or 9 solar radii from the Sun. There, the spacecrafts Carbon-composite heat shield must withstand temperatures greater than 1400°C and survive blasts of radiation at levels not experienced by any previous aircraft. Naturally, the probe is solar powered; it will get its electricity from liquid-cooled solar panels that can retract behind the heat shield when sunlight becomes too intense. From these near distances, the Sun will appear 23 times wider that it does in the skies of Earth.

The two mysteries prompting this mission are the high temperature of the Sun's corona and the puzzling acceleration of the solar wind:

Mystery 1: The Corona: If you stuck a thermometer in the surface of the3 Sun, it would read about 6000°C. Intuition says the temperature should drop as you back away; instead, it rises. The Sun's outer atmosphere, the corona, registers more than a million degrees Celsius, hundreds of times hotter than the star below. This high temperature remains a mystery more than 60 years after it was first measured.

Mystery 2: The Solar Wind: The Sun spews a hot, million miles per hour (mph) wind of charged particles throughout the solar system. Planets, comets, asteroids - they all feel it. Curiously, there is no organized wind close to the Sun's surface. Yet, out among the planets there blows a veritable gale. Somewhere in between, some unknown agent gives the solar wind its great velocity. The question is what?

"To solve these mysteries, Solar Probe+ will actually enter the corona," says Guhathakurta. "That's where the action is".

The playload consists mainly of instruments designed to sense the environment right around the spacecraft – e.g., a magnetometer, a plasma wave sensor, a dust detector, and electron and iron analyzers and so on. "In-situ measurements will tell us what we need to know to unravel the physics of coronal heating and solar wind acceleration," she says.

Solar probe+'s lone remote sensing instrument is the Hemisphere Imager. The "HI" for short is a telescope that will make 3D images of the Sun's corona similar to medical CAT scans. The technique, called tomography, is a fundamental new approach to solar imaging and is only possible because the photography is performed from a moving platform close to the Sun, flying through coronal clouds and steamers and imaging them as it flies by and through them.

With a likely launch in May 2015, Solar Probe+ will begin its prime mission near the end of solar cycle 24 and finish near the predicted maximum of solar cycle 25 in 2022.This would allow the space craft to sample the corona and solar wind at many different phases of solar cycle. It also guarantees that Solar Probe+ will experience a good number of solar storms near the ends of its mission. While Perilous, this is according to plan: Researchers suspect that many of the most dangerous particles produced by solar storms are energized in the corona –Just where Solar Probe+ will be. Solar Probe+ may be able to observe the process in action and show researchers how to forecast Solar Energetic Particles (SEP) events that threatens the health and safety of astronauts.

Solar Probe+'s repeated plunges into the corona will be accomplished by means of Venus flybys. The spacecraft will swing by Venus seven times in six years to bend the probe's trajectory deeper and deeper into the Sun's atmosphere.

Bonus: Although Venus is not a primary target to the mission, astronomers may learn new things about the planet when the heavily-instrumented probe swings by.

"Solar Probe+ is an extraordinary mission of exploration discovery and deep understanding," says Guhathakurta. "We can't wait to get started".

Source: Science @NASA

Anuj Limbu

2nd yr B.Sc(Phy.Hons)

Heaven's Above The Solar Eclipse

A Solar eclipse occurs when the moon passes between the sun and the earth so that the sun is fully or partially covered. This can only happen during a new moon, when the sun and the moon are in conjunction as seen from the earth. At least two and up to five solar eclipses can occur each year on earth, with between zero and two of them being total eclipses. Total solar eclipses are nevertheless rare at any location because during each eclipse totality exists only along a narrow corridor in the relatively tiny area of the moon's umbra.

A total solar eclipse is a spectacular natural phenomenon and many people travel to remote locations to observe one. The 1999 total solar eclipse in Europe helped to increase public awareness of the phenomenon, as illustrated by the number of journeys made specifically to witness the 2005 annular eclipse and the 2006 total eclipse. The recent solar eclipse of January 26, 2009 was an annular eclipse, while the solar eclipse of July 22, 2009 was a total solar eclipse.

In ancient times, and in some cultures today, solar eclipses have been attributed to supernatural causes. Total solar eclipses can be frightening to people who are unaware of their astronomical explanations, as the sun seems to disappear in the middle of the day and the sky darkens in a matter of minutes.

Raja Nongkhlaw,
Class XII(Sc), 2009.

The Threat Of Uranium Mining

What is Uranium?

All the Uranium on the earth was formed years ago in the cores of giant stars. At the end of their lives, these stars explode, scattering the heavy elements they have created into the-inter stellar medium. When our sun was born four and a half billion years ago, this ancient dust was drawn into planets as they formed, so along with the more common elements such as silicon, iron and oxygen that make up our world, we inherited a blend of more erotic substances. The heaviest amongst them was Uranium.

Uranium is found in trace quantities around the world, but in only a few places it is found in concentrated deposits or ores. The world's richest deposits are found in Saskatchewan {Canada}, Australia and in some parts of Africa.

Here in Meghalaya, Uranium is found in Domiasiat in West Khasi Hills District and contains about 10,000 tons of uranium reserves. The Domiasiat deposit has been characterized as the largest, richest, near surface and low cost sand stone-type Uranium deposit discovered in India. The ores are spread over a 10 square kilometer area in deposits varying from 8 to 47 meters from the surface.

Uses of Uranium: Uranium is used in inertial guidance devices, in gyro compass, as counterweights for aircraft control surfaces, as ballast for missile re-entry vehicles and as a shielding material. Uranium metal is used for X-ray targets for the production of high energy X-rays. It is also used in generation of electricity and for making nuclear weapons. The radio-isotopes of uranium are also used in the field of medicine, food preservation, crop production, water supply and insect control.

Effects of Uranium:

1. Tailings wastes – The left over waste rock after processing is called tailings. In the course of processing it is crushed to a fine powder which is almost as radioactive as uranium itself. It is hazardous for more than 250,000 years, which might as well be forever.

2. Radon gas – It is a radioactive gas which can travel for hundreds of kilometers before decaying. Mine workers and others who breathe in this gas risk developing lung cancer and other forms of lung diseases.

3. Nuclear waste – There is a massive amount of high level nuclear waste still being spewed out by reactors around the world and there is no where safe to put it.

4 Environmental contamination – Uranium mining contaminates the air, water and earth with radioactive chemicals and heavy metals which can never be properly cleaned up. In addition to the radiation hazard, mining is also associated with poisonous process chemicals, heavy metals and the use of huge quantities of water. In the short term, uranium mine sites wreck the ecology of the local region; in the long term they pose a risk to a much broader area.

Uranium mining at Domiasiat compounds the threat of environmental degradation hanging over the people and wildlife of Meghalaya on account of new dangerous radiation contamination.

5 Health risk – The health risk of uranium mining are by now well known, although still aggressively disputed by mining industry. Collectively, uranium miners suffer the highest radiation doses of all workers in the nuclear fuel chain.

As long as it remains outside the body, uranium poses little hazard. If inhaled or ingested, however its radioactivity poses increased risks of lung cancer and bone cancer. Uranium is also chemically toxic at high concentrations and can cause damage to internal organs, notably the kidneys. Low level radiation is also implicated in reproduction {the developing foetus, birth defects, high infant mortality} and increase the risk of leukemia and soft tissue cancers. As the contamination from the mines spread away from the mine site, local people are also exposed to contamination.

From the various effects of uranium mining as seen from the examples of Jadugada , Chernobyl and many other places , uranium mining can be termed as potentially one of the most dangerous and hazardous mining operations in the country apart from being a catalyst for a nuclear disaster . It involves extremely hazardous exposure to radiation and could cause damage to the environment which will be hard to compensate in the future.

Using of nuclear power differs in different countries. Some countries maintained their vigorous programs, a few countries stopped further expansion in nuclear power, while many others proceeded with a slowed down program, due to safety concerns and financial constrains, reduced demand growth rates, public resistance.

Now, the questions arises that what do we want to do with our State? Do we want it to be another Jadugada where sickness prevails and rules or do we want to put an end to the already exploited Domiasiat in the name of sampling operations and initial prospecting which involved hundred of tons of ore? If mining is allowed in our state then about 30,000 people will be displaced and sickness and death will surely come to rule over our beloved land. So isn't it our duty for us to prevent our own state and put a full stop on this uranium mining??

"Nature is enough for every one's need

But not for every one's greed"

Mebanriti Jitem

XII Sc, 2009

Unique Positive Law

Once upon a time there lived two guys. One was very handsome and the other was very ugly. One day, when these two guys were walking together, many girls insulted the ugly guy that he looks like a monkey, and then he became very timid and narrow minded. So he asked his friend if he really looks like a monkey. His friend don't want him to be timid and narrow minded, so he replied "you are not the one who looks like a monkey, but it is the monkey is the one who looks like you ".

Therefore by applying unique positive law, let's look like a physics student but not the physics to be looked like us.

Khayaishang Zimik

B Sc 1st year

Lesser Known Facts About Some Of The World's Greatest Scientists

Galileo Galilei

Galileo, perhaps more than any other single person was responsible for the birth of modern science. His renowned conflict with the catholic church was central to his philosophy, for Galileo was one of the first to argue that man could hope to understand how the world works, and, moreover, that we could do this by observing the real world.

Galileo had believed Copernican Theory (that the planets orbit the sun) since early on, but it was only when he found the evidence needed to support the idea that he started to publicly support it. He wrote about Copernicus's Theory in Italian (not the usual academic Latin), and soon his views become widely supported outside the Universities. This annoyed the Aristotelian professors, who united against him seeking to persuade the Catholic Church to ban Copernicanism.

Galileo, worried by the developments, traveled to Rome to speak to the Ecclesiastical authorities. He argued that the Bible was not intended to tell us anything about scientific theories, and that it was usual to assume that, where the Bible conflicted with common sense, it was being allegorical. But the church was afraid of the scandal that might undermine its fight against Protestantism, and so took repressive measures. It declared Copernicanism "False and Erroneous" in 1616, and commanded Galileo never again to "Defend or Hold" the doctrine Galileo acquiesced.

In 1623, a long friend of Galileo became the Pope. Immediately Galileo tried to the 1616 decree revoked. He failed, but he did managed to get permission to write a book discussing both Aristotelian and Copernican theories, on two conditions: He would not take sides and would come to the conclusion that man could in any case not determine how the world worked because God could bring about the same effects in ways unimagined by man, who could not place restrictions in God's omnipotence.

The book, Dialogue Conquering The Two Chief World Systems, was completed and published in 1632, with the full backing of the censors and was immediately greeted throughout Europe as a literary and philosophical masterpiece. Soon the Pope, realizing that the people were seeing the book as a convincing argument in favour of Copernicanism, regretted having allowed its publications. The Pope argued that although the book had the official blessings of the censors, Galileo had nevertheless contravened the1616 decree. He brought Galileo before the inquisition, which sentenced him to house arrest for life and commanded him to publicly renounce copernicanism. For a second time Galileo acquiesced.

Galileo remained a faithful catholic, but his belief in the independence of science had not been crushed. Four years before his death in1642, while he was still under house arrest, the manuscript of his second major book was smuggled to a publisher in Holland. It was this work referred to as Two New Sciences, even more than his support for Copernicus, which was to be the genesis of ***Modern Physics.***

Isaac Newton

Isaac Newton was not a pleasant man. His relations with other academics were notorious, with most of his later life spent embroiled in heated disputes. Following publication of ***Principia Mathematica-*** surely the most influential book written in Physics- Newton had risen rapidly into public prominence. He was appointed president of the Royal Society and became the first scientist ever to be knighted.

Newton soon clashed with Astronomer Royal, John Flamstead, who had earlier provided Newton with much needed data for ***Principia***, but was now withholding information that newton wanted. Newton would not take no for an answer; he had himself to the governing body of the Royal Observatoryand then tried to force immediate publication by Flamstead's mortal enemy, Edmund Halley. But Flamstead took the case to court and, in the nick of time, won a court order preventing distribution of the stolen work. Newton was incensed and sought his revenge by systematically deleting all references to Flamstead in later editions of ***Principia.***

A more serious dispute arose with the German philosopher, Gottfried Leibnitz. Both Leibnitz and Newton had independently developed a branch of mathematics called *calculus*, which underlies most of Modern Physics. Although Newton discovered calculus years before Leibnitz but he published his work much later. A major row ensued over who had been 1^{st}, with scientists vigorously defending both contenders. It is remarkable, however, that most of the articles appearing in defense of Newton were originally written by his own hand- and only published in the name of friends! As the row grew, Leibnitz made the mistake of appealing to the Royal Society to reso9lve the dispute. Newton, as president, appointed an "impartial" committee to investigate, coincidentally consisting entirely of Newton's friends! But that was not all: Newton wrote the committee's report himself and had the Royal Society publish it, officially accusing Leibnitz of plagiarism. Still unsatisfied, he wrote an anonymous review of the report in the Royal Society's own periodical. Following the death of Leibnitz, Newton is reported to have declared that he had taken great satisfaction in "breaking Leibnitz heart".

During the period of these two disputes, Newton had already left Cambridge and Academe. He had been active in anti catholic politics at Cambridge, and later in parliament, and was rewarded eventually with the lucrative post of warden of the Royal Mint. Here he used his talents for deviousness and vitriol in a more socially acceptable way, successfully conducting a major campaign against counterfeiting, even sending several men to their death on the gallows.

Kitdor Kharbuli

Class-XII Sciecnce

A Story Of A Genius

Albert Einstein was born on 14^{th} March in the German City of Ulm, without any indication that he was destined for greatness on the contrary; his mother thought Albert was a freak, to her, his head seemed much too large. At the age of two- and –a-half, Einstein still wasn't talking. When he finally did learn to speak, he uttered everything twice.

Otto Neugebauer, the historian of ancient mathematics, told a story about the boy Einstein that he characterizes as a "Legend", but that seems fairly authentic. A headmaster once told his father that what Einstein chooses as a profession wouldn't matter, because "he'll never make a success at anything" Einstein began learning to play the violin at the age of six and he later became a gifted amateur violinist, maintaining this skill through his life.

Albert Einstein was not a bad pupil. He went to high school in Munich and scored good marks in almost every subject. Einstein hated the school's regimentation and often clashed with his teachers. At the age of 15, Einstein felt so stifled there that he left the school for good. Einstein was highly gifted in mathematics and interested in Physics, and after finishing school, he decided to study at the University of Zurich.

In 1900, at the age of 21, Einstein was a university graduate and unemployed. He worked as a teaching assistant, gave private lessons and finally secured a job in 1902 as a technical expert in the patent office in Bern. While he was supposed to be assessing other people's investigations, he was actually developing his own ideas in secret. He is said to have jokingly called his desk-drawer at work the "bureau of theoretical Physics"

One of the famous papers of 1905 was Einstein's SPECIAL THEORY OF RELATIVITY, according to which, time and distance are not absolute. Indeed, two perfectly accurate clocks will not continue to show the same time if they come together again after a journey, if one of them has been moving very fast relative to the other. From this followed the world's most famous formula which describes the relationship between mass and energy. $E = MC^2$

"When you sit with a handsome boy for two hours, it seems like two min, when you sit on hot stove for two min, it seems like two hours- that's relativity"- Einstein.

In 1903, Einstein got married to a woman, Mileva, who was three years elder to him. They had two sons. After years of constant fighting, the couple finally divorced in 1919. Einstein married his cousin Elsa the same year. Einstein's new personal chapter coincided with his rise to world fame. In 1915, he published his general theory of relativity, which proved a new interpretation of gravity. An Eclipse of the sun in 1919 brought proof that it was accurate. Einstein had correctly calculated in advance the extent to which the light from fixed star would be deflected through the sun's gravitational field. The news paper proclaimed his work as "Scientific Revolution". Einstein received the Noble Prize for Physics in 1921. He was showered with honors and invitations from all over the World and lauded by the Press.

When Nazis came to power in Germany in 1933, Einstein immigrated to the US. Five years later, the discovery of nuclear fission in Berlin, had American physicists in uproar. At urging of a colleague, Einstein wrote a letter to the American President, Frankiln D.Roosevelt on 2nd of August 1939, in which he warned. A single bomb of his type .... exploded in a port, might very well destroy the whole part together with some of the surrounding territory. His words did not fail to have an effect. The Americans developed the Atomic bomb in the Japanese cities of Hiroshima and Nagasaki in August 1945. Einstein deeply shaken by the extent of the destruction this time he wrote a public missive to the UN. In it he proposed the formation of a world Government. Unlike the letter to Roosevelt, this one made no impact. But over the next decade, Einstein got ever more involved in Politics- agitating for an end to the arms build-up and using his popularity to campaign for peace and democracy.

When Einstein died in 1955 at the age of 76, he was celebrated as a visionary and world citizen as much as a scientific genius.

Manbharisha Ranee& Anjulyne Nengnong

Class-XII Sciecnce

Jokes Of Rutherford And Neil Bohr

Sir Ernest Rutherford, president of the Royal Academy and recipient of Nobel Prize had the following related story:

"Some time ago I received a call from a colleague. He was about to give a student a zero mark for his answer to physics question. While a student claimed a perfect score, the instructor and the student agreed to an impartial arbiter, and I was selected

I read the examination question "show how it is possible to determine the height of a tall building using a barometer"

The student had answered "take a barometer to the top of the building, attach a long rope to it, lower it to the street and bring it up, measuring the length of the rope in the height of the building"

The student really had a strong case for full credit since he had really answered the question completely and correctly. On the other hand if full credit were given it could be well contribute to high grade in his physics, but the answer does not confirm this. I gave the student six minute to answer the question with a morning that the answer should show some knowledge of physics.

At the end of five minute he had not written anything, I asked if he wished to give up, he said he had many answers to the problems, he just thinking of the best one. I excused myself for interrupting him and asked him to please go on. In the next minute he dashed off his answer, which read "take a barometer to the top of the building and lean over the edge of the roof, drop the barometer timing it with a stopwatch, then using the formula $x = 0.5^x a^x t\wedge 2$, calculate the height of the building"

At this point I asked my colleague it would give up. He conceded and gave the student almost full credit. While leaving my colleague office, I recalled that the student had said that he has other answer to the problem. So I asked him what they were.

"Well, said the student, there are many ways of getting the height of a tall building with the aid of a barometer. For example, you could take the barometer out on a sunny day and measure the height of the barometer, the length of its shadow, and the length of the shadow of the building as by the case of simple proportion, determine the height of the building. Probably, the best," he said," is to take the barometer to the basement and knocked on the Superintendent's door. When the Superintendent answer you speak to him as follows: Mr. Superintendent, here is a fine barometer, if you tell me the height of the building I'll give you this building"

The name of the student is Neil Bohr.

Khayaishang Zimik

B Sc 1st year

" Save Mother Nature "

This selfish heart would always say,
Our earth's resources are here to stay.
What Nature feed we never spare
Her tender love we never care.

Oh! Jealous heart you've had your way;
Alas! You will regret one day.
The barren lands and dried up lakes,
Are there to appear in their wake.

But time right now is not too late;
If we awake for our own's sake.
Let's plant young trees when cut the old,
The lovely greens will again unfold.

For this great cause we're on our way;
To nurse back nature we hope and pray.
For ever man to mend his way;
For mother nature's every day.

Raja Nongkhlaw,
Class XII(Sc) , 2009.

" Einstein - One And Only One "

Einstein with his cool, weird hair
About his looks, he'd never care.
During his school days he'd always fail
But he was a pro in equation's game.
It was physics that corrupted his mind
That an equation for relativity he could find
He said energy is m c squared,
Because of him, this we could share.
His Nobel Prize we cannot disguise;
The photo electric effect, we cannot deny,
Time dilates and length contracts,
Einstein is awesome, these are his facts.

Raja Nongkhlaw
Class – XII Sc, 2009

Science Quiz

Q1.. How many Earths would fit inside the Sun?

ANSWER: 1.3 million

Q2.. A bright patch seen near the edge of the Sun is called ?

ANSWER: Facula

Q3.. What type of eclipse happens when the Moon is a little bit closer to the Sun than it is for a total eclipse?

ANSWER: Annular eclipse

Q4.. What filter do we need to use with a telescope to see prominences and flares on the Sun?

ANSWER: Hydrogen-alpha filter

Q5.. How many Jupiters would fit across the diameter of the Sun?

ANSWER: About 10

Q6.. What are the black spots on the sun that can be seen by the naked eye called?

ANSWER: sunspots

Q7.. Which element was discovered on the Sun before it was discovered on Earth?

ANSWER: Helium

Q8.. The Great Dark Spot - a cloud of methane as big as the Earth itself, can be found on which planet?

ANSWER: Neptune

Q9. The asteroid belt is located between the orbits of two planets. Which are these?

ANSWER: MARS AND JUPITER

Q10. Name the first space ship which hit the moon

ANSWER: LUNIK-II

Q11. What is it called when the Moon is directly between the Earth and the Sun?

ANSWER: Solar eclipse

Q12. Which is the largest constellation?

ANSWER: HYDRA

Q13. A group of stars named by ancient people because of heroes or animals they reminded them of is called a ...

ANSWER: constellation

Q14. What is the name of the closest star to our Earth?

ANSWER: Sol

Q15. Which of the constellations represents a goat?

ANSWER: Capricornus

Q16. Name the planet which is known for its duststorm?

ANSWER: JUPITER

Q17. How far away from the Earth is our sun, approximately...?

ANSWER: 93 million miles. Or 9.46 x 10^{11} km or 1 AU

Q18. What was the name of the man who discovered Neptune with his telescope in 1846?

ANSWER: Johann Galle.

Q19. The word 'planet' comes from a Greek word meaning....?

ANSWER: wanderer.

Q20. This object is a neutron star that emits pulses of radiation toward Earth as it spins. Name it!

ANSWER: Pulsar

Q21. Which comet passed so close to Jupiter, in 1994, that it was broken into fragments by Jupiter's immense gravity?

ANSWER: Shoemaker-Levy

Q22. Which planet has the largest volcano and largest valley in the solar system?

ANSWER: Mars

Q23. Who was the first astronomer to discover galaxies beyond the Milky Way?

ANSWER: Edwin Hubble

Q24. What is the name of the largest moon in our solar system?

ANSWER: Ganymede

Q25. What is the name of the closest large spiral galaxy to our own Milky Way?

ANSWER: Andromeda

Q26. Who discovered the relationship between Redshift and distance within the universe?

ANSWER: Hubble

Q27. Who was the first person to determine that Saturn had a ring system?

ANSWER: Christiaan Huygens

Q28. A Supernova is the explosion of what?

ANSWER: Star

Q29. What is the name of the largest moon of Saturn?

ANSWER: Titan

Q30. What is the fuel that powers our sun?

ANSWER: Hydrogen

Q31. The Earth has how many natural satellites?

ANSWER: One

Q32. If you could find a tub of water large enough, and put all the planets in it, which one would float?

ANSWER: Saturn

Q33. Which constellation has the star Sirius in it?

ANSWER: Canis Major.

Q34. What is the name of the only asteroid visible to the naked eye?

ANSWER: Vesta.

Q35. What is the most active meteor shower that takes place in August every year?

ANSWER: Perseids.

Q36. What state of matter is our Sun mainly consisted of?

ANSWER: Plasma

Q37. What galaxy is the largest member of the Local Group?

ANSWER: The Andromeda Galaxy.

Q38. What is the name for the point when an object in orbit around the Earth comes its closest to the Earth?

ANSWER: Perigee

Q39. When 3 celestial bodies within the same gravitational system align to form a straight line, what is it called?

ANSWER: Syzygy

Q40. In the solar system, what are classified into Groups, Stones, Irons, and Stony Irons?

ANSWER: Meteorites.

Q41. The Great Dark Spot - a cloud of methane as big as the Earth itself can be found on this planet. What is the name of this planet?

ANSWER: Neptune.

Q42. How hot is the core of the sun?

ANSWER: 15 million Kelvins

Q43. Who was the first person to determine that Saturn had a ring system?

ANSWER: Christiaan Huygens

Q44. The terms 'event horizon' and 'singularity' relate to what astronomical bodies?

ANSWER: black holes.

Q45. What is the name given to the string of light beads that appear on the horizon just before a solar eclipse?

ANSWER: Baily's beads.

Q46. What is 1.4 times the mass of the sun called?

ANSWER: Chandrasekhar limit.

Q47. What is the name of stream of charged particles emitted from the sun?

ANSWER: Solar flares.

Q48. What is the name of a comet that crashes into the sun or get so close that it burns up?

ANSWER: Sungrazers

Q49. What is the name of the largest known volcano in our solar system?

ANSWER: Olympus mons.

Q50. What is the name of the biggest Asteroid in the solar system?

ANSWER: ANSWER: Ceres

Q51. Name the two moons of planet Mars

ANSWER: Deimos & phobos

Q52. When was Pluto discovered and by whom?

ANSWER: 1930, by Clide W Tombaugh.

Q53 Which Planet gets its name from the Mythical Roman winged messenger and escort of dead souls to the underworld?

ANSWER: Mercury

Q54. On August 24th, 2006 the status of this member of our solar system was officially changed from planet to dwarf planet. Give its name.

ANSWER: Pluto

Q55. How many years does it approximately take for Halley's comet to return to our inner solar system?

ANSWER: 75 years

Q56. Which of these planets is the largest?

Earth

Venus

Mars

Mercury

ANSWER: Earth

Q57. What distinctive phenomenon can light not escape from?

ANSWER: Black hole