COHERENCE

VOLUME 1 | JANUARY 2015

(A Collection of Articles by the Students of Science Section)

SCIENCE SECTION

THE BHAWANIPUR EDUCATION SOCIETY COLLEGE

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THE BHAWANIPUR EDUCATION SOCIETY COLLEGE

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From the Desk of the Editor

We would like to present, with great pleasure 'COHERENCE' our scientific magazine encompassing all the branches of sciences like Physics, Chemistry, Mathematics, Computer Science, Electronics, Economics, Statistics and Environmental Science.

The main object of publishing this magazine is to encourage the undergraduate students to express their thoughts, views and ideas in diverse fields of sciences. New and emerging trends in science are the key highlights of the articles written by the students. Most of the articles are well illustrated with explanatory pictures and diagrams. Articles are thoroughly checked and presented under direct supervision of all Science faculty members.

Readers interested in advancement in Science and Technology would enjoy reading our magazine.

We convey our grateful thanks to all those who have inspired us in our endeavour. We are extremely obliged to the President Sri Champakbhai Doshi and Senior Vice President Sri Miraj D. Shah of Governing Body of our College for their encouragement and financial support. Our special thanks to Prof. Debjani Ganguly, Teacher in-Charge and Dr. Sandip K Dan, Rector of our College for their encouragement. My sincere thanks to all our faculty members for their cooperation.

Samir Kanti Datta

Contents

Chemical Toxicity & Chelation Therapy

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Introduction

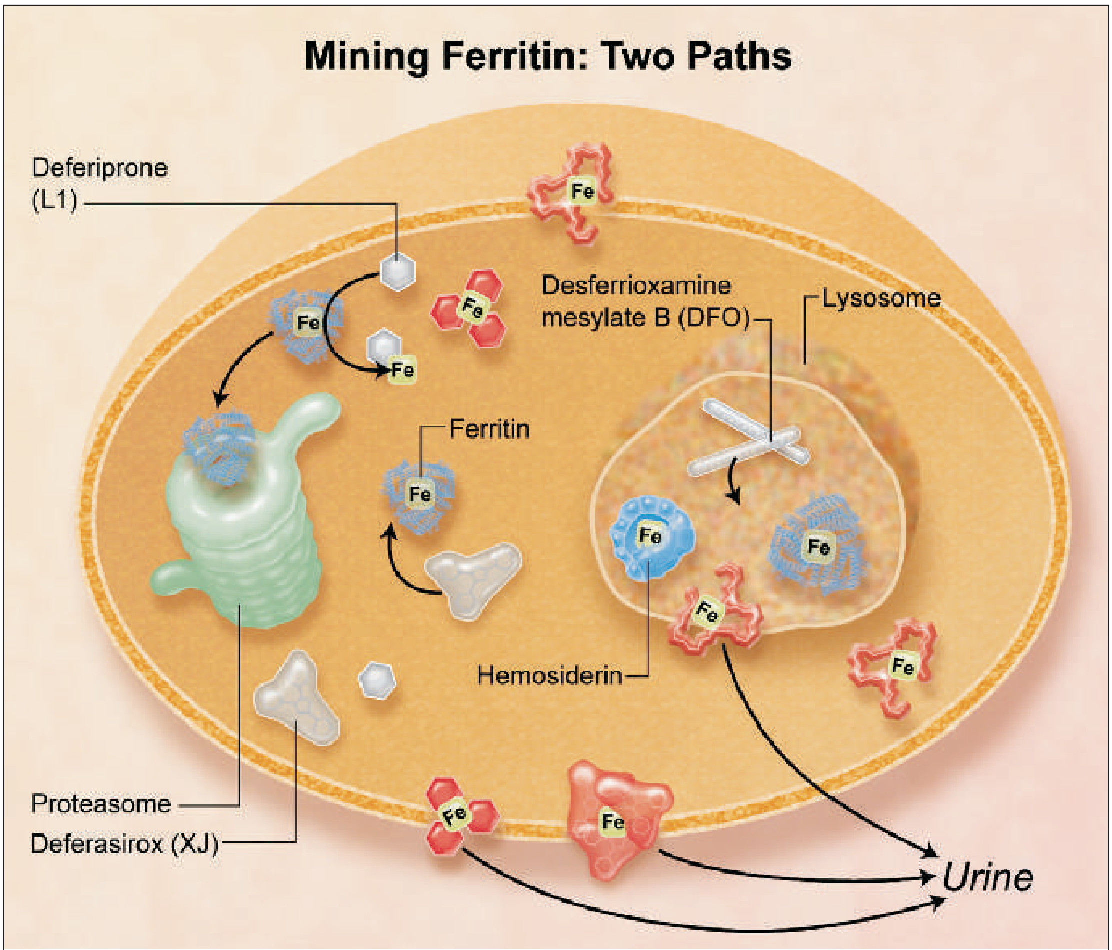
To perform one or more physiological functions in the human body several metal ions are required. The number of elements that are known to be biologically important comprises a relatively small fraction of the 109 known elements. Nature always selects elements of small atomic number to carry out the biological process. Heavy elements are usually very toxic. Molybdenum is the heaviest metal and iodine is the heaviest non-metal found in the biological system. The metals of importance in enzymes are principally those of the first transition series, and the other elements are sodium, potassium, magnesium, calcium, carbon, nitrogen, phosphorus, oxygen, chlorine and of course, hydrogen.

Source of chemical toxicity

Nowadays due to unplanned industrialization and other factors toxic metal exposure is universal, thus everyone is converted to a little bit of 'toxic'. All children are born with some toxic metals that pass through the placenta from their mothers. This is why removing toxic metals with a nutritional balancing program before one becomes pregnant is essential if one wishes to have healthy children. After birth, vaccine exposure is an important source of mercury and aluminium, along with food, drinking water, pharmaceutical drugs of many kinds, over-the-counter drugs, cosmetics, and other environmental sources. These include, but are not limited to air pollution, dental amalgams and other dental materials, and contact with toxic metals at home and at work. However metals like lead, mercury, and arsenic serve no function in the human body. If they accumulate in large enough amounts, they cause poisoning. Other metals which are essential to human function can become toxic if they accumulate in large amounts; examples of such metals include iron and copper. Hence, accumulation of excess metal ions whether it is 'essential' or 'toxic' can cause a severe problem in our biological system.

Toxicity of the elements in biological systems

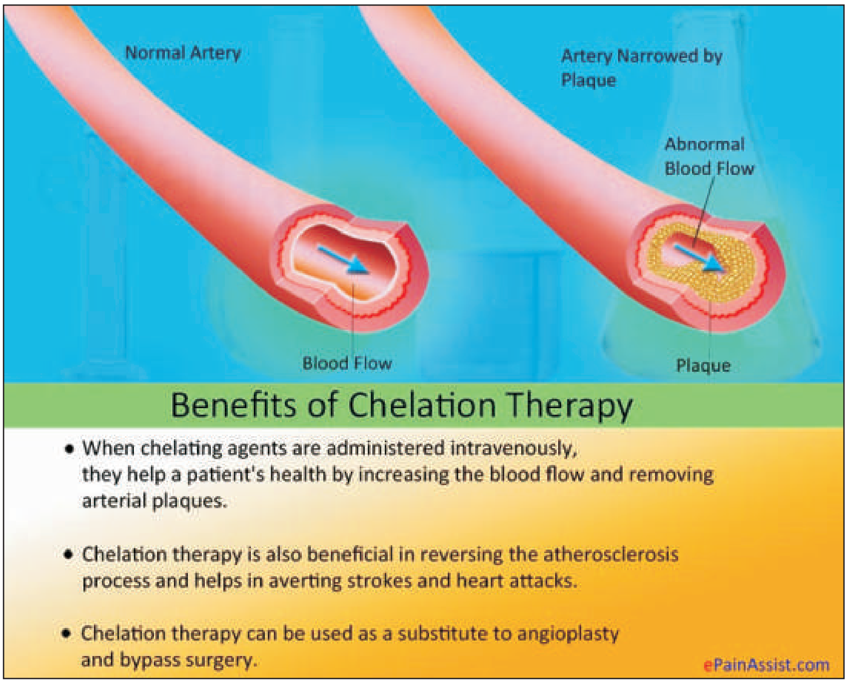
Long term exposure to *cadmium* is associated with renal dysfunction. Cadmium is biopersistent and once absorbed remains resident for many years. High exposure can lead to obstructive lung diseases and has been linked to lung cancer. Cadmium may also cause bone defects in humans and animals; low exposure to *chromium* can irritate the skin and cause ulceration. Long term exposure can cause kidney and liver damage. It can also cause damage to circulatory and nerve tissues; high doses of *copper* can cause anaemia, liver and kidney damage, and stomach and intestinal irritation. People with Wilson's



Iron chelators that enter cells by different pathways remove iron from different subcellar compartments: deferasirox and deferiprone target cytosolic ferritin iron and desferrioxamine mesylate targets lysosomal ferritin iron increased by stimulated autophagy and damaged ferritin (hemosiderin) iron. (Professional illustration by A.Y. Chen.)

disease are at greater risk of health effects from overexposure to copper; exposure to *lead* can lead to a wide range of biological defects in human depending on duration and level of exposure. The developing foetus and infants are far more sensitive than adults. High exposure can cause problems in the synthesis of haemoglobins, damage to the kidneys, gastrointestinal tract, joints, reproductive system and the nervous system; inorganic *mercury* poisoning is associated with tremours, gingivitis and/or minor psychological changes together with spontaneous abortion and congenital malformation. Monomethylmercury causes damage to the brain and the central nervous system while foetal and post-natal exposure have given rise to abortion, congenital malformation and development changes in young children; excessive amounts of *nickel* can be mildly toxic. Long term exposure can cause decreased body weight, heart and liver damage and skin irritation; exposure to high levels of *arsenic* can cause death. All types of arsenic exposure can cause kidney and liver damage and in the most severe exposure there is erythrocyte hemolysis; *manganese* is known to block calcium channels and with chronic exposure results in CNS dopamine depletion. This duplicates almost all of the symptomology of Parkinson's disease; *aluminium* toxicity is associated with the development of bone disorders including fractures, osteopenia and osteomalacia.

So if the toxic metal ion is introduced into the body by ingestion, inhalation, or skin contact, and we have to detoxify it. People with very high levels of these heavy metals are treated with drugs called “chelators”. These medicines bind to the metals in the blood stream; this metal-chelator compound is then eliminated in the urine. Thus detoxification of metal ions can be achieved by the use of suitable chelating agents. While chelators are valuable drugs, they have side effects which limit their use to only a few medical conditions involving heavy metal toxicity, especially those due to lead, mercury, arsenic, and iron. This branch of medicine is called *chelation therapy*.

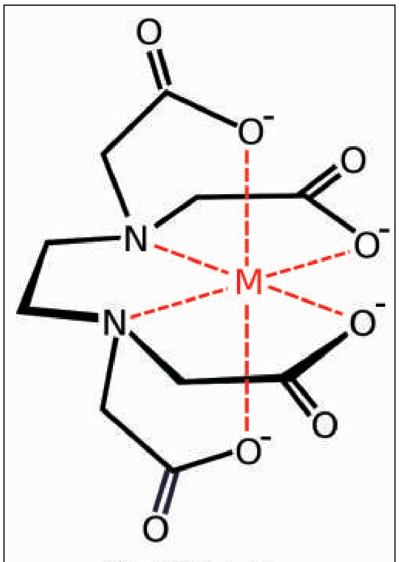


History

Chelation therapy can be traced back to the early 1930s, when Ferdinand Munz, a German chemist working for I.G. Farben, first synthesized ethylenediaminetetraacetic acid (EDTA). Munz was looking for a replacement for citric acid as a water softener. Chelation therapy itself began during World War II when chemists at the University of Oxford were searching for an antidote for lewisite, an arsenic-based chemical weapon. The chemists learned that EDTA was particularly effective in treating lead poisoning.

Medical uses and uses in alternative medicine

Chelation therapy is used as a treatment for metal poisoning, including acute mercury, iron (including in cases of thalassemia), arsenic, lead, uranium, plutonium and other forms of toxic metal poisoning. The chelating agent may be administered intravenously, intramuscularly, or orally, depending on the agent and the type of poisoning.



Metal-EDTA chelate

Common Chelating Agents

There are a variety of common chelating agents with differing affinities for different metals, physical characteristics, and biological mechanism of action. For the most common forms of heavy metal intoxication – lead, arsenic, or mercury – a number of chelating agents are available. Dimercaptosuccinic acid (DMSA) has been recommended for the treatment of lead poisoning in children by poison control centres around the world.

Chelator	Used in
Dimercaprol (British anti-Lewisite; BAL)	• acute arsenic poisoning • acute mercury poisoning • lead poisoning (in addition to EDTA) • Lewisite poisoning (for which it was developed as an antidote)
Dimercaptosuccinic acid (DMSA)	• lead poisoning • arsenic poisoning • mercury poisoning
Dimercapto-propane sulfonate (DMPS)	• severe acute arsenic poisoning • severe acute mercury poisoning
Penicillamine	*Mainly in:* • copper toxicity *Occasionally adjunctive therapy in:* • gold toxicity • arsenic poisoning • lead poisoning • rheumatoid arthritis
Ethylenediamine tetraacetic acid (calcium disodium versante) ($CaNa_2$-EDTA)	• lead poisoning
Deferoxamine and Deferasirox	• acute iron poisoning • iron overload

Side Effects and Safety Concerns

When used properly in response to a diagnosis of harm from metal toxicity, side effects of chelation therapy include dehydration, hypocalcemia, harm to kidneys, increased enzymes as would be detected in liver function tests, allergic reactions, and lowered levels of dietary elements. When administered inappropriately, chelation therapy brings risk of cancer, neurodevelopmental disorder from toxicity, and death.

Sources

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Nanometerials and its Diverse Application in Present Day Research and Technology

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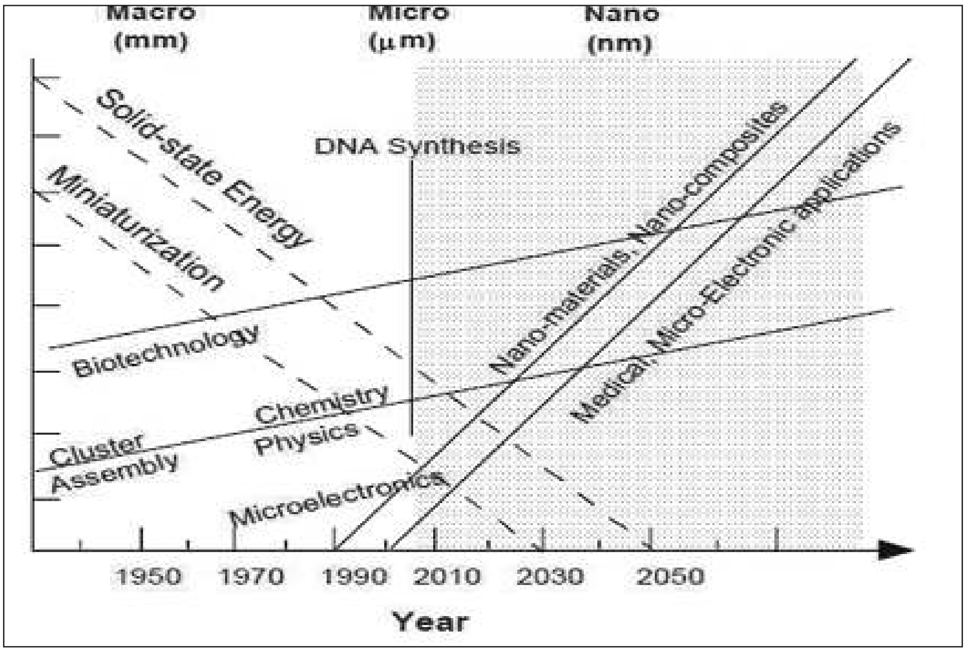
1. Introduction

Nanomaterials are cornerstones of nanoscience and nanotechnology. Nanostructure science and technology is a broad and interdisciplinary area of research and development activity that has been growing explosively worldwide in the past few years. It has the potential for revolutionizing the ways in which materials and products are created and the range and nature of functionalities that can be accessed. It is already having a significant commercial impact, which will assuredly increase in the future.

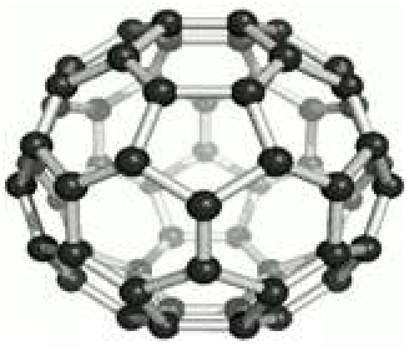


2. Definition of nanomaterials

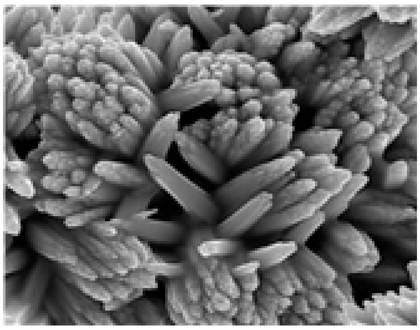
Nanometarials describe, in principle, materials of which a single unit is sized (in at least one dimension) between 1-1000 nanometers (10^{-9} meter) but is usually 1-100 nanometers.

3. Examples of Nanomaterials

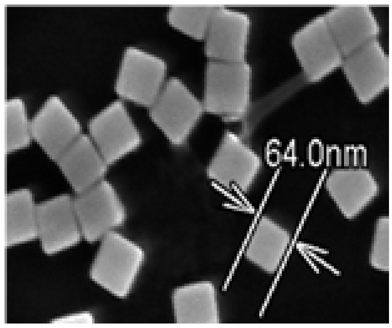
Nanomaterials (gold, carbon, metals, metal oxides and alloys) with variety of morphologies (shapes) are depicted in the following figures.



Buckminsterfullerene

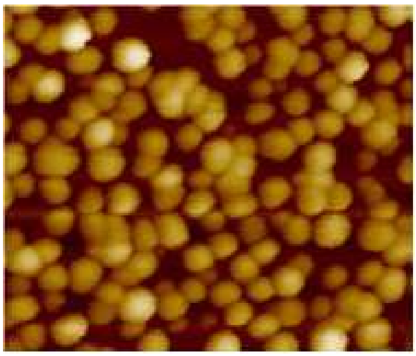


Titanium nanoflower



Silver nanotubes

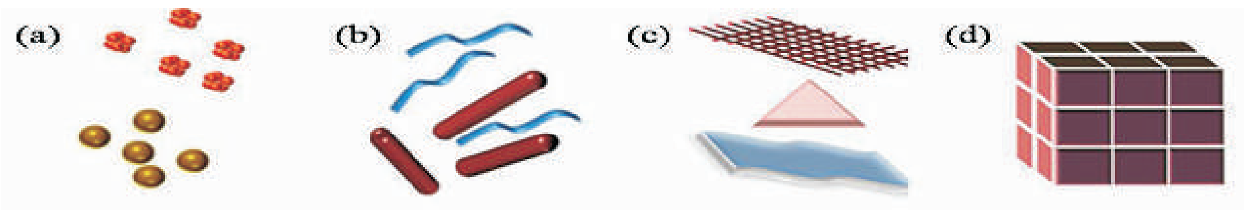
SnO_2 nanoflower



Au nanoparticle

4. Classification of Nanomaterials

Nanomaterials have extremely small size which having at least one dimension 100 nm or less. Nanomaterials can be nanoscale in one dimension (eg. surface films), two dimensions (eg. Strands or fibres), or three dimensions (eg. particles). They can exist in single, fused, aggregated or agglomerated forms with spherical, tubular, and irregular shapes. Common types of nanomaterials include nanotubes, dendrimers, quantum dots and fullerenes. According to Siegel, Nanostructured materials are classified as 0 dimensional,1 dimensional, 2 dimensional, 3 dimensional nanostructures.



Classification of Nanomaterials (a) 0 D spheres and clusters, (b) 1D nanofibers, wires, and rods, (c) 2D films, plates, and networks, (d) 3D nanomaterials

5. Properties of Nanomaterials

Nanomaterials have the structural features in between of those of atoms and the bulk materials. While most microstructured materials have similar properties to the corresponding bulk materials, the properties of materials with nanometer dimensions are significantly different from those of atoms and bulks materials. This is mainly due to the nanometer size of the materials which render them:

(i) large fraction of surface atoms; (ii) high surface energy ; (iii) spatial confinement; (iv) reduced imperfections, which do not exist in the corresponding bulk materials.

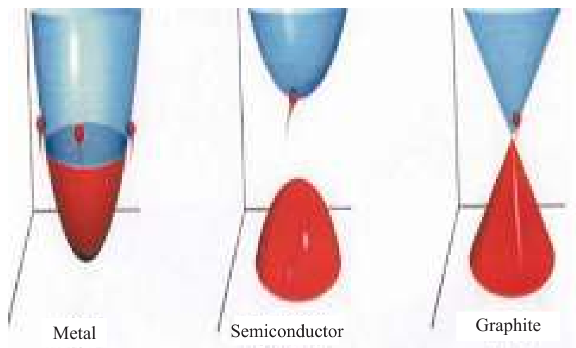
Nanometarials also have other properties:

(a) Optical property (optical detector, laser, sensor, imaging, phosphor, display, solar cell, photocatalysis, photoelectrochemistry and biomedicine);

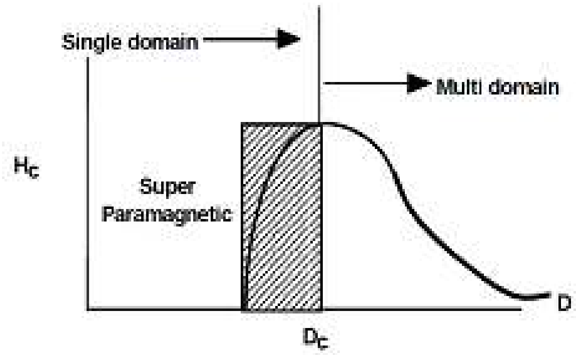
(b) Electrical property (nanotubes and nanorods, carbon nanotubes, photoconductivity of nanorods, electrical conductivity of nanocomposites);

(c) Mechanical property (ceramic materials, influence of porosity, influence of grain size, super plasticity, filled polymer composites, particle-filled polymers, polymer-based nanocomposites filled with platelets, carbon nanotube-based composites);

(d) Magnetic Property (Au, Pd and Pt are non-magnetic, but at the nano size they are magnetic).



Electric behavior of nanotubes



Magnetic properties

6. Importants of Nanometarials

(i) Nanophase ceramics are of particular interest because they are more ductile at elevated temperatures as compared to the coarse-grained ceramics.

(ii) Nanostructured semiconductors are known to show various non-linear optical properties and used as window layers in solar cell.

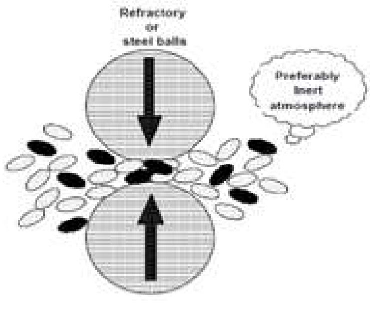
(iii) Nanosized metallic powders have been used for the production of gas tight materials, dense parts and porous coatings. Cold welding properties combined with the ductility make them suitable for metal-metal bonding especially in the electronic industry.

(iv) Single nanosized magnetic particles are mono-domains and one expects that also in magnetic nanophase materials the grains correspond with domains, while boundaries on the contrary to disordered walls. Magnetic nanocomposites have been used for mechanical force transfer (ferro fluids), for high density information storage and magnetic refrigeration.

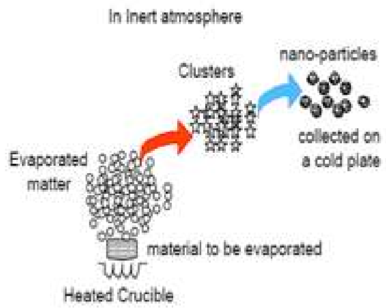
(v) Nanostructured metal clusters and colloids of mono- or plurimetallic composition have a special impact in catalytic applications.

7. Nanomaterial - synthesis and processing

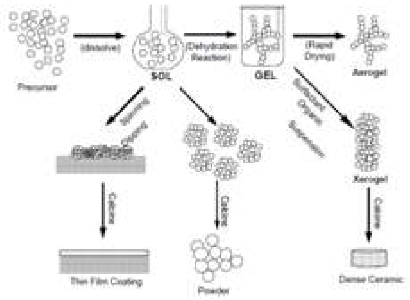
There are so many types of process and synthesis of nanometarials which are depicted in the following figures:



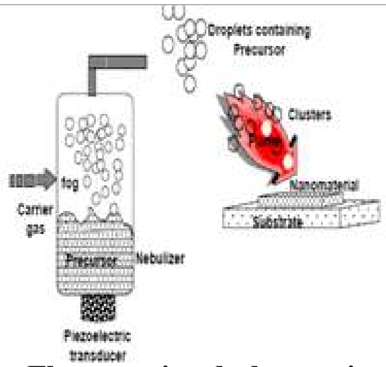
Mechanical grinding



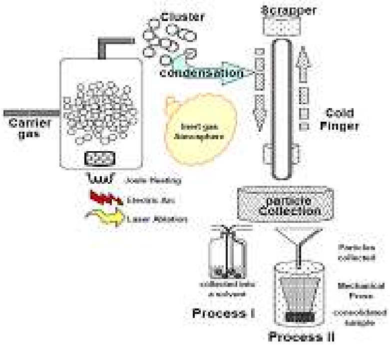
Gas phase process



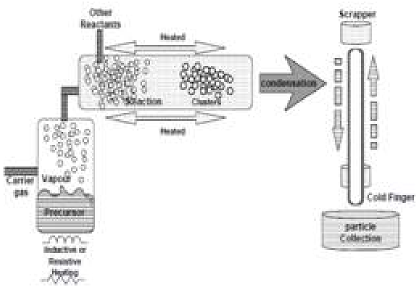
Sol-gel process



Flame assisted ultrasonic spray pyrolysis



Gas condensation process



Chemical vapour condensation process

8. Application of nanomaterials

Nanomaterials having wide range of applications in the field of electronics, fuel cells, batteries, agriculture, food industry, and medicines, etc. It is evident that nanomaterials split their conventional counterparts because of their superior chemical, physical, and mechanical properties and of their exceptional formability. Some applications of nanometarials in our modern life are denoted in the following:

8.1. Fuel cells

A fuel cell is an electrochemical energy conversion device that converts the chemical energy from fuel (on the anode side) and oxidant (on the cathode side) directly into electricity.

8.2. Catalysis

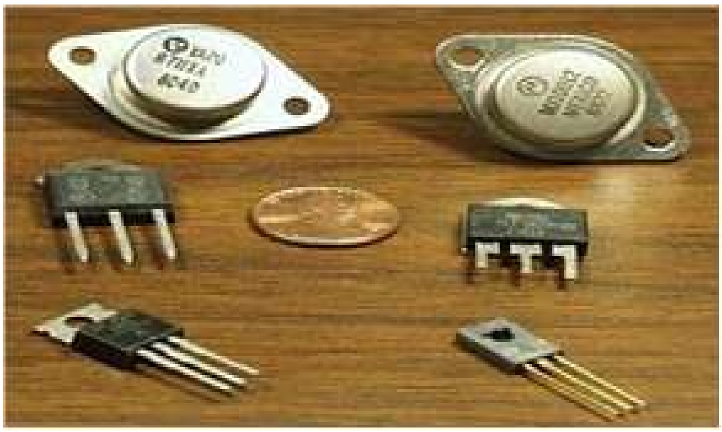
Higher surface area available with the nanomaterial counterparts, nano-catalysts tend to have exceptional surface activity. For example, reaction rate at nano-aluminum can go so high, that it is utilized as a solid-fuel in rocket propulsion, whereas the bulk aluminiumis widely used in utensils.

8.3. Phosphors for High-Definition TV

The resolution of a television, or a monitor, depends greatly on the size of the pixel. These pixels are essentially made of materials called "phosphors," which glow when struck by a stream of electrons inside the cathode ray tube (CRT). The resolution improves with a reduction in the size of the pixel, or the phosphors. Nanocrystalline zinc selenide, zinc sulfide, cadmium sulfide, and lead telluride synthesized by the sol-gel techniques are candidates for improving the resolution of monitors. The use of nanophosphors is envisioned to reduce the cost of these displays so as to render high definition televisions (HDTVs) and personal computers affordable to be purchase.

8.4. Next-Generation Computer Chips

The microelectronics industry has been emphasizing miniaturization, whereby the circuits such as transistors, resistors, and capacitors, are reduced in size. Researchers have succeeded in making the junction less transistor having nearly ideal electrical properties.



Silicon nanowires in junctionless transistors

8.5. Other application

Nanomaterials have more other application in our modern life. It is used in sunscreen lotion, Sensors and used to eliminate pollutants.

9. Disadvantages of Nanomaterials

(I) Nanomaterials are thermodynamically metastable and lie in the region of high-energy local minima. Hence they are prone to attack and undergo transformation. These include poor corrosion resistance, high solubility, and phase change of nanomaterials.

(II) Fine metal particles act as strong explosives owing to their high surface area coming in direct contact with oxygen. Their exothermic combustion can easily cause explosion.

(III) Nanomaterials are usually considered harmful as they become transparent to the cell- dermis. Toxicity of nanomaterials also appears predominant owing to their high surface area and enhanced surface activity. Nanomaterials have shown to cause irritation, and have indicated to be carcinogenic. If inhaled, their low mass entraps them inside lungs, and in no way they can be expelled out of body. Their interaction with liver/blood could also prove to be harmful.

(IV) There are some complexcity and difficulty in synthesis, isolation and application of nanometarials.

(V) There are no hard-and-fast safe disposal policies evolved for nanomaterials. Issues of their toxicity are still under question, and results of exposure are not available. Hence the uncertainty associated with affects of experiments nanomaterials is yet to be assessed in order to develop their disposal policies.

References

https://www.google.co.in

Conducting Polymers

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B.Sc., Chemistry Hons., 1st Year

Project Mentor :
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Introduction

When you think of electricity, what's the first thing that comes to your mind? Probably a wire which is made of metal! We use to think that the metals are best in conducting current and it's true that metals are found in pretty much all the electronics that we use such as T.V.s, phones, computers, etc but, believe it or not, there are certain non metals such as conducting polymers that can act as good conductors too. These conducting polymers are commonly known as *Intrinsically conducting polymers* and also termed as *Inherently Conducting Polymers* (ICPs). These are also affectionately called as *Synthetic Metals*.

Historical background

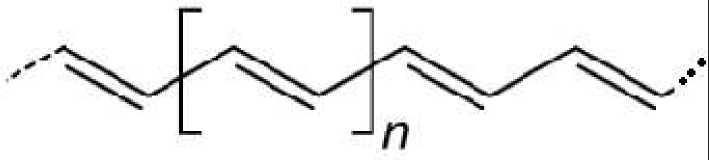
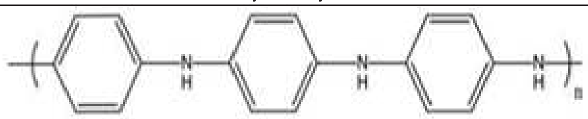
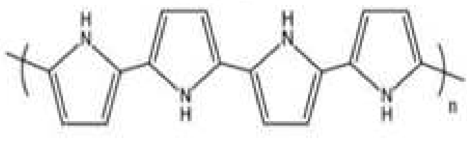
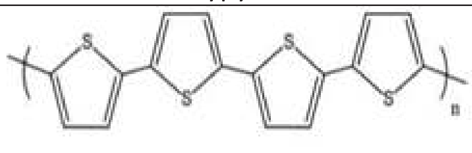
Polymers prepared from organic molecules were previously considered as insulators or as best as semiconductors. Wondering if this strange substance (one thin film prepared from polyacetylene) could sustain metallic properties, renowned Japanese scientist Shirakawa shared his discovery with another famous American scientists Alan MacDiarmid and Alan Heeger. After experimenting with many processes, they found that the conductivity of polyacetylene actually increased to the extent of metals by the treatment of iodine, the process is called doping [Doping is accomplished by chemical methods of direct exposure of the conjugated polymer to a charge transfer agent (dopant) in the gas or solution phase, or by electrochemical oxidation or reduction]. The accidental discovery of polyacetylene rocked the field of polymers (1978) to the forefront and opened up revolutionary possibilities for experimentation. This discovery was recognized by the nobel prize in chemistry in 2000. Metals could generally be the best conductors we have available today, but there are many downside to its use. Mining, shipping and processing metals are expensive. Conducting polymers are attractive alternative being very cheap and functionally versatile. Because of its ease of synthesis, ready dopability with a range of dopants, good environmental and thermal stability, redox properties and relatively high electrical conductivity, ICPs occupy a pivotal position in the field of modern advanced materials.

You might think that some acclaimed scientists made these conducting polymers with significant purpose, but like some other discoveries in science, this one was an accident. It happened in the laboratory of Hideki Shirakawa, a Japanese Scientist, when the polymer, polyacetylene was mixed incorrectly with Iodine.

Why conducting?

Like in metals the flow of electric charge in conductive polymers is generated by voltage, the difference in the electric potential of the positive and negative poles of the battery. The negatively charged electrons are drawn towards the positive pole and they create a current as they pass from atom to atom. The electrons in polymers are not delocalized and cannot easily move to conduct current. But if we look closely at polyacetylene, we will notice there is an alternating pattern of single and double bonds holding the atoms of the polymers together. This is known as the conjugated backbone. Along this backbone delocalized orbitals are formed where the mobility of electrons could be enhanced by a process called doping. This process changes the no of electrons in the polymers either by removing or adding electrons to the atom. Removing electrons (oxidizing) create empty spaces in the outermost orbital of the atom allowing the remaining electrons to move around freely through the chain of polymers. Adding electrons (reducing) create another orbital and so long as this orbital is in vogue the electrons have more space to move around from atom to atom. Conducting organic polymers associated with a protic solvent may also be self-doped.

Few common Inherently Conducting Polymers

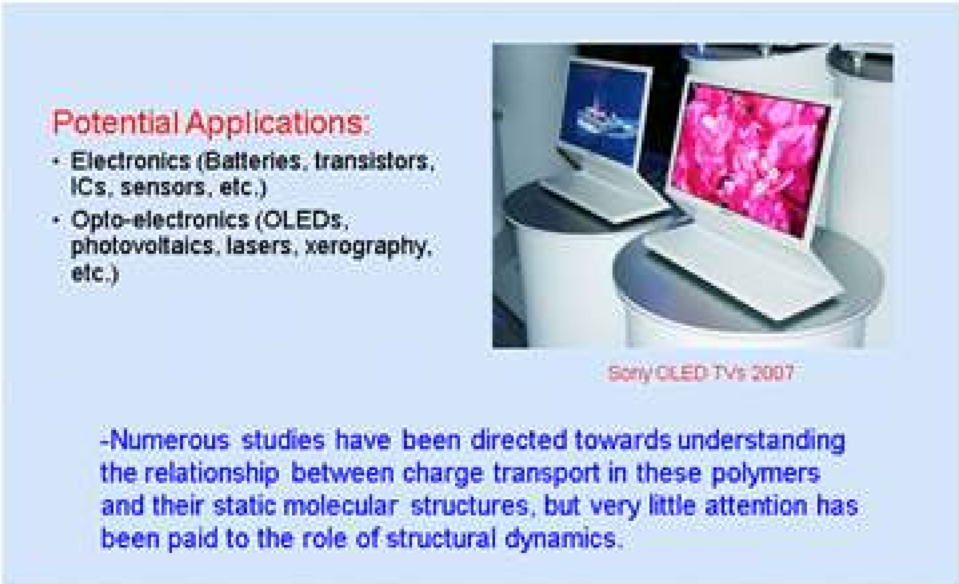
Monomers used	Polymers formed	Doped with	Conductivity (S/Cm)
Acetylene	 Polyacetylene	I_2, Br_2, Cl_2, AsF_5	$\sim10^5$
Aniline	 Polyaniline	HCl	$\sim10^3$
Pyrrole	 Polypyrrole	$FeCl_3$	$\sim2\text{-}10^5$
Thiophene	 Polythiophene	I_2, $FeCl_3,6H_2O$, Gold trichloride	~1000 ~1

Applications

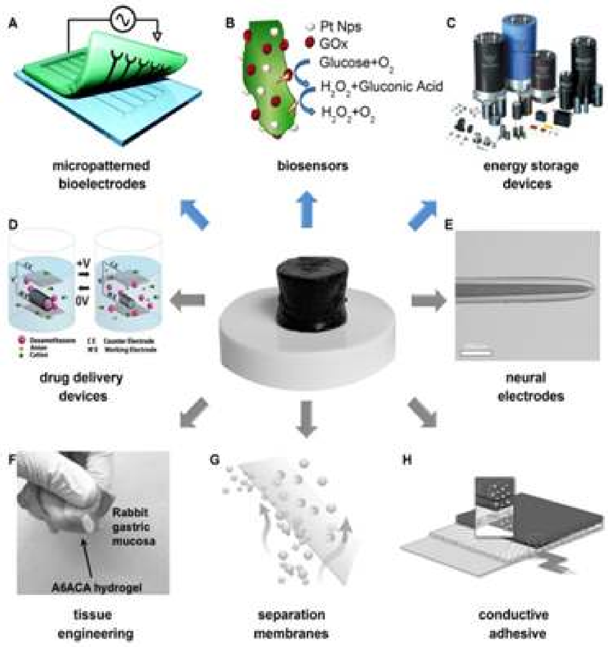
Conducting polymers are extensively studied due to their remarkable electronic properties such as electrical conductivity, low ionization potential and high electron affinity. Since the late 1980s ICPs are being expolited in different field. Organic light- emitting diodes (OLEDs) have emerged as an important application of conducting polymers.


OLED

In this case light is emitted when a voltage is applied to a thin layer of a conductive organic film.Their application to solar cells, biosensors, and biofuels have been extensively explored during the last decade.

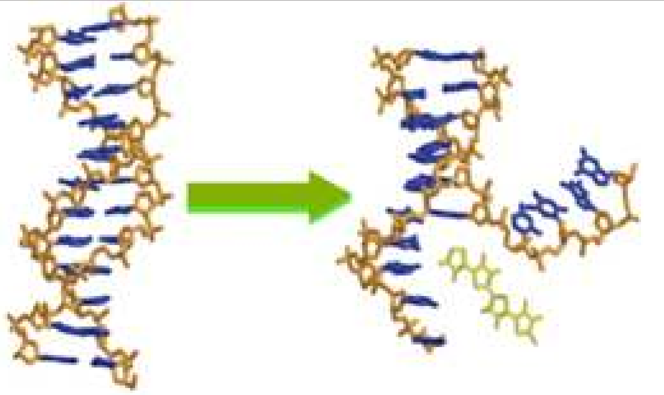


Due to several disadvantages, such as, heavy weight, high cost and lack of flexibility, the silicon-based solar cells were replaced by organic photovoltaic cells and dye-sensitised solar cells which have conducting polymers as electron transfer mediators or photoreceptors to increase efficiency. Biosensors based on conducting polymers have been used to detect an inducible nitric oxide synthase, NADH, DNA, superoxide, thrombin etc. Conducting polymers are also known for their ability to be compatible with biological molecules and cells due to its sensitive conductivity and reversible doping/ de-doping process, thus allowing their applicability in vitro and in vivo biosensor fabrication,fabrication of drug releasing agents and gas separation membrane.



Applications of conducting Polymers

They are promising also in printing electronic circuits, supercapacitors, actuators, flexible transparent displays, electrochromism, electromagnetic shielding, microwave absorbent coatings,radar absorptive coatings on stealth aircraft.



Schematic view of the proposed mechanism for the interaction between plasmid DNA and the polythiophene derivatives bearing polar side groups.

White crystals of a thiophene monomer don't conduct electricity. After heating polymerises the material, it turns black and conducts electricity well enough to turn on a light bulb.

Rechargeable batteries made from conducting polymers are now being used in a variety of new applications which replaces the metallic electrodes. However, such batteries suffer from low charging rates, partly because thick layers of polymers are needed to achieve high charge capacities. Color change of the conducting polymers induced by the electrochemical doping/de-doping enables its use in the manufacture of multi-chromic displays or electrochromic windows.

True solutions from conducting polymers do not exist. Their surface tension is higher than any of the available solvents. The low solubility of most polymers have been addressed through the formation of nanostructures and surfactant-stabilised conducting polymer dispersions in water. Oxidative doping diminishes the solubility of conductive polymers in organic solvents and water and hence their processibility.

Conducting polymers are rapidly gaining attraction in new applications with increasingly processable materials with better electrical and physical properties and lower costs.The new nano structured forms of conducting polymers (Nanofibres and nanotubes), with higher surface area and better dispersability have their potential applications in nanodiodes, field emission, field effect transistors, super-capacitors and energy storage, neural interfaces, and protein purification. Thus, ICPs have a variety of applications in all areas including industrial, scientific and medical fields. So, synthetic metals are one of the most promising material in this 21st century.

Sources

This is to certify that present project report is the outcome of our team's efforts and our indebtness to the Wikipedia, you tube, author Siegel Group,Bernhard Wessling and Prof. Yoon-Bo Shim has been duly acknowledged at the relevant places.

Quantum Computers : Computers of the Future

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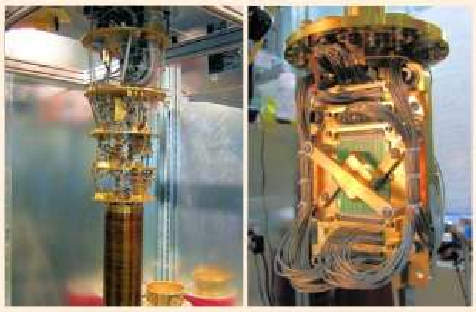
Introduction

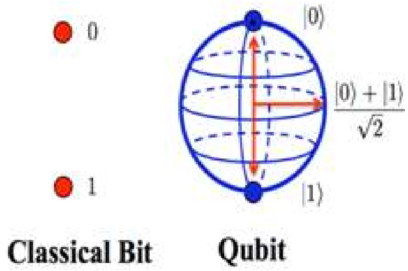
A **quantum computer** is a computation system that makes direct use of quantum-mechanical phenomena, such as superposition and entanglement, to perform operations on data. Quantum computers are different from digital computers based on transistors. Whereas digital computers require data to be encoded into binary digits (bits), each of which is always in one of two definite states (0 or 1).Quantum computers aren't limited to two states; they encode information as quantum bits, or **qubits**, which can exist in superposition. Qubits represent atoms, ions, photons or electrons and their respective control devices that are working together to act as computer memory and a processor. Quantum computers share theoretical similarities with non-deterministic and probabilistic computers.



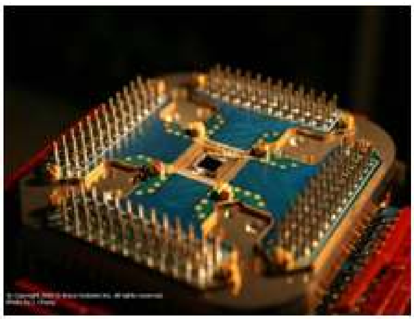
A Quantum Computer

Theoretical working of a quantum computer

Today's computers, like a Turing machine, work by manipulating bits that exist in one of two states: a 0 or a 1. Quantum computers aren't limited to two states; they encode information as quantum bits, or **qubits**, which can exist in superposition. Qubits represent atoms, ions, photons or electrons and their respective control devices that are working together to act as computer memory and a processor. Because a quantum computer can contain these multiple states simultaneously, it has the potential to be millions of times more powerful than today's most powerful supercomputers.



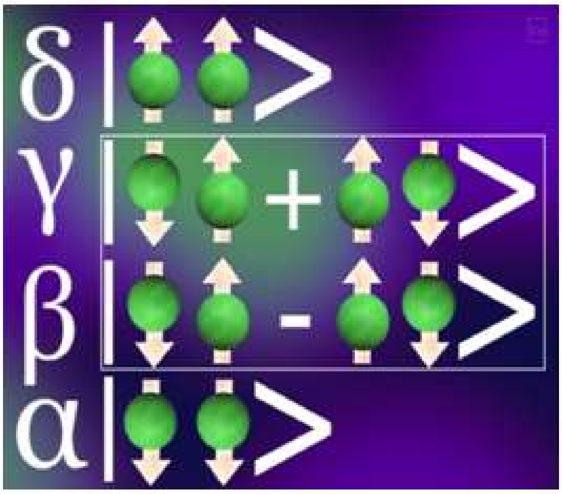
This superposition of qubits is what gives quantum computers their inherent **parallelism**. According to physicist **David Deutsch**, this parallelism allows a quantum computer to work on a million computations at once, while our desktop PC works on one. A 30-qubit quantum computer would equal the processing power of a



View of a 16-qubit processor mounted in its sample hold.

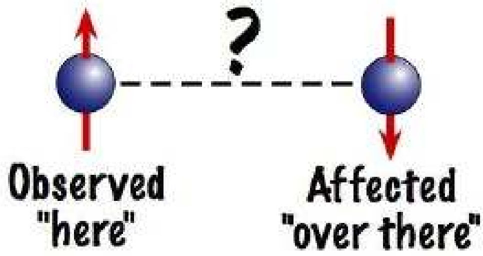
conventional computer that could run at 10 **teraflops** (trillions of floating-point operations per second). Today's typical desktop computers run at speeds measured in gigaflops (billions of floating-point operations per second).

Researchers use the outermost electron in phosphorus as a qubit. All electrons have a magnetic field so they are like tiny bar magnets and this property is called spin if we place them in a magnetic field they will align with the field just like a compass needle aligns with the magnetic field of the Earth. Now this is the lowest energy state so we call it the 'zero state' or we call it for the electron, 'spin down'. We can put it in a 'one state' but it'd take some energy and it's the highest energy state in principle if we are delicate and somehow put it exactly against the magnetic field, then it would stay there till it is disturbed by some external force.



If we have 2 bits of information then we can write 00, 10, 01 and 11. Here instead quantum mechanics allows us to make superposition of each one of the 4 states so we can write a quantum mechanical state which is perfectly legitimate i.e. shown in the image where alpha, beta, gamma and delta are the coefficients. So, to determine the state of this two spin system (where, 0 is the up spin and 1 is the down spin)we need to have 4 number or 4 coefficients. This is how we understand why 2 qubits actually contain 4 bits of information.Now if we have 3 spins then we would have 8 different states and we need 8 different numbers to define the state of those two spins. If we keep going what we find is that the amount of equivalent classical information contained in 'N' qubits is 2^N classical bits.

Limitations



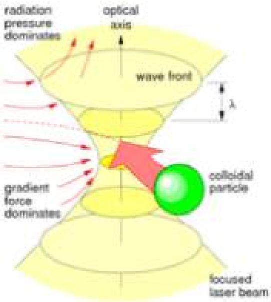
Entanglement of particles

The problem with the idea of quantum computers is that if we try to look at the subatomic particles, wewould bump them, and thereby change their value. If we look at a qubit in superposition to determine its value, the qubit will assume the value of either 0 or 1, but not both (effectively turning our spiffy quantum computer into a mundane digital computer). To make a practical quantum computer, scientists have to devise ways of making measurements indirectly to preserve the system's integrity. Entanglement provides a potential answer. In quantum physics, if we apply an outside force to two atoms, it can cause them to become entangled and the second atom can take on the properties of the first atom. So if left alone, an atom will spin in all directions. The instant it is disturbed it chooses one spin, or one value; and at the same time, the second entangled atom will choose an opposite spin, or value. This allows scientists to know the value of the qubits without actually looking at them.

Another problem is that we need to keep notice that we don't need up with a final result of our quantum computation which contains a highly complex superposition state because we can't measure a superposition state we can only measure the basic states. So what we need to do is we have to design the logical operation that we need, to the final computational result in such a way that the final result is something we can measure i.e. just the unique states.

Possible Solutions

Computer scientists can control the microscopic particles that act as qubits in quantum computers by using **control devices** and it's called qubit control.



Ion traps use optical or magnetic fields (or a combination of both) to trap ions.

Optical traps use light waves to trap and control particles.

Quantum dots are made of semiconductor material and are used to contain and manipulate electrons.

Optical Trap **Strontium Ion Trap**

Semiconductor impurities contain electrons by using "unwanted" atoms found in semiconductor material.

Superconducting circuits allow electrons to flow with almost no resistance at very low temperatures.

Future Developments

The future of Quantum computers as of now is not very certain particularly due to already known problems in areas such as de-coherence, error correction, output observance and cost related issues. But, if scientists succeed in developing a practically useful quantum computer, it may replace traditional computers in sectors such as robotics (Industrial Automation), cyber security, alternative energy etc. Such computers may also be deployed for solving emerging tactical problems like Tsunami alerts.

Quantum computers can scale up the possibility of enhancing computation power to a new and unanticipated peak point by providing a fast and efficient platform for high performance computing.

At present, we don't have very efficient systems capable of solving tactical problems such as

1. Correct weather forecasting
2. Predicting right patterns in stock markets
3. Analysing the molecular/ DNA part of human body in medical research.

Let's have a look at some areas where quantum computers can play a vital role in near future:

a) Robotics

Artificial intelligence (AI) was primarily meant to assist humans in executing complex jobs such as handling operations in the middle of a furnace blast or during space and military missions.

Today, robotic systems are heavily used in the industrial automotive world for boosting production. Introduction of quantum computing can give a major boost to AI by ensuring creation of even more powerful & intelligent robots. The capability of encoding information in fuzzy quantum states will multiply the power of these artificial creatures.

It would be possible to scan through large databases in few seconds with qubits.

Quantum AI techniques can dramatically speed up image acquisition and processing techniques.

Algorithms have already been developed and ready for implementation in quantum computers now. But recent failures in controlling Qubits inside laboratories, pose serious questions regarding the viability of quantum computing.

b) Cryptography

Developed robots featuring powerful qubit will be able to break maximum encryption code within near zero time. A quantum computer will possibly crack any possible password in an instant. No security algorithm will then be able to provide 100% security to content placed on web servers. As far as the Internet is concerned, everything will have to be redefined using quantum computers.

c) Alternative Energy

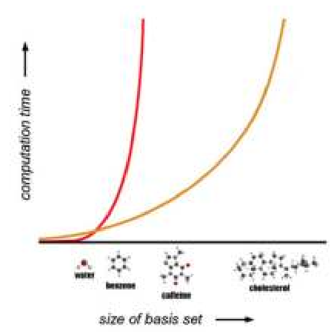
Qubits (known as Quantum dots in solar terminology) can be largely deployed in solar panels to replace the current photovoltaic cells technology. Quantum dot is a nanoscale particle of semiconducting material that can be embedded. It can therefore revolutionize the renewable energy sector. Qubits can also be used to make quantum batteries in order to store energy generated by powerful windmills.

d) Quantum Communication

Quantum computers can be connected in series to form a quantum network, thus building a smart grid. They will offer high encoding and decoding speeds with fast transfer of information (qubits).Smart energy grids will offer high efficiency in energy delivery system. Additionally, quantum computers can also be used to process large amount of data coming from geothermal activities. The already developed and much touted quantum computer from ‘D-Wave’ systems is 3600 times powerful than a conventional PC. But the project was declared a failure on application front by Google. Questions about the real-world feasibility of such expensive projects remain unanswered. But, given the fact that everything from cellphones, wireless networks and electricity was no less than a miracle few dozen years ago, quantum computing too may appear as a miracle at first and slowly become an integral part of our lives.

Conclusion

Quantum computers are not a replacement for classical computers they are not universally faster. They are only faster for special types of calculation where we can use the fact that we all these quantum superposition available to us at the same time to do some kind of computational paralysis. If we just want to watch videos, listen to music, write a document or browse the internet i.e. we need to use a classical algorithm to get to the result then quantum computers are not going to give us any particular improvement from that of classical computers. So, we shouldn’t think of quantum computers as something were every operation is faster in fact, every operation is probably going to be slower



An impressionistic view of why quantum computers are needed for exact solutions of the electronic structures of large molecules: as basis sets (the information needed to describe the orbital states of each particle in the system) grow, the calculation time increases, exponentially in the case of classical computers (red) but only polynomially in the case of quantum computers (orange).

but it’s a computer where the number of operations required to arrive at the result is exponentially small. The improvement is not in the speed of the individual operation it’s in the total number of operation we need to arrive at the result.

Quantum computers could one day replace silicon chips, just like the transistor once replaced the vacuum tube. But for now, the technology required to develop such a quantum computer is beyond our reach. Most research in quantum computing is still very theoretical.

The most advanced quantum computers have not gone beyond manipulating more than 16 qubits, meaning that they are a far cry from practical application. However, the potential remains that quantum computers one day could perform, quickly and easily, calculations that are incredibly time-consuming on conventional computers.

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Cryptography & Hacking

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Abstract

For the first few decades computer networks are primarily used by university researchers for sending e-mail and by corporate employees for sharing printers. Under these conditions security did not get a lot of attention. Now as millions ordinary citizens are using networks for banking, shopping & filling their tax returns and weakness after weakness has been found in network security. Hence it becomes a problem of massive proportions. In this topic we will learn about network security from several angles, point out numerous pitfalls & discuss many algorithms & protocols for making network more secure.

Introduction

Most security problems are intentionally caused by malicious people trying to gain some benefit, get attention or harm someone. A few of those are listed below. But security systems should be designed accordingly.

Adversary	Goal
Student	To have fun snooping on people's e mail
Terrorists	To steal biological warfare secrets
Cracker	To steal someone's data; test security system
Accountant	To steal money from a company
Government	To learn enemy's military or industrial state

Network security problems can be divided roughly into four closely areas:

1. Secrecy
2. Authentication
3. Non- Repudiation
4. Integrity Control.

Searcy also called confidentiality, has to do with keeping information out of the grubby little hands of unauthorized users. Authentication deals with signatures. Finally Integrity Control has to do with how you can be sure that a message you received was really the one sent and not something that a malicious adversary modified in transit.

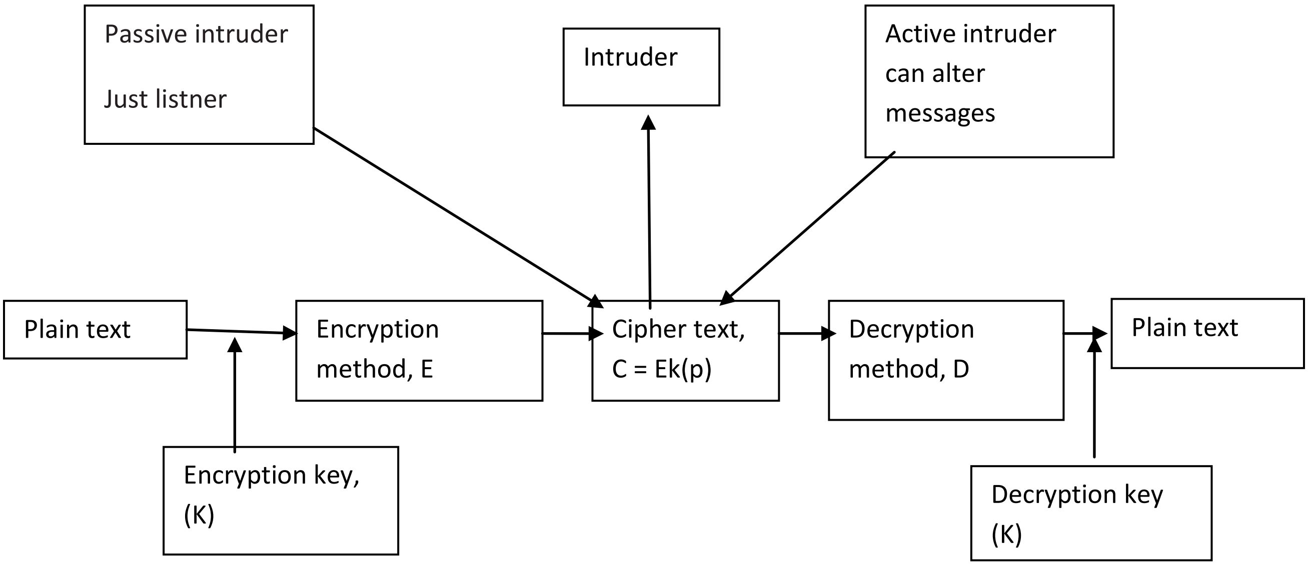
Cryptography

Cryptography is a method of shorting & transmitting data in a particular form so that only those for whom it is intended ca read and process it. The term is most often associated with scrambling plain text (ordinary text, sometimes referred to as clear text) into cipher text (a process called encryption) then back again (known as decryption).

Historically four groups of people have used and contributed to the art of cryptography

1. The Military
2. The Diplomatic Corps
3. The Diarists
4. The Lovers

Of these the military has had the most important role & has shaped the field over the centuries.



The Encryption Model

The message to be encrypted known as plain text, are transformed by a function that is parameterized by a key. The art of breaking ciphers, known as cryptanalysis & is collectively known as Cryptography.

A fundamental rule of cryptography is that one must assume that the cryptanalyst knows the method used for encryption & decryption. This is where the key enters. The key consists of a short string that selects one of many potential encryptions. The idea that the cryptanalyst knows the algorithm and that the secrecy lies exclusively in the keys called Kerckhoff's principal which is "All algorithms must be public: only the keys are secret". Encryption methods have been historically divided into two categories.

1. Substitution Ciphers
2. Transposition Ciphers

In a substitution cipher, each letter or group of letter is replaced by another letter or group of letter. For example, ATTACK becomes DWWDFN.

Transposition ciphers, in contrast, re- order the letters but do not disguises them. In this example MEGABUCK is the key. Like:

M EGABUCK

7 4 5 1 2 8 3 6

P l e a s e t r

a n s f e r o n

e m i l l I o n

d o l l e r s t

o m y s w i s s

b a n k a c c o

u n t s i x t w

o t w o a b c d

Plain text: Please transfer one million dollars to my Swiss bank account six two two.

Cipher text: afllsksoselewaiatoossctclnmomantesilyntwrnntsowdpaedobuoerlricxb.

Hacking

The explosive growth of internet has brought many good things; electronic commerce, e-mail etc but it has a dark side too; criminal hackers. Government Company, private citizens are anxious to be a part of it. The term 'Hacker' means A person who enjoys learning the details of computer; who program's enthusiastically or who enjoys programming rather than just theorizing about programming. In the search for a way to approach the problems, organizations come to realize that one of the best ways to evaluate intruder threat to their internets would be to have independent computer security professional attempts break into computer system. In this case of computer security these "Tiger Terms" or Hackers" would employ the same tool and techniques as the intruders but they would neither damage target systems nor steal information. Instead they would evaluate the target system's security & report back to the owners with the vulnerabilities they found and instructions for how to remedy them. They are called Ethical Hackers. Now hackers typically have a very strong programming and computer networking skills and have been in computer & networking business for several years and they are known to be extremely patient and willing to monitor system for days or weeks while waiting for an opportunity. They notice three things:

1. What can he see on the target?
2. What can he do with the information?
3. Does anyone notice his attempts or success?

While first & second of these are clearly important but the third is more than it. When owner does not notice when tries to break it, he can and ha will spend weeks or months and eventually succeed. The main goal of these hackers simply do not care who your company or organization is; they hack your web as they can. For example in 1998 somebody attack UNICEF'S page and replaced it with pornography.

Conclusion

The idea of testing the security of a system by trying to break into it is not new. From a practical standpoint the security problem will remain as long as manufactures remain committed to current system without a firm requirement for security. Regular auditing, good system administration practice are all essential part of an organizations security. While Ethical Hackers can help clients better understand their security needs and protect from criminal hackers. Now it is up to clients to keep their guards in place.

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Balance of Payment Performance and Exchange Rate

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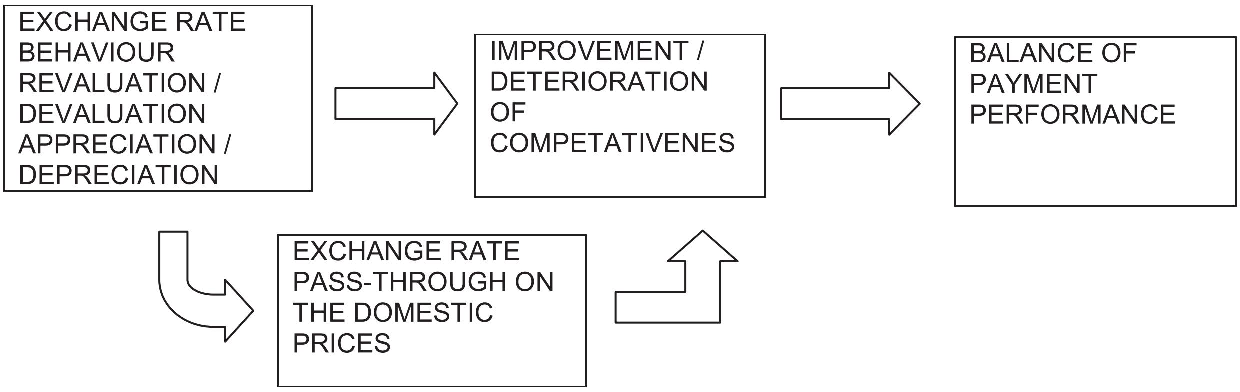
Abstract

There is a very close linkage between the exchange rate policy and BOP position of an economy for stabilization. India had been following a basket – pegged regime until the 1991 reforms. However, after 1991 India shifted to a floating exchange rate regime. Empirical evidence shows that such changes in policies by nations have produced varying results. While some countries were greatly benefitted by such policy measures, other have had to face catastrophic results. During the period from 1947 to 1991, India followed the par value system of exchange rate whereby the rupee's external par value was fixed at 4.5 grains of fine gold. The devaluation of the rupee in September 1949 and June 1966 in terms of gold resulted in the reduction of par value of rupee in terms of gold to 2.88 and 1.83 grains of fine gold respectively. After 1991, the dual exchange rate system was replaced by unified exchange rate system in March 1993. The entire period of 1991 moved towards a market determined exchange rate system which revealed that the Indian rupee has generally depreciated against the dollar during the last 15 years except 2003-2005 and 2007-2008 when the Indian rupee appreciated on account of dollar's global weakness and large capital inflows. India suffered a prolonged deficit in the current account and poor BOP performance during the pre reform period whereas the situation improved after India achieved economic openness in 1991 which led to a trade surplus in BOP in the subsequent years. This paper has studied the scenario prevailing in India prior to 1991 with special emphasis on 2012 and thus provides us with results which is very useful for policy makers to control the BOP situation and foreign exchange reserves effectively.

Introduction

The exchange rate is the price of national currency in terms of foreign currency. The close linkage of the exchange rate to the general price levels of the economies produce an economy wide importance of policy making since it affects the real income and wealth of those economies. One of the major objectives of the exchange rate based stabilizations is to improve the Balance of Payment (BOP) performance through international competitiveness. Countries have been using this strategy for a considerable period of time producing varying results. The empirical observations reveal that some countries were successful in following the particular strategy while some countries produced disastrous results. Under these circumstances the obvious question that has to be answered is "What are the reasons for producing such varying results?" The objective of this study is to analyze India's exchange rate behavior, competitiveness and BOP performance. As per Flow Chart, the main policy objective is to improve the BOP performances through external competitiveness allowing the nominal exchange rate to depreciate. External competitiveness is generally measured using the behavior of the Real Exchange Rate (RER) in terms of bi-lateral trade and Real Effective Exchange Rate (REER) in multi-lateral trade.

CONCEPTUAL FRAMEWORK FOR RELATIONSHIP BETWEEN EXCHANGE RATE, PRICE LEVEL AND BOP PERFORMANCE



Exchange rate management plays a role complementary to trade policy as exchange rate movements can be used for correcting the imbalances in the current account of the balance of payments. With rapidly increasing integration of global financial markets and increased capital mobility across the world, exposure to exchange rate risks has also increased. Many instances can be cited when exchange rate changes have played havoc with the economies-like the Mexican crisis in 1992, East Asian meltdown in1997, Russian crisis in 1998, and the experience of Argentina in 2002. This paper aims to study the effect of exchange rate on the balance of payment and has been divided in to 4 major sections

- **SECTION I** – Presents research question and includes the literature survey on the assigned topic.
- **SECTION II** – Deals with the research question with the help of Bar Diagrams and Line chart
- **SECTION III** – Includes data and methodology explaining the methods of the research and corresponding results based on the research question.
- **SECTION IV** – Concludes the paper with a conclusion based on the analysis and research.

SECTION 1

1.1 Literature Survey

In Mishra and Puri (2010) it was pointed out that **The Balance of payments (BOP)** Statement is essentially a double-entry system of record of all economic transactions between the "residents" of a country and the rest of the world carried out in a specific period of time.(Mishra & Puri, 2010)

The above definition can be summed up as following – "Balance of payment is a summary of all transactions between the residents of one country and rest of the world for a given period of time, usually one year.According to Mishra and Puri BOP have 2 major categories: the current account and the capital account.

The Current Account - The transactions relating to goods, services and income, constituting the current account on the balance of payments, are functionally classified into two broad categories: merchandise and invisibles.(Mishra & Puri, 2010)

The Capital Account in India is classified into three main sectors: i) private capital, ii) banking capital, and iii) official capital. Private capital is sub-divided into a) long term and b) short-term, with loans of original maturity of one year or less constituting the relevant dividing line. Banking capital essentially covers movements in the external financial assets and liabilities of commercial and cooperative banks. Official capital transaction's, RBI's holding of foreign currency assets and monetary gold, are classified in i) loans, ii) amortisation and iii) miscellaneous receipts and payments.(Mishra & Puri, 2010)

The significance of a deficit or surplus in the BOP has changed since the advent of floating exchange rates. Traditionally, BOP measures were used as evidence of pressure on a country‘s foreign exchange rate. This pressure led to governmental transactions that were compensatory in nature, forced on the government by its need to settle the deficit or face devaluation. The effect of an imbalance in the BOP of a country works somewhat differently depending on a country having a fixed exchange rate, nominal exchange rate or real effective exchange rate.

Exchange rate

According to The Reserve Bank of India the exchange rate is a key financial variable that affects decisions made by foreign exchange investors, exporters, importers, bankers, businesses, financial institutions, policymakers and tourists in the developed as well as developing world. Exchange rate fluctuations affect the value of international investment portfolios, competitiveness of exports and imports, value of international reserves, currency value of debt payments, and the cost to tourists in terms of the value of their currency.(Publications, 2010)

The Nominal Exchange rate is simply the price of one currency in terms of the number of units of some other currency. This is determined by fiat in a fixed rate regime and by demand and supply for the two currencies in the foreign exchange rate market in a floating rate regime. It is 'nominal' because it measures only the numerical exchange value, and does not say anything about other aspects such as the purchasing power of that currency. In a floating rate regime, an increase in the value of the domestic currency against other currencies is called an appreciation, while a decrease in value is called depreciation.(Publications, 2010)

The Real Exchange Rate In contrast, an increase in the exchange rate in a fixed rate regime is called a revaluation and a decrease in the exchange value of the domestic currency is referred to as devaluation. The real exchange rates on the other hand are nothing but the nominal exchange rates multiplied by the price indices of the two countries. This means the market price level of goods and services, given by indices of inflation. So if the price level in the US is higher than the price level in India, then the real exchange rate of the rupee versus the dollar will be greater than the nominal exchange rate.

NEER and REER: NEER is the Nominal Effective Exchange Rate, and REER is the Real Effective Exchange Rate. Unlike nominal and real exchange rates, NEER and REER are not determined for each foreign currency separately. Rather, each is a single number (usually expressed as an index) that expresses what is happening to the value of the domestic currency against a whole basket of currencies.(Publications, 2010)

Following section points out some research questions that are dealt in the subsequent sections.

1.2 Research Questions

- Trends in Balance of payment during and after planning period
- Exchange rate prevailing in India during planning period and after reform period
- Did the Balance of payment situation improve when India moved from basket-pegged exchange rate system to flexible exchange rate system?

SECTION II

2.1 Trends in Balance of Payment During and After Planning Period

India faced pressure on the balance of payment since the planning period due to either the external or internal factors. Planning period was divided into three parts to study the trends in balance of payment which are as follows:

I. Period 1:1950-1980

The period comprising the second, third and fourth plans and first two years of fifth plan saw a heavy deficit in balance of payment due to wars, several droughts and the first oil shock in 1973.

The BOP in 50'S

In 1951-52, there was a large trade deficit and as a result, despite net surplus invisible transfers and capital account surplus there was overall deficit on the current and capital accounts, which was met by the official reserves account. In 1952-53 and 1953-54, the net surplus invisible transfers was more than the trade deficit and capital account deficit. As a result India faced a current account surplus and an overall surplus in BOP. In 1954-1955 there was a surplus in both current and capital account due to the repayments by IMF. The scenario changed after the second five year plan, India laid to development of heavy and basic industries which laid to large imports of heavy machinery from the foreign market. Throughout the late 50's India experienced the outflow of official reserve account leading to fall in foreign exchange reserve.

The BOP in 60's

There was an increase in trade and current account deficit due to the large scale imports of food grains, machinery and equipment's. Due to the presence of large deficit in BOP India approached the IMF for assistance, IMF borrowing supplemented loans to meet the current account deficit. On the whole there was a net outflow of foreign reserves. Heavy trade deficit, debts and sharp fall in foreign exchange reserve led to a devaluation of rupee in 1966. The rupee was devalued against the US dollar by 57.5 percent. This exchange rate adjustment enabled India to curtail imports and encouraged the growth of exports. However India continued to have a trade and current account deficit as a result, there was a substantial increase in external assistance.

The BOP in 70's

In early 70's there was a large increase in imports due to which there was a trade deficit and even the deficit can be seen in invisible transfers. In 1973-74, however, the country had a substantial current account surplus despite a trade deficit of Rs. 510 crore. This was due to large surplus in terms of invisible transfers. In 1973-74, the oil importing countries, experienced the first oil-price hike-shock. This put a severe pressure on the balance of payments of these countries by raising the import bill. The adjustment to the first oil shock of 1973-74 was by a combination of exports, private transfer receipts and increased inflow of external aid.

II. Period II: 1981-82 to 1990-91

This period broadly correspond the period of Sixth and seventh plan which witnessed a severe BOP difficulties. The main reason for these difficulties were widening of trade deficits, decline in net receipts, the third oil shock during 1990-91, during 1990's domestic political development affected confidence abroad etc. Due to the severe international recession the export performance of India depressed. The latter half of the 80s saw the building up of strains on the balance of payments. Trade deficits and consequently current account deficits increased substantially and remained at high levels throughout. Recovering from the stagnation in 1985-86, the volume growth of exports in thesubsequent four years ranged between 10 to 12 percent per annum.

III. Period III: 1991-92 onwards

The reforms of 1990's have facilitated India to Move away from closed economy framework towards a more open and liberal economy, foreign exchange reserves were built to very comfortable and the difficulties of BOP has come under control the reason for the same were in 1991-92 the government introduced a sharp compression policy for imports and also restored the source to finance the current account deficit, due to this policy the current account deficit became less than 1% of the GDP. Since 1991 there was an increase in exports but from 1996 to 97 there a slowdown in the world trade. After 2003-04 the foreign exchange reserve were very comfortable.

The BOP situation during the 2012 was more comfortable. In January 2012 there was an appreciation in rupee by 2.6 percent due to Reserve Bank of India (RBI) intervention, measures to augment supply of foreign exchange in the domestic market, steps to curb speculative activities, and general improvement in India's economic outlook.(Karmakar, 2010)

2.2 Exchange Rate Prevailing in India

This section highlights the characteristics of the exchange rate before and after the reform period.

I. Exchange Rate Before Reform Period

In the post-independence period, India's exchange rate policy has seen a shift from a par value system to a basket-peg and further to a managed float exchange rate system. During the period 1947 till 1971, India followed the par value system of the exchange rate whereby the rupee's external par value was fixed at 4.15 grains of fine gold. The RBI maintained the par value of the rupee within the permitted margin of ±1% using pound sterling as the intervention currency. The devaluation of the rupee in September 1949 and June 1966 in terms of gold resulted in the reduction of the par value of rupee in terms of gold to 2.88 and 1.83 grains of fine gold, respectively. Since 1966, the exchange rate of the rupee remained constant till 1971 (Chart 2.1).

Chart 2.1: History of rupee dollar exchange rate

Source: www.rbi.com

With the breakdown of the Bretton Woods System, in December 1971, the rupee was linked with pound sterling. Sterling was fixed in terms of US dollars under the Smithsonian agreement of 1971; the rupee also remained stable against dollar. In order to overcome the weaknesses associated with a single currency peg and to ensure stability of the exchange rate, the rupee, with effect from September 1975, was pegged to a basket of currencies. The currencies included in the basket as well as their relative weights were kept confidential by the Reserve Bank to discourage speculation.

II. Reform Measure After 1991

The initiation of reform a two-step downward exchange rate adjustment by 9 per cent and 11 per cent between July 1 and 3, 1991 to counter the massive draw down in the foreign exchange reserves, to install confidence in the investors and to improve domestic competitiveness. The two-step adjustment of July 1991 effectively brought to a close the period of pegged exchange rate. Following the recommendations of Rangarajan Committee to move towards the market determined exchange rate, the Liberalised Exchange Rate Management System (LERMS) was put in place in March 1992 involving dual exchange rate system in the interim period. The dual exchange rate system was replaced by unified exchange rate system in March 1993. The entire

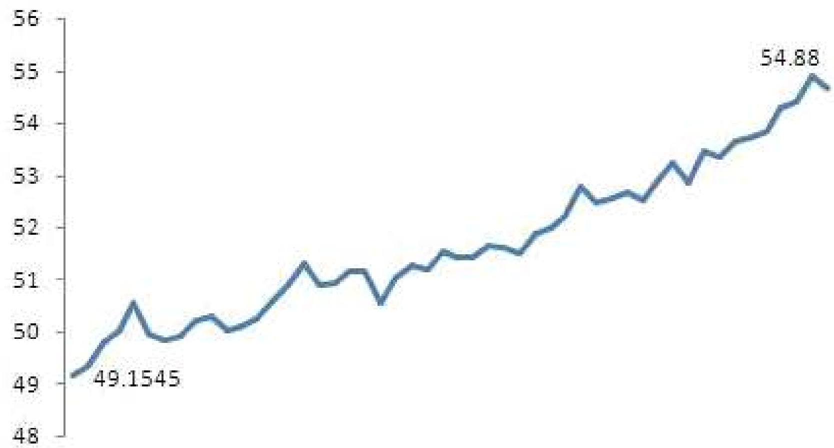


Figure 1: Changes In Exchange Rate During 2012

Source RBI,Clearing Corporation of India Limited (Vasudevan, 2012) period of 1991 moved towards a market determined exchange rate system which reveals that the Indian Rupee has generally depreciated against the dollar during the last 15 years except during the period 2003 to 2005 and during 2007-08 when the rupee had appreciated on account of dollar's global weakness and large capital inflows.

In 2012 India still follows a market determined exchange rate system and in the recent trend it can be seen that the rupee has depreciated steeply against the dollar. From figure 2 it can be seen that INR/USD exchange rate from August 2011 (45.3) to May 2012 (around 53-54) to highlight the 18% decline in that period.

2.3 Fluctuation in Balance of Payments after the Reform Period

In March 1993 India moved from the earlier dual exchange rate regime to a single, market determined exchange rate system. Under this system, there is no officially fixed exchange rate of the rupee. Instead, the rate is determined by the demand and supply conditions in the foreign exchange market. The role of R.B.I. is confined to intervening to maintain orderly market conditions and to curb excessive speculation. The changes in exchange rate lead to changes in current account balance and overall fluctuation in BOP surplus and deficit.

I. Fluctuation in Current Account Balances

Current account balances are presented in Table 1 and Table 2.

Table 1: Current Account Balances From 1990-2001

	1990-91	1991-92	1992-93	1993-94	1994-95	1995-96	1996-97	1997-98	1998-99	1999-00	2000-01
1. EXPORTS	18477	18266	18869	22700	26783	32311	34133	35680	34298	37542	44894
2. IMPORTS	27914	21064	23237	23985	31269	43670	48948	51187	47544	55383	59264
OF WHICH:POL	6028	5364	6100	5650	5882	7526	10036	8164	6399	12611	15650
3. TRADE BALANCE	-9437	-2798	-4368	-1285	-4506	-11359	-14815	-15507	-13294	-17481	-14370
4. INVISIBLES(NET)	-243	1620	842	970	2191	5449	10196	10007	9208	13143	11791
NON-FACTOR SERVICES	979	1207	1168	777	-494	-197	726	1319	2165	4064	2478
INVESTMENT INCOME	-3752	-3830	-3422	-4002	-3905	-3250	-3307	-3452	-3544	-3559	-3841
PVT TRANSFERS	2069	3783	2773	3825	6200	8506	12367	11830	10280	12256	12798
OFFICIAL TRANSFERS	461	460	363	370	390	345	410	379	307	382	336
5. CURRENT ACCOUNT BALANCE	-9680	-1178	-3526	-315	-2315	-5910	-4619	-5500	-4038	-4698	-2579

Source Economic Survey Part II 1991-92 (Government Of India, 1991-11)

Table 2: Current Account Balance 2001-12

	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12
1. EXPORTS	44915	53774	66285	85206	105152	128083	73665	189001	182442	250468	150909
2. IMPORTS	57618	64464	80003	118908	157056	191254	116066	308520	300644	381061	236674
OF WHICH:POL	14000	3255	1209	1244	30445	2300	3216	6577	3546	2434	10900
3. TRADE BALANCE	-12703	-10690	-13718	-33702	-51904	-63171	-42401	-119519	-118203	-130593	-85765
4. INVISIBLES(NET)	14054	17035	27801	31232	42002	53405	31688	91604	80022	84647	52923
NON-FACTOR SERVICES	4199	3643	10144	15426	23170	31180	14689	53916	36016	48816	31060
INVESTMENT INCOME	-2654	-3446	-4505	-4979	-5855	-6573	-1444	-7110	-8038	-17309	-9025
PVT TRANSFERS	12125	16387	21608	20525	24493	27941	18420	44798	52045	53140	30887
OFFICIAL TRANSFERS	384	-7047	-3574	-18276	-28734	-31361	-27712	-65603	-82187	-81777	-54705
5. CURRENT ACCOUNT BALANCE	1351	6345	14083	-2570	-9902	-9766	-10713	-27194	-38181	-45945	-32842

Source Economic Survey Part II 1991-92 (Government Of India, 1991-11)

Despite the shift to market determined system, the rupee dollar rate remained stable at about Rs.31.4 for over two years since March 1993. This was mainly due to the large inflow of foreign investments. If the rupee had been left to be determined solely by market supply and demand for foreign exchange, rupee would have appreciated sharply against dollar in this period. This would have affected exports and pushed up imports. Therefore, to prevent rupee appreciation, R.B.I. intervened by buying dollars (to the extent of US $ .13 billion during March 1993 – December 1994) in the market.

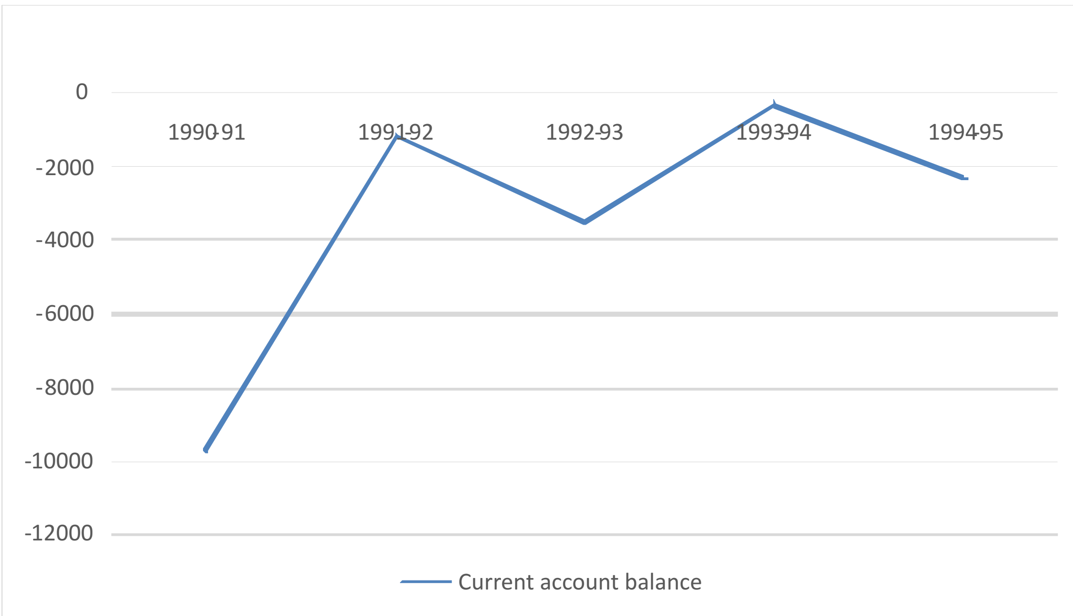


Figure 2: Current Account Balance 1990-95

From the above Figure 2 it can be seen that the current account balance during the year 1990-91 was -9680 it was a period in which India maintained a dual exchange rate regime. The situation improved in the year 1991-92. After adopting a market determined exchange rate in march 1993 the current account situation improved and had a balance of -315. In order to prevent the further appreciation RBI intervened which degraded the current account situation to a balance of -2315.

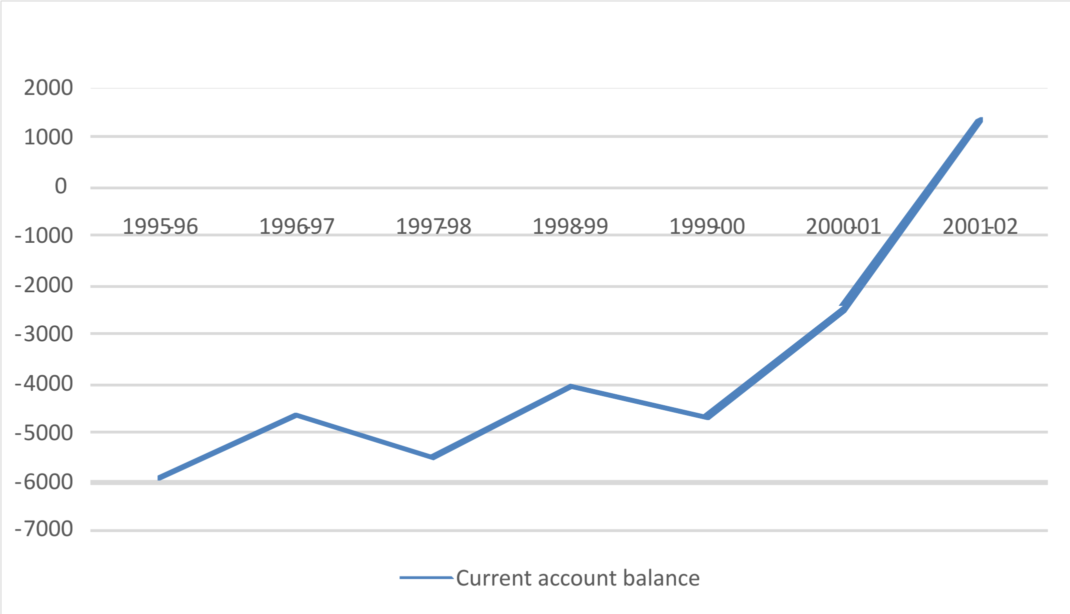


Figure 3: Current Account Balance 1995-02

The reduction in net capital inflows and the widening of the current account deficit in 1995-96 ended the period of surplus dollar availability. In fact, during the prolonged period of stability of the rupee-dollar rate from March 1993 to July 1995. India's competitiveness in international markets eroded due to higher rate of inflation in India as compared to the major trading partner nations. As a result, Real Effective Exchange Rate (REER) of the rupee appreciated by about 8 percent between 1993-94 and August 1995(TABLE 1).Had this erosion of India's competitiveness continued, it would have adversely affected exports, the trade balance and overall balance of payments. The market-triggered adjustment in the exchange rate which occurred after August 1995 resulted in an exchange rate of Rs.36.63 in February 1996. This brought REER of rupee back to approximately the level prevailing in March 1993. Thus, the change which occurred in the exchange rate in 1995-96 corrected the erosion in India's competitiveness and thereby stabilized export growth and contained import growth which can be seen in Table 1. But since then, the exchange rate of the rupee against the US dollar recovered to Rs.34.24 in April 1996(Government Of India, 1991-11). In the subsequent months of 1996 and early months of 1997, the rate moved in the narrow range of Rs.35.01 to Rs.35.93. The rupee-dollar rates remained steady although inflation in India was higher than in the major trading partner nations. This, again, resulted in some appreciation of the rupee in REER terms. Depreciation in rupee-dollar exchange rates will therefore, be helpful once again to improve the trade balance and current account balance.

The above Figure 3 shows the current account situation from the year 1995 to 2002 in which it can be seen that from the year 1995 to 2001 India had a current account deficit whereas in the year 2001-02 India had a current account surplus due to increase in exports and Invisibles.(Government Of India, 1991-11)

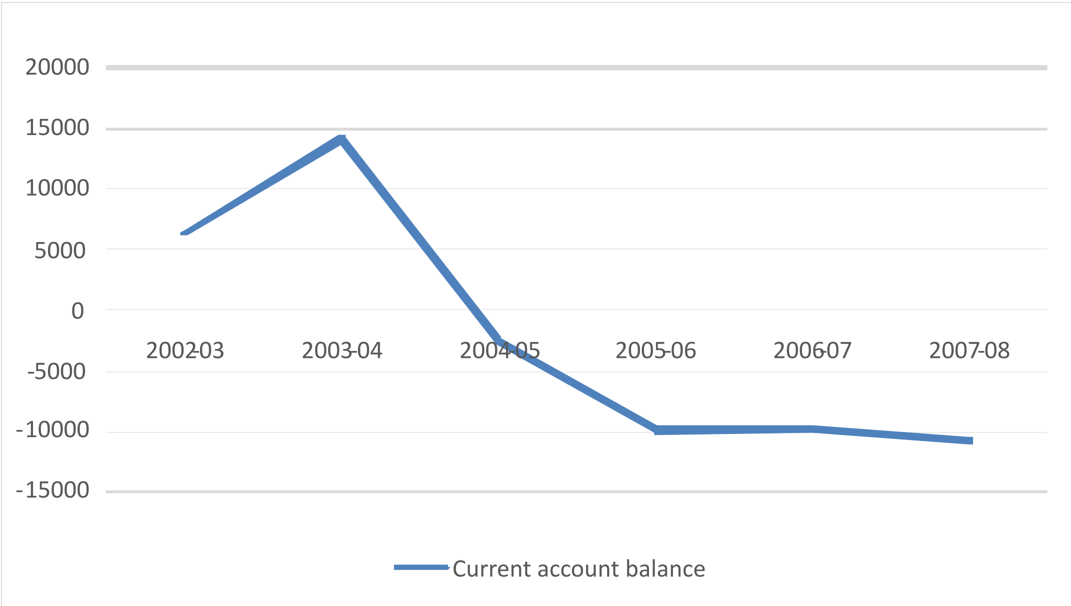


Figure 4: Current Account Balance 2002-08

There was a rise and fall in current account deficit during the period 2001-02 to 2007-08 Both the trade (goods & services) balance and the factor surplus improved between 2000-01 and 2003-04 leading to an improvement of the current account. The current account, after being in surplus during 2001-02 to 2003-04, faced a deficit in 2004-05.This was despite a growth in net invisibles account fuelled by export. During early 2004-05, the rupee ended a continuous twenty four months (May 2002-April 2004) run of appreciation against the US dollar and started weakening from May 2004 onwards which lead to an increase in exports from 85206 to 105152 (TABLE 2) The new phase, however, turned out to be relatively short-lived, as the rupee started to gain against the US dollar from September 2004. The third quarter of 2004-05 (i.e. October-December) saw a sharp firming up of the rupee against the US dollar with the nominal monthly appreciation a high of 2.6 percent in

December 2004. With a flexible exchange rate regime, and interventions limited to maintaining market conditions, the Rupee exhibited considerable two-way movement in 2005-06 and 2006-07 rupee value appreciated to Rs.44.27 per US dollar in 2005-06(Government Of India, 1991-11). .In April-December 2007 exports grew by 21.6 per cent in dollar terms. In rupee terms the growth of exports was 7.7 per cent during the same period, which is a reflection of the exchange rate changes.

FIGURE 4 showing the current account balance from the year 2002 to 2008. By observing the above trend it can be seen that the year 2002 to 2004 faced a prolonged current account surplus. After the year 2004 there was a gradual fall in current account balance leading to a deficit in current account.

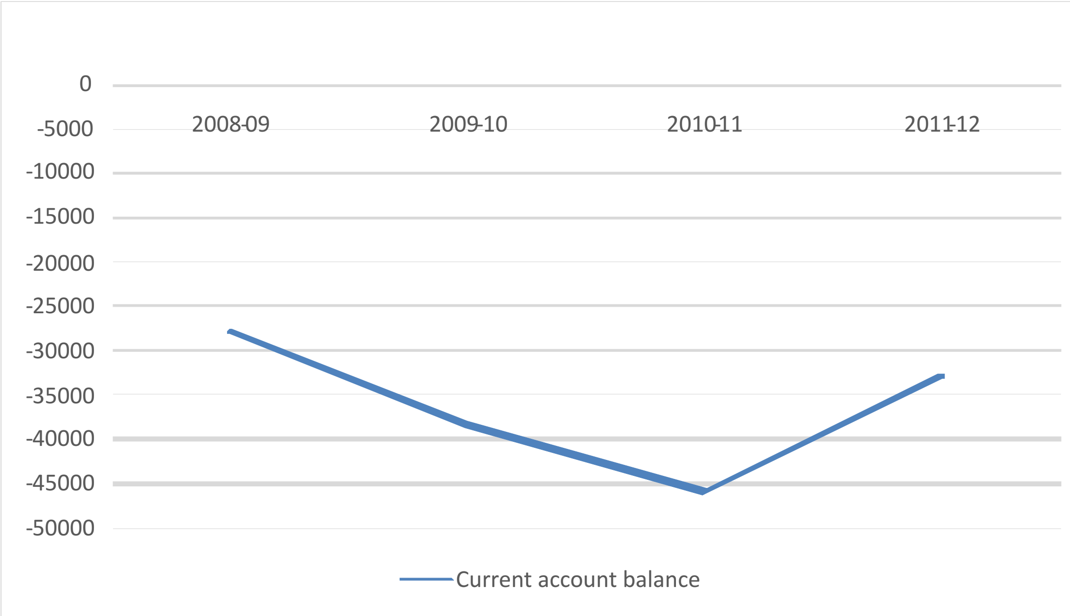


Figure 5: Current Account Balance 2008-12

A widening of merchandise trade was one way to absorb foreign savings and the increase in exports and imports was a key component of the growth process. Exports rose from 11.0 per cent of GDP in 2003-04 to 14.1 per cent in 2007-08 and 15.2 per cent during 2008-09. The average annual growth rate of exports during 2005-06 to 2007-08 was 25.0 per cent. Imports, however, grew even faster at an annual average rate of 29.5 per cent during 2005-06 to 2007-08. In the year 2008-09, India's merchandise exports (on BOP basis) at US$ 133.5 billion posted a growth of 17.5 per cent as compared with 23.0 per cent in the corresponding period of 2007-08 which mainly due to the depreciation of rupee against US dollar The annual average exchange rate was Rs 45.99 per US dollar, Rs 64.98 per euro and Rs 46.22 per 100 yen, indicating depreciation by 12.5 per cent, 12.2 per cent and 23.5 per cent respectively in 2008-09. During the year 2010-2011, India's merchandise exports during the first quarter (Q1- April-June 2010) and Q2 (July-September 2010) of 2010-11 recorded a growth of 43.6 per cent and 25.0 per cent respectively, as against a decline of 31.8 per centand 19.1 per cent in the corresponding quarters of 2009-10.During 2010-11, exports crossed the US$ 200 billion mark for the first time, increasing by 37.3 per cent from US$ 182.4 billion in 2009-10 to US$ 250.5 billion. The rupee has appreciated by 2.6 per cent in January 2012 due to Reserve Bank of India (RBI) intervention, measures to augment supply of foreign exchange in the domestic market, steps to curb speculative activities, and general improvement in India's economic outlook which lead to the downfall of exports from 107331 to 150909. Imports of US$ 236.7 billion recorded an increase of 34.3 per cent during H1 of 2011-12 as against an increase of 27.3 per cent in H1 of 2010-11 over H1 of 2009-10. Figure 5 showing the fluctuation in current account balance during 2008 to 2012 according to which it can be seen that current account suffered a prolonged deficit balance due appreciation and deprecation of rupee against US dollar.

II. Changes in Balance of Payment Surplus and Deficit:

Table 3: Balance of Payment from 1985-2005

	1985-86	1986-87	1987-88	1988-89	1989-90	1990-91	2000-01	2001-02	2002-03	2003-04	2004-05
CURRENT ACCOUNT	- 5927.3	-5830	-6292	-10410	- 9823.8	-9680	-2666	3400	6345	14083	-2470
CAPITAL ACCOUNT	2740.2	2041.6	881.9	4101.9	3543	7188	8535	8357	10640	17338	28629
TRADE SURPLUS/ DEFICIT	- 3187.1	- 3788.4	- 5410.1	- 6308.1	- 6280.8	-2492	5869	11757	16985	31421	26159

Source Economic Survey Part II 1991-92(Government Of India, 1991-11)

Table 4: Balance of Payment from 2005-2012

	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12
CURRENT ACCOUNT	-9902	-9766	-10713	-27914	-38181	-45945	-32842
CAPITAL ACCOUNT	24954	46372	51149	7395	51634	61989	41061
TRADE SURPLUS/ DEFICIT	15052	36606	40436	-20519	13453	16044	8219

Source Economic Survey Part II 1991-92(Government Of India, 1991-11)

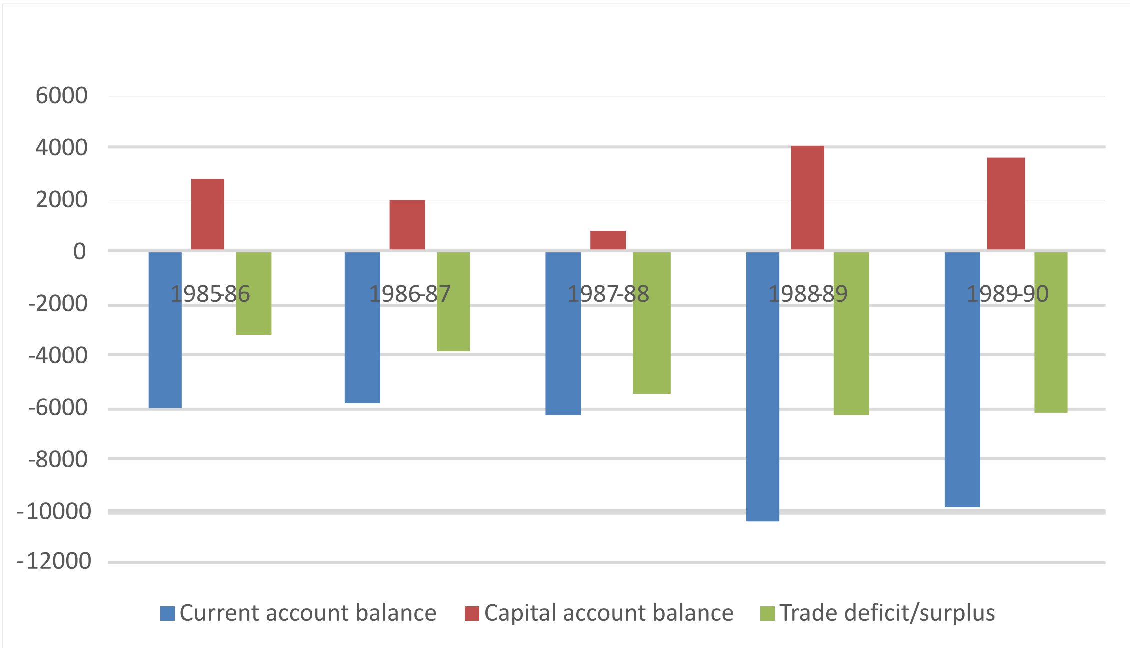


Figure 6: BOP Situation from 1985-90

Before 1991 India had a closed economy under which it followed a par value exchange rate mechanism in which the exchange rate was fixed against dollar value. From the above data it can be seen that before 1991 Trade deficits and consequently current account deficits increased substantially and remained at high levels throughout. Recovering from the stagnation in 1985-86, the volume growth of exports in the subsequent four years ranged between 10 to 12 percent per annum. But imports rose more sharply. The volume of net imports increased from 12.4 million tons in 1984-85 to 23.5 million tons in 1989-90. At the same time, support from invisible receipts fell due to steadily growing interest payments and outgo on account of profits, dividends, royalty, technical fees and professional fees. The current account deficit averaged around Rs.7800 crore during 1985-90. External assistance, commercial borrowings and non-resident deposits together made up the balance. However, as a result, India's external debt doubled and the debt service ratio rose from 13.6 percent in 1984-85 to almost 31 percent in 1989-90.

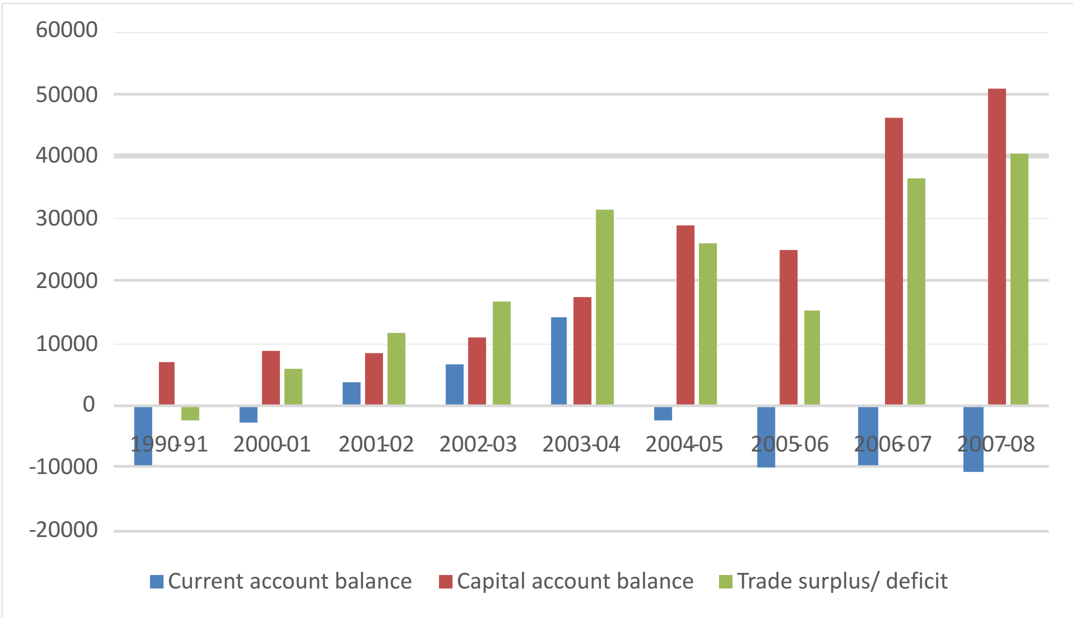


Figure 7: BOP Situation from 1991-2008

India achieved economic openness after 1991 in which exchange regime shifted from basket pegged system to market determine system in which exchange rate was determined by forces of demand and supply. During 1993-94, there was a distinct improvement in the balance of payments position. A significant growth in exports the fall in international prices of crude oil and the slack in the growth of non-POL imports resulted in a sharp contraction in trade deficit. The market determined exchange rate led to strong growth in remittances. As a result of all these, the current account deficit declined significantly which can be seen in above column chart. The balance of payments (BOP) has been in an overall surplus since 1996-97, with reserves rising, on an average, by US $ 6.21 billion per annum during 1996-97 to 2001-02. Overall balance of payments position has, thus, transformed over the past decade from a difficult one at the beginning of 1990s to a comfortable situation in 2001-02 and continued till 2007-08.(Government Of India, 1991-11)

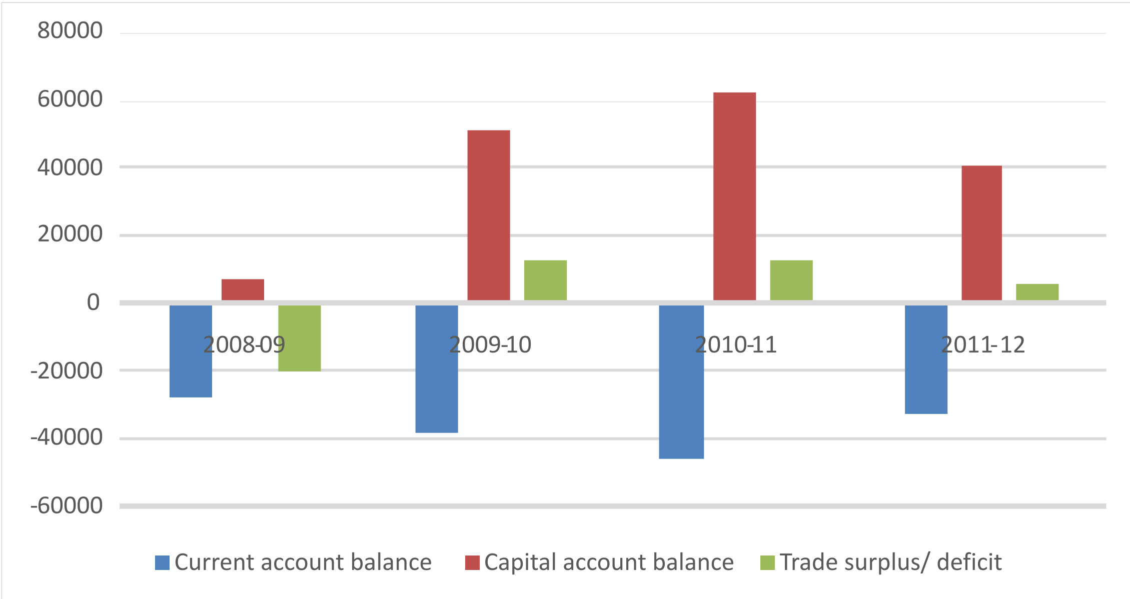


Figure 8: BOP Situation from 2008 - 12

India still operates under a market determined exchange rate system, highlights of BoP 2010-11 were higher exports, imports, invisibles, trade, CAD and capital flows in absolute terms as compared to fiscal 2009-10. Both exports and imports showed substantial growth of 37.3 per cent and 26.8 per cent respectively in 2010-11 over the previous year. The trade deficit increased by 10.5 per cent in 2010-11 over 2009-10. However, as a proportion of gross domestic product (GDP), it improved to 7.8 per cent in 2010-11 (8.7 per cent in 2009-10). Net invisible balances showed improvement, registering a 5.8 per cent increase in 2010-11. The Current account deficit (CAD) widened to US$ 45.9 billion in 2010-11 from US$ 38.2 billion in 2009-10, but improved marginally as a ratio of GDP to 2.7 per cent in 2010-11 vis-a-vis 2.8 per cent in 2009-10. Net capital flows at US$ 62.0 billion in 2010-11 were higher by 20.1 per cent as against US$ 51.6 billion in 2009-10, mainly due to higher inflows under ECBs, external assistance, short-term trade credit, NRI deposits, and bank capital. In 2010-11, the CAD of US$ 45.9 billion was financed by the capital account surplus of US$ 62.0 billion and it resulted in accretion to foreign exchange reserves to the tune of US$ 13.1 billion (US$ 13.4 billion in 2009-10). During the first half (H1–April-September 2011) of 2011-12, CAD in absolute terms was higher than in the corresponding period of the previous year, mainly due to higher trade deficit. The net capital flows in absolute terms were also higher during H1 of 2011-12 Vis-a Vis the corresponding period of 2010-11 (Table 4). During H1 of 2011-12, exports increased from US$ 107.3 billion during H1 of 2010-11 to US$ 150.9 billion, registering a growth of 40.6 per cent as compared to 30 per cent in H1 of 2010-11 over H1 of 2009-10. Exports in 2011-12 were driven mainly by the items such as engineering goods and petroleum products. From the above column chart it can be seen that India had trade deficit during 2008-09 but it had a prolonged surplus from 2009 till 2012.

SECTION III

3.1 Data and Methodology

In order to make the analysis between the Bop trend and the exchange rate the above data is taken from Reserve Bank Of India(Publications, 2010), the economic survey of India (Government Of India, 1991-

11), Books related to BOP and exchange rates and Books prescribed by Calcutta university which includes Mishra & Puri(Mishra & Puri, 2010), Krugmen P. and Obsfield M(Krugman & Obstfeld, 2011), Journals(Goyal & Arora, 2012)

Numerical analysis and secondary data has been used in this paper is a trend analysis with help of which trends in balance of payments has been analysed due to the fluctuation in exchange rate system during and after planning period when India achieved economic openness and shifted its exchange rate system from basket-pegged to flexible exchange rate system. Tables and charts have been made with the help of MS Word and MS Excel using the data provided by the economic survey of India and www.rbi.com.

3.2 Result and Analysis

From the analysis in section 2.3 the following analysis could be made with includes changes in balance of payment situation and exchange rate mechanism.

I. Situation of Current Account Balance

The balance of payment situation since 1991 has been distinctly different from the situation that prevailed in the earlier period expecting the year 1991-92 and 1992-93. The situation in 1992-93 was in line with earlier years as the current account deficit was 1.7 percent of the GDP. However the balance of situation improved considerably in 1993-94. In this year current account deficit was 0.4 percent of the GDP. The year 1996-97 witnessed a reduction in current account deficit from $5.9 billion in 1995-96 to $ 4.6 billion. This was 1.2 percent of the GDP. The deficit in the current account of balance of payment declined to 1.0 percent of the GDP in 1998-99 mainly reflecting the decline in POL and non-customs Imports. According to BOP the most significant years were 2001-03, 2002-03 and 2003-4 as there was surplus in BOP for three consecutive years. During 2007-08, the trade deficit increased considerably to $ 91,467 due to sustained demand for non-oil imports and escalation in international crude prices. During 2009-10, both exports and imports declined reflecting the impact of global recession. During 2011-12 the situation of BOP was stable with a deficit of 3.6 percent according to GDP.

II. Exchange Rate Regime and Fluctuation in Overall Balance of Payment

India followed a par value exchange rate regime after gaining independence from 1947 to 1971 under which the BOP situation was under an intense pressure as the economy was closed to protect the domestic industry. From 1971 – 1992 India maintained basket pegged exchange rate regime under which it can be seen that despite having a capital account balance as positive there was a deficit in current leading to an overall increase in trade deficit. After achieving economic openness during the reform period of 1991 India moved its exchange rate regime from basket pegged to flexible exchange rate regime under which there was a trade deficit during 2008-09 but from the year 2009 till 2012 there was prolonged surplus in overall trade balance leading to a better balance of payment situation compared to the pre reform period.

SECTION IV

Finally this section concludes the present study.

4.1 Conclusion

Due to the openness of the economy it is now increasingly important to keep a constant vigilance on the BOP situation and the foreign exchange rate. This paper helps review the situation that existed in India prior to 1991 and since 1991,with special emphasis on 2012 so that it is very helpful for policymakers to control the BOP situation and foreign exchange rate effectively, taking help from past instances

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An Introduction to Satellite Communication

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Introduction

Communication (from Latin commūnicāre, meaning "to share") is a purposeful activity of exchanging information and meaning across space and time using various technical or natural means, whichever is available or preferred.

Communication requires a sender, a message, a medium and a recipient, although the receiver does not have to be present or aware of the sender's intent to communicate at the time of communication; thus communication can occur across vast distances in time and space. Communication requires that the communicating parties share an area of communicative commonality. The communication process is complete once the receiver understands the sender's message.

Importance of Communication in Every Day Life

The importance of communication may be noticed in everyday life, for merely a little connection can hold a large influence in your entire globe.

We've all noticed as well as observed accounts of precisely how one specific phrase of assistance, one specific declaration of apology, just one mild touch or maybe just one laugh can effortlessly enhance a marriage, change a life or additional a job. Individuals who have succeeded in performing so produce some thing various also as thrilling inside their daily lives, which frequently offer unity, peace and happiness not only inside their individual daily lives however in to other individuals day-to-day lives also as. The kind of human becoming that you simply changed into has primarily to complete using the way that you simply communicate and speak with people who're about you.

Different Modes of Communication

Face-to-face, video, audio and text-based are all different modes of communication. These are the basic umbrella forms of communication, but they can be broken down into more specific styles.

Face-to-face communication is the most common. This includes casual conversation between two or more people and business meetings. Face-to-face is a very easy communication style that everyone has experienced. It requires no extra materials, making this the cheapest option for communication. It is also instant, and you get the benefit of visual cues from the person or people to whom you are communicating.

Video communication is achieved by using Web cameras to connect two or more parties. This is the next-best communication option after face-to-face, as you get most of the same benefits. However, there is always the possibility of bad connections or other technical issues that hinder the communication.

Audio is a voice-only form of communication, such as a conversation on a telephone. This is a good instant communication tool if you catch the person instead of getting an answering machine or voice mail, but it does not have the benefit of allowing you to see the other person. It is also more difficult to include more than two parties.

Text communication includes Internet communication, such as email, instant messaging and forums, text messaging and printed papers. Text communication does not have the benefits of audio and video, but it is much easier to distribute information to a large group of people and save records of the communication.

Satellite Communication

Satellite - An artificial body placed in orbit around the earth or another planet in order to collect information or for communication. Satellites are specifically made for telecommunication purpose. They are used for mobile applications such as communication to ships, vehicles, planes, hand-held terminals and for TV and radio broadcasting. Satellite communication is mainly done through geostationary satellites. These satellites are fitted with special devices. These devices can receive signals from an Earth station and transmit them again in different directions. These special devices are called transponders.

Basics

Satellites orbit around the earth. Depending on the application, these orbits can be circular or elliptical. Satellites in circular orbits always keep the same distance to the earth's surface following a simple law: The attractive force Fg of the earth due to gravity equals $\frac{mgR^2}{r^2}$. The centrifugal force Fc trying to pull the satellite away equals $mr\omega^2$.

The variables have the following meaning:
m is the mass of the satellite;
R → radius of earth with R = 6,370 km;
r → distance of the satellite to the centre of the earth;
g → acceleration of gravity with $g = 9.81\ m/s^2$;
ω → angular velocity with ω = 2•π•f, f is the frequency of the rotation.

To keep the satellite in a stable circular orbit, the following equation must hold: Fg = Fc, i.e., both forces must be equal. Looking at this equation the first thing to notice is that the mass m of a satellite is irrelevant (it appears on both sides of the equation). Solving the equation for the distance r of the satellite to the centre of the earth results in the following equation:

The distance $r = \left[\frac{gR^2}{(2\pi f)^2}\right]^{\frac{1}{3}}$

From the above equation it can be concluded that the distance of a satellite to the earth's surface depends on its rotation frequency.

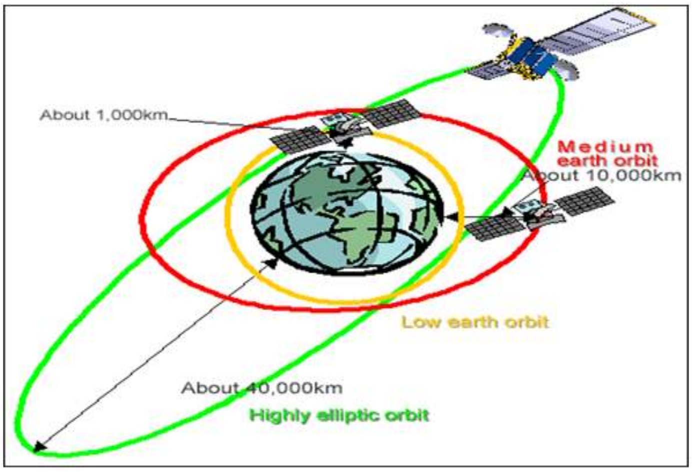
Important parameters in satellite communication are the inclination and elevation angles. The inclination angle δ is defined between the equatorial plane and the plane described by the satellite orbit. An inclination angle of 0 degrees means that the satellite is exactly above the equator. If the satellite does not have a circular orbit, the closest point to the earth is called the perigee.

The elevation angle ε is defined between the centre of the satellite beam and the plane tangential to the earth's surface. A so called footprint can be defined as the area on earth where the signals of the satellite can be received.

Various Kinds of Satellites

There are different kind of satellites depending on their functions and orbits, namely

Geostationary or geosynchronous earth orbit (GEO) - Looking from a fixed point from Earth, these satellites appear to be stationary. These satellites are placed in the space in such a way that only three satellites are sufficient to provide connection throughout the surface of the Earth. The orbit of these satellites is circular.



Communication satellites - Communication satellite or Comsat is sent in to space for the purpose of telecommunications. Modern communications satellite use a variety of orbits including geostationary orbits, elliptical orbits low earth orbits.

Low Earth Orbit (LEO) satellites - These satellites are placed 500-1500 kms above the surface of the earth. As LEOs circulate on a lower orbit, hence they exhibit a much shorter period that is 95 to 120 minutes. LEO systems try to ensure a high elevation for every spot on earth to provide a high quality communication link.

Process of Communication

Radio Wave Propagation - Radio propagation is the behavior of radio waves when they are transmitted, or propagated from one point on the Earth to another, or into various parts of the atmosphere. As a form of electromagnetic radiation, like light waves, radio waves are affected by the phenomena of reflection, refraction, diffraction, absorption, polarization and scattering.

Radio propagation is affected by the daily changes of water vapor in the troposphere and ionization in the upper atmosphere, due to the Sun. Understanding the effects of varying conditions on radio propagation has many practical applications, from choosing frequencies for international shortwave broadcasters, to designing reliable mobile telephone systems, to radio navigation, to operation of radar systems.

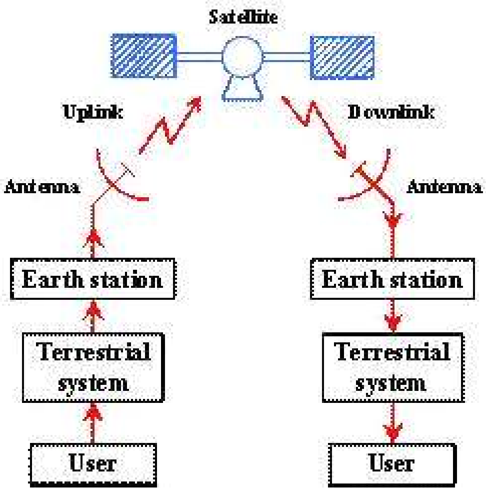
Allocation of Frequencies for Satellite Communication

Allocation of frequencies to satellite services s a complicated process which requires international coordination and planning. This is done as per the International Telecommunication Union (ITU). To implement this frequency planning, the world is divided into three regions:

- Region1: Europe, Africa and Mongolia
- Region 2: North and South America and Greenland
- Region 3: Asia (excluding region 1 areas), Australia and south-west Pacific. Within these regions, he frequency bands are allocated to various satellite services. Some of them are listed below.
- Fixed satellite service: Provides Links for existing Telephone Networks Used for transmitting television signals to cable companies
- Broadcasting satellite service: Provides Direct Broadcast to homes. E.g. Live Cricket matches etc
- Mobile satellite services: This includes services for: Land Mobile Maritime Mobile Aeronautical mobile
- Navigational satellite services : Include Global Positioning systems
- Meteorological satellite services: They are often used to perform Search and Rescue service. Below are the frequencies allocated to these satellites: Frequency Band (GHZ) Designations:
- VHF: 01-0.3
- UHF: 0.3-1.0
- L-band: 1.0-2.0

- S-band: 2.0-4.0
- C-band: 4.0-8.0
- X-band: 8.0-12.0
- Based on the satellite service, following are the frequencies allocated to the satellites: Frequency Band (GHZ) Designations:
- VHF: 01-0.3 ---Mobile & Navigational Satellite Services
- L-band: 1.0-2.0 --- Mobile & Navigational Satellite Services
- C-band: 4.0-8.0 --- Fixed Satellite Service

Technicalities of Satellite Communication



* Other means of telecommunication like telephone (mainly for long distances), telex (i.e., printed messages) and FAX (i.e., facsimile of printed matter or pictures) use a similar mechanism. In the case of intercontinental telecommunication, two or more satellites are linked together.

* High frequency radio and submarine cable systems have been widely used for long- distance overseas telecommunications. The high frequency band from 3 MHz to 30 MHz has provided worldwide telephone and telegraph circuits.

But it has following two drawbacks.

(i) High noise levels

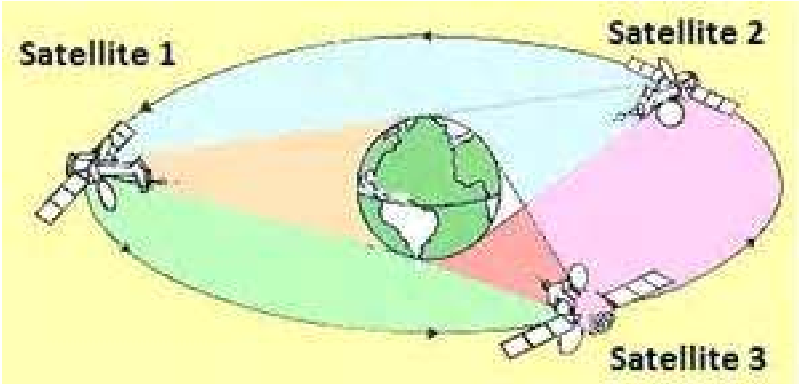
(ii) Limited bandwidth

To a limited extent, cables can provide high quality circuits and can carry up to 1000 or more telephone circuits and even television signals.

*Ionospheric reflections are not possible for frequencies in the very high frequency and microwave bands. So, line-of-sight links are required with an array of repeaters. With the advent of Earth satellites, we can provide a microwave repeater at almost any desired altitude. So, distances of thousands of kilometer can be covered by a single Earth-satellite-Earth link.

*The feasibility of wide-band communication over large distances has been demonstrated by the Telstar, Relay, Syncom and Early Bird satellites. A good quality service can be continuously ensured by a global operational satellite system. Thus, communication satellites would give a valuable service in addition to the submarine cable and high frequency radio systems.

*Geostationary communication satellites have enabled not only national but also international television programmes to be relayed among many ground stations around the world. Three artificial satellites placed in equatorial orbits at 120o from one another can cover practically the whole populated land area of the world. The transmitters transmit wide band microwave signals to the geostationary satellite above the transmitter. These land-based transmitters are high-power and highly directive. Each microwave channel has a large bandwidth, which can accommodate many TV signals and thousands of TV channels.



*The satellites (generally powered by solar batteries) receive the transmission, demodulate and amplify it and remodulate on a different carrier before transmitting again. The transmitting antenna on the satellite, by the use of a suitable reflector, directs the beam to a narrow region on the Earth. For national distribution, the transmission is downward from a wide angle antenna so that the whole national area is "illuminated" by the transmission. For international distribution, the transmission is also towards the other one or two satellites (in line of sight direction) from highly directive antennas. The demodulation amplification-remodulation-transmission process is repeated in the second satellite. The final "down channel" transmission is received in the same or in a different country by a large cross-section antenna. It is then processed in low-noise receivers and finally re-radiated from regular TV transmitters.

There are a number of INTERSAT satellites over the Atlantic, Pacific and Indian oceans operating as relay stations to as many as forty ground stations around the world. The international system of satellite communication caters to the continental 625/50 as well as the American 525/60 systems. Since television standards differ from country to country, the transmitting station adopts the standard of the originating country. The ground station converts the received signal with the help of digital international conversion equipment to the local standard before relaying it. Frequency modulation is used for both 'up channel' and 'down channel' transmission. Though FM needs a larger bandwidth, it offers good immunity from interference and requires less power in the satellite transmitter.

Orbit of Communication Satellite

For global communication, a communication satellite should move orbit of the communication satellite where r is the radius of the orbit of the communication satellite and R is the radius of the Earth.

A circular orbit of the communication satellite is specified in terms of the following:

(i) The orbit radius

(ii) The angle of inclination of the orbit plane to the Earth's equatorial plane

(iii) The position of the ascending mode

(iv) The phase angle of the satellite.

Height of Communication Satellite

The area of the Earth from which a satellite is visible increases with the altitude. So, satellites at higher altitudes give larger coverage. At altitudes below 10,000 km, the number of satellites required for global coverage would be excessive. At altitudes above 20,000 km, the time taken by signals may be large enough to cause confusion in telephone conversation. If time-delay difficulties are ignored, then a synchronous satellite at 36000 km height can be advantageously used.

Earth Track Integral System for Communication Satellites

If several satellites are spaced around the same orbit in space, the tracks of the satellites will be different due to Earth's rotation about its own axis. But if, for example, four satellites are placed into different orbits with their ascending modes displaced successively by 30° intervals to the east direction, the difference, in effects of Earth's rotation, can be counteracted and the paths of all the satellites relative to the Earth will be the same. Such Earth-track integrals systems can be arranged to have the satellite period an integral factor of the sidereal day in order to have the same track repeated day after day.

Role of Satellites in Weather Monitoring Satellite technology is very useful in collecting information about various factors of the atmosphere, which governs the weather and climatic conditions. An aerial photograph of the Country is shown daily on the television. It is also published daily in the newspapers. The data collected by INSAT satellite enables our scientists to make short-term and long-term predictions about weather. We are able to get prior information about an emerging cyclone or floods or drought conditions. This enables the government to take suitable measures to minimize the loss of lives and property.

Why Satellite Communication is Costly ?

The satellite communication is costly because of the limited life of a satellite. A geosynchronous satellite using high gain antenna requires close control of both its position and altitude. The position and altitude control rockets require fuel that has to be put in once for all before launch. With a given payload, the longer the life, heavier the satellite and more the, cost. All communication satellites are designed for a maximum operating life limited by its positioning fuel capacity.

Limited Life of a Satellite has an Advantage

The successive generations of communication satellites can incorporate the latest developments in electronics and communication engineering technology. This would help to pack much more capacity into satellites of comparable size. It is possible that with the advances in technology, the cost of satellite communication would be considerably reduced in the near future.

Applications of Satellite Communication

Weather Forecasting - Certain satellites are specifically designed to monitor the climatic conditions of earth. They continuously monitor the assigned areas of earth and predict the weather conditions of that region. This is done by taking images of earth from the satellite. These images are transferred using assigned radio frequency to the earth station. (Earth Station: it’s a radio station located on the earth and used for relaying signals from satellites.) These satellites are exceptionally useful in predicting disasters like hurricanes, and monitor the changes in the Earth's vegetation, sea state, ocean color, and ice fields.

Radio and TV Broadcast - These dedicated satellites are responsible for making 100s of channels across the globe available for everyone. They are also responsible for broadcasting live matches, news, world-wide radio services. These satellites require a 30-40 cm sized dish to make these channels available globally.

Global Telephone - One of the first applications of satellites for communication was the establishment of international telephone backbones. Instead of using cables it was sometimes faster to distance as in fiber optic cable, light is used instead of radio frequency, hence making the communication much faster (and of course, reducing the delay caused due to the amount of distance a signal needs to travel before reaching the destination.).

CONCLUSION

Advances in satellite technology have given rise to a healthy satellite services sector that provides services to broadcasters, internet service providers, the military, and other sectors. Satellite communications technology is often used during natural disasters and emergencies when land based communications are down. Mobile satellite equipment can be deployed in to disasters areas to provide emergency communication service. Hence satellite communication is playing an important role in everyday life.

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Greenhouse Effect

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1.0 Introduction

The greenhouse effect is defined as a process in which thermal radiation from a planetary surface is absorbed by atmospheric greenhouse gases and is re-radiated in all directions. These greenhouse gasses are mostly carbon dioxide, water vapor, methane etc.

Earth's stable temperature is a featuristic effect of greenhouse gases which begins with sun. Roughly 30% of the incoming radiation is reflected by bright surfaces like clouds and ice. Of the remaining 70% most is absorbed by land and ocean as well as the atmosphere. This absorbed energy heats our planet. As the rocks, air and the seas warm, they radiate "heat" energy (thermal infrared radiation). From this surface, the energy travels into the atmosphere where much of it is absorbed by the water vapor and long lived greenhouse gases such as carbon dioxide and methane. When they absorb energy, these greenhouse gases turn into tiny heaters¬ (like bricks in a fireplace radiating heat even after fire go out). The heat radiated towards earth heats both the lower atmosphere and the surface, increasing earth's temperature. This phenomenon of absorption and radiation of heat by atmosphere is called the natural greenhouse effect, which is essential for sustaining life on earth.

2.0 Objective

The objective of this study is a) to enquire about the reasons 2) to analyse the effects of green house gases statistically and 3) to suggest some measures to mitigate the global problem of green house effect.

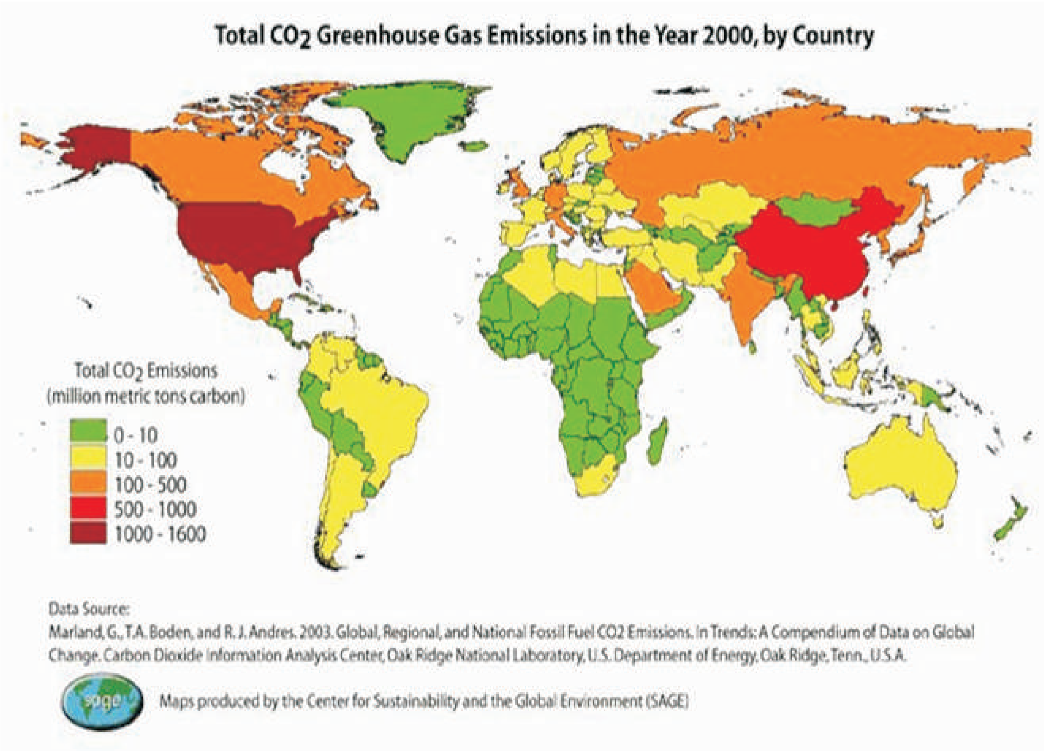
Fact –

If there were no greenhouse gasses the Earth's surface temperature would be a very chilly - 18^0C at nights instead of comfortable 15^0C that we feel today.

3.0 Areas of Study

3.1 Areas Under Serious Threat Around the Globe

Regional effect varies in nature. Some are the result of a generalized global change, such as rising temperature, resulting in local effects, such as melting ice. In other cases, a change may be related to a change in a particular ocean current or weather system. In such cases, the regional effect may be disproportionate and will not necessarily follow the global trend.



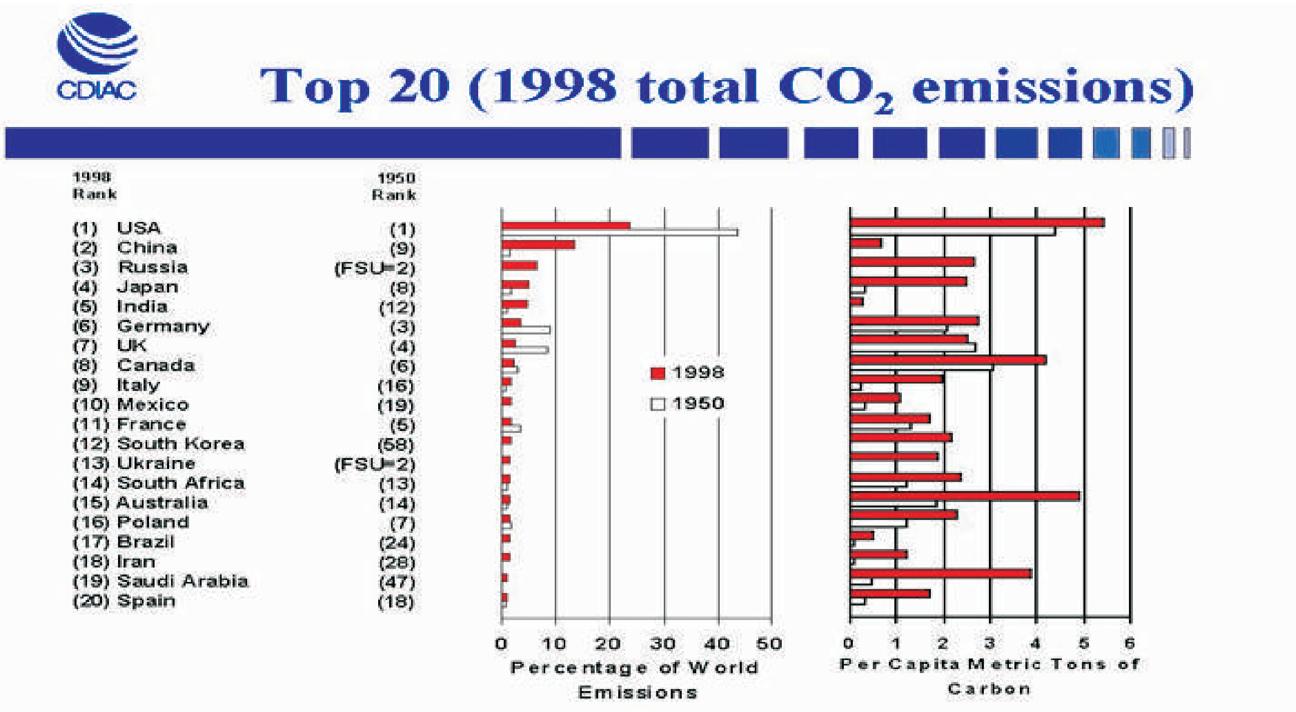
African SCENARIO - Africa is one of the most vulnerable continents to climate variability and change because of multiple existing stresses and low adaptive capacity. Existing stresses include poverty, political conflicts, and ecosystem degradation. Climate variability and change is severely compromising agricultural production, including access to food, across Africa. Climate variability and change is negatively effecting human health. In many African countries, other factors already threaten human health. For example, malaria threatens health in southern Africa and the Eastern Highlands.

Asian SCENARIO - Glaciers in Asia are melting at a faster rate than ever documented in historical records. Melting glaciers increase the risks of flooding and rock avalanches from destabilized slopes. Climate change has decreased freshwater availability in central, south, east and southeast Asia, particularly in large river basins. With population growth and increasing demand from higher standards of living, this decrease could adversely affect more than a billion people by the 2050s. Increased flooding from the sea and, in some cases, from rivers, threatens coastal areas, especially heavily populated delta regions in south, east, and Southeast Asia.

New Zealand and Australian SCENARIO - Significant loss of biodiversity is projected to occur by 2020 in some ecologically rich sites, including the Great Barrier Reef and the Wet Tropics of Queensland. Sea level rise and more severe storms and coastal flooding are coastal areas. Coastal development and population growth in areas such as Cairns and Southeast Queensland (Australia) and Northland to Bay of Plenty (New Zealand), are endangering more people and infrastructure at risk. Extreme storm events are likely to increase failure of floodplain protection and urban drainage and sewerage, as well as damage from storms and fires.

European SCENARIO - Wide-ranging impacts of climate change have already been documented in Europe. These impacts include retreating glaciers, longer growing seasons, species range shifts, and heat wave-related health impacts. In southern Europe, higher temperatures and drought may reduce water availability, hydropower potential, summer tourism, and crop productivity. In central and eastern Europe, summer precipitation is projected to decrease, causing higher water stress. Forest productivity is projected to decline. The frequency of peat land fires is projected to increase.

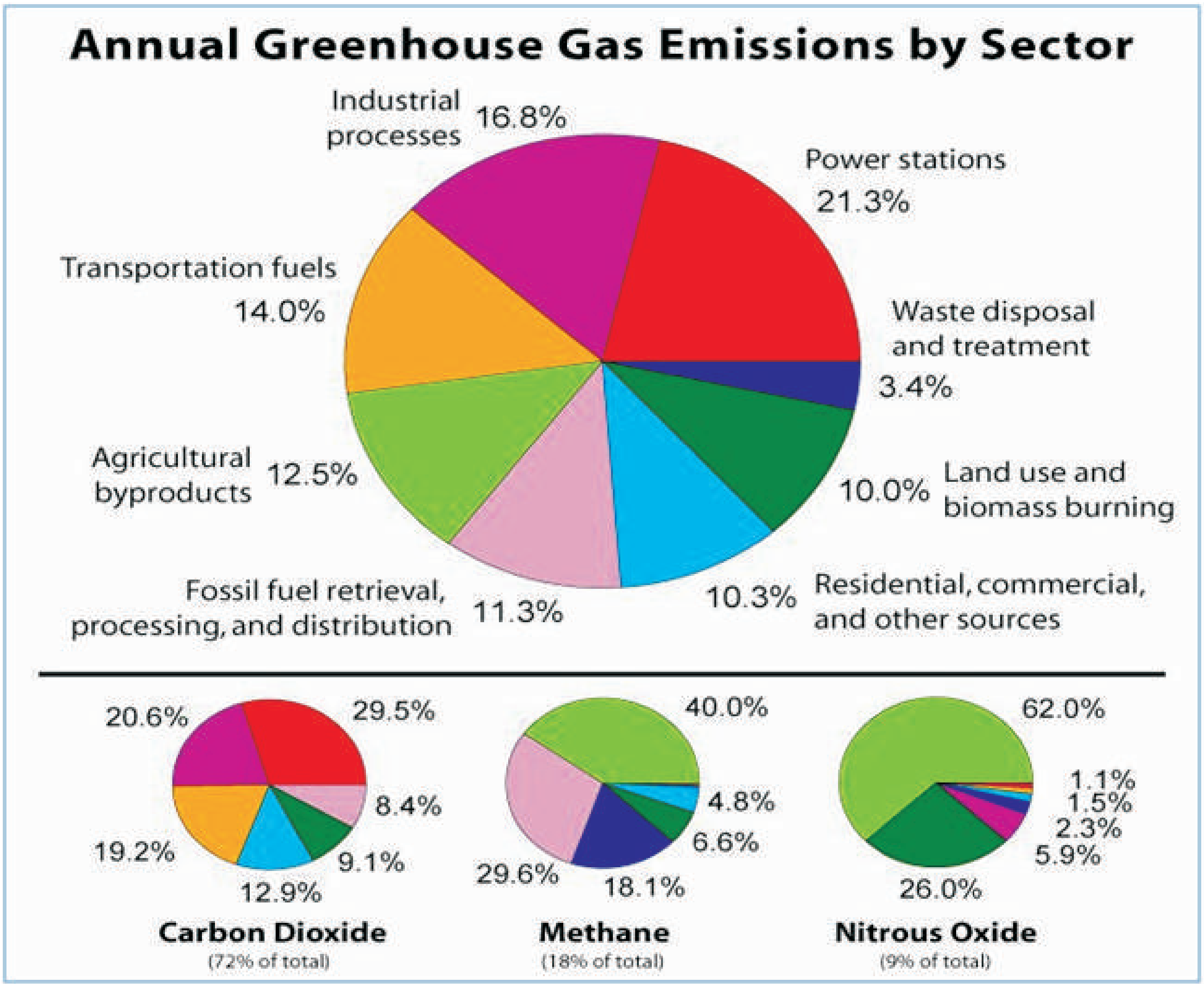
Latin American SCENARIO - By mid-century, increases in temperature and decreases in soil moisture are projected to cause savanna to gradually replace tropical forest in eastern Amazonia. Sea level rise is projected to increase risk of flooding, displacement of people, salinization of drinking water resources, and coastal erosion in low-lying areas. Changes in precipitation patterns and the melting of glaciers are



projected to significantly affect water availability for human consumption, agriculture, and energy generation. Greenhouse effect threats hover around the entire globe due to excessive emissions of CO2. Let us take a look at those countries producing CO2 in large scale.

3.2 Indian Scenario

Greenhouse effect on the climate of India has led to climate disasters as per some experts. India is a disaster prone area, with the statistics of 27 out of 35 states being disaster prone, with floods being the most frequent disasters. The process of greenhouse effect has led to an increase in the frequency and intensity of these climatic disasters. According to surveys, in the year 2007-2008, India ranked the third highest in the world regarding the number of significant disasters, with 18 such events in one year, resulting in the death of 1103 people due to these catastrophes. The anticipated increase in precipitation, the melting of glaciers and expanding seas have the power to influence the Indian climate negatively, with an increase in incidence of floods, hurricanes, and storms. Greenhouse effect may also pose a significant threat to the food security situation in India. According to Indira Gandhi Institute of Development Research, if the process of global warming continues to increase, resulting climatic



disasters would cause a decrease in India's GDP to decline by about 9%, with a decrease by 40% of the production of the major crops. A temperature increase of 2° C in India is projected to displace seven million people, with a submersion of the major cities of India like Mumbai and Chennai. The Indian Metropolis of Mumbai is one of the places at risk of dangerous and costal floods due to climate change. It is identified as one of the coastal cities that face a high risk of devastating floods due to global warming.

4.0 Method of Study

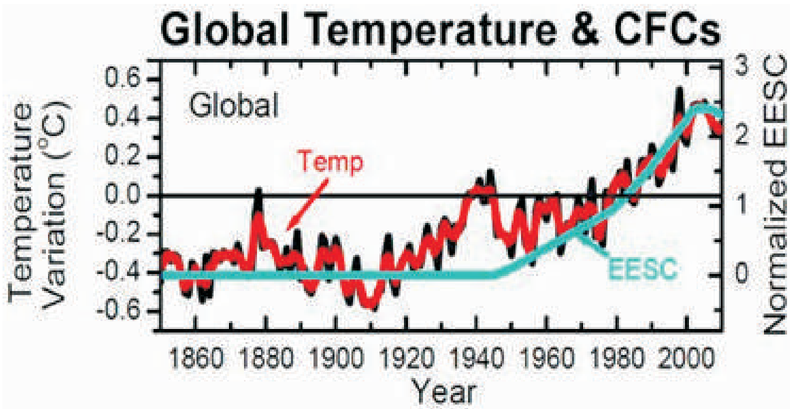
The present study follows a few methodical steps to attain the final shape. The steps are as follows: a) to go through some informative websites on Green House Effect, b) to apply statistical diagrams for graphical presentation, c) to analyse the cause and effect and d) to suggest some effective remedial measures in order to minimize the problem of Green House Effect accentuated around the present world.

5.0 Causes of Greenhouse Effect

Fossil fuels - Coal, Oil and Natural gas are the three different forms of fossil fuels that are widely used. They are formed by the process of anaerobic decomposition of organic matter under the surface of earth for millions of years ago. Large scale use of these fossil fuels started in the industrial revolution. Today these are the most widely used sources of energy across the globe for both commercial and industrial purposes. Petroleum is used to fuel our vehicles, while coal and natural gas are used to produce electricity for our homes and offices. Statistics show that almost three-fourth of the demands of the energy is the world is fulfilled by fossil fuels. Fossil fuels are basically hydrocarbons (made from hydrogen and carbon). Burning fossil fuels releases a large amount of carbon dioxide into the air. The presence of high levels of carbon dioxide in the atmosphere results in an increase in the amount of heat on the surface of Earth. This is because carbon dioxide traps heat obtained from sunlight and does not let it dissipate out of the atmosphere. When there is a significant rise in the , the amount of heat captured by the carbon dioxide gas also increases.

Forest Fires - One of the natural contributing factors to greenhouse effect is forest fires. Fires are natural occurrences in many forests as its nature's way to clear up old growth to encourage new ones. However new trees take much time to grow large enough to absorb large quantities of carbon dioxide and produce sufficient oxygen. The fires also cause much carbon filled smoke to rise from the forests to the atmosphere. These smoke particles not only pollute the nearby environment but also may also potentiality to choke animals and humans nearby. Both results have dramatic effects on the rate at which global warming is currently occurring.

Chlorofluorocarbons - Chlorofluorocarbons, commonly known as CFCs, are a group of man-made compounds containing chlorine, fluorine and carbon. They are not found anywhere in nature. The production of CFCs began in the 1930s for the purpose of refrigeration. Since then they have been extensively utilized as propellants in aerosols, as blowing agents in foam manufacture and in air conditioning. There are no removal processes or sinks for CFCs in the lowest part of the atmosphere called the troposphere. As a result they are transported up into the stratosphere, between 10 to 50 km above the Earth's surface, where they are broken down by ultraviolet (UV) radiation from the Sun, releasing free chlorine atoms which cause significant ozone depletion. Although the amounts of CFCs in the atmosphere are very small, measured in parts per trillion (million million), they do contribute significantly to the enhancement of the natural greenhouse effect, because they are very good at trapping heat. Molecule for molecule some CFCs are thousands of times stronger than carbon dioxide as greenhouse gases. Since the dangers caused by CFCs to the ozone layer were first identified, their use has gradually been phased out. However, CFCs have long lifetimes in the atmosphere before they are broken down by sunlight, and consequently they continue to enhance the greenhouse effect well into the 21st century.



Volcanic eruptions - During a volcanic eruption, atmospheric gases come from the earth's interior. Water vapor constitutes 70 to 95 percent of all eruption gases. The rest consists of carbon dioxide, sulfur dioxide and traces of nitrogen, hydrogen, carbon monoxide, sulphur, argon, chlorine and fluorine. These different volcanic gases affect the earth's atmosphere in different ways. Sulfur dioxide can cause harm by forming acid rains. Fluorine gases and their acid aerosols can be lethal to animals. Water vapor and carbon dioxide adds to the effects of greenhouse effect. There is circumstantial evidence that volcanic eruptions can affect short-term weather patterns, and possibly trigger long-term climatic change. One of the main concerns is global warming. This could cause ocean levels to rise if the glaciers in Antarctica melt, and seriously disrupt many large population centers on earth -- London, Tokyo-Yokohama, Los Angeles, New York etc Carbon dioxide is abundant in volcanic gases, but not so enough to significantly contribute to the greenhouse effect. **Volcanoes contribute about 110 million tons of carbon dioxide per year.**

Agriculture - The global food system, from fertilizer manufacture to food storage and packaging, is responsible for up to one-third of all human-caused greenhouse-gas emissions. The food-related emissions and the impacts of climate change on agriculture and the food system will profoundly alter the way we grow and produce food. Estimates from 2005, 2007 and 2008, the researchers found that agricultural production releases up to 12,000 megaton's of CO2 every year — up to 86% of all food-related anthropogenic greenhouse-gas emissions. Fertilizer manufacture releases up to 575 megaton's, followed by refrigeration, which emits 490 megaton's. The researchers found that the whole food system released 9,800–16,900 megaton's of carbon dioxide equivalent into the atmosphere in 2008, including indirect emissions from deforestation and land-use changes. In high-income countries such as the United Kingdom, post-production — including storage and transport — contributes a large proportion of the food system's greenhouse-gas emissions, whereas in China, for example, fertilizer manufacture plays the biggest role in CO2 emission.

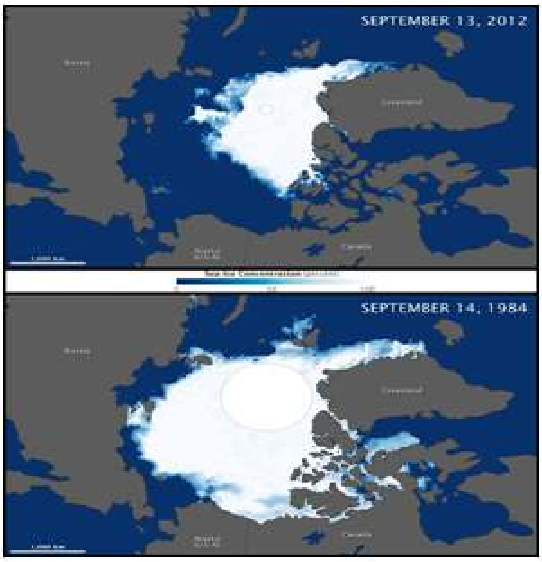
Deforestation - Trees play a huge role in carbon cycle. They convert the CO2 in the air to oxygen, through the process of photosynthesis, and in this way they can be looked upon as a natural regulator of carbon dioxide. Since we live in an age when carbon dioxide is very abundant in the atmosphere, released through man-made inventions such as cars, factories, and power plants, it is vital, more than ever, that trees fulfill their part in the environment and take some of the excess carbon dioxide out of air. Unfortunately, deforestation is preventing the job to be fully accomplished. With half of the forest gone, and four million trees are cut down each year just for paper use, the amount of carbon dioxide is rising. With more and more rise in carbon dioxide, one of the major greenhouse gasses, more of the sun's radiation is being reflected back to earth, instead of space, and this is causing our average temperature to rise and thus giving birth to the most dangerous climatic condition called global warming.

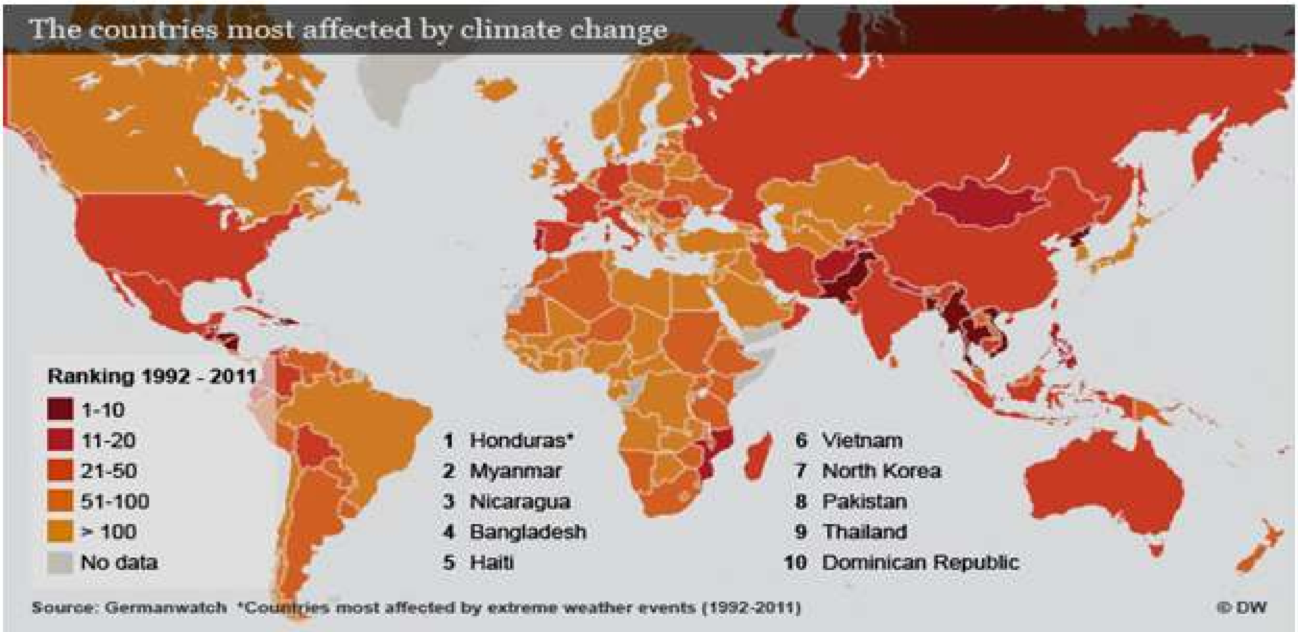
6.0 Environmental Impact

The Earth's average temperature has warmed by about 0.76°C over the past 100 years, with most of this warming occurring in the past 20 years. This temperature rise may appear small, but small rises in temperature translate into big changes for the world's climate. This is because the amount of extra energy needed to increase the world's temperature, even by a little, is vast. This extra energy is like force-feeding the global climate system.

So what does a 0.76°C temperature rise actually mean?

- More hot days.
- More severe storms, floods, droughts and fire
- Higher sea levels
- More hurricanes and cyclones in the Caribbean, the United States and Burma etc.
- More extensive droughts in eastern Africa, Australia, southern Europe and parts of China and India.
- More devastating flood s like those in Pakistan (in 2010), Brazil and Australia (in 2011), and other parts of the world.
- This small temperature rise could threaten human health, lives, industries and jobs. It also threatens agricultural production, fresh water supplies and the survival of native species and ecosystem.





6.1 Impact on Polar Region

Arctic Region - The Arctic is global warming's canary in the coal mine. It's a highly sensitive region, and it's being profoundly affected by the changing climate. Most scientists view what's happening now in the Arctic as a harbinger of things to come. Since 1979, the size of the summer polar ice cap has shrunk more than 20 percent. Average temperatures in the Arctic region are rising twice as fast as they are elsewhere in the world. Arctic ice is getting thinner, melting and rupturing. For example, the largest single block of ice in the Arctic, the Ward Hunt Ice Shelf, had been around for 3,000 years before it started cracking in 2000. Within two years it had split all the way through and is now breaking into pieces. The polar ice cap as a whole is shrinking. Images from NASA satellites show that the area of permanent ice cover is contracting at a rate of 9 percent each decade. If this trend continues, summers in the Arctic could become ice-free by the end of the century. The melting of once-permanent ice is already affecting native people, wildlife and plants. When the Ward Hunt Ice Shelf splintered, the rare freshwater lake it enclosed, along with its unique ecosystem, drained into the ocean. Polar bears, whales, walrus and seals are changing their feeding and migration patterns, making it harder for native people to hunt them. And along Arctic coastlines, entire villages will be uprooted because they're in danger of being swamped. The people of the Arctic view global warming as a threat to their cultural identity and survival.

Impacts of greenhouse effect – global warming

Global warming is melting glaciers in every part of the world, putting millions of people at risk from floods, droughts and shortages of drinking water. Arctic sea ice reached its third lowest recorded level during the melt season of 2010. The lowest level since satellite measurements began in 1979 was in 2007. Rising sea levels threaten entire nations on low-lying islands in the Pacific and Indian oceans.

Effects in Alaska - The effects of Greenhouse effect on the north are not limited to the Arctic -- higher temperatures are already affecting people, wildlife and landscapes across Alaska in Barrow, Shismaref, Yukon River, Wasilla, Kenai Peninsula, McCall Glacier and Fairbanks. Melting glaciers and land-based ice sheets also contribute to rising sea levels, threatening low-lying areas around the globe with beach erosion, coastal flooding, and contamination of freshwater supplies. (Sea level is not affected when floating sea ice melts.) At particular risks are island nations like the Maldives; over half of that nation's populated islands lie less than 6 feet above sea level. Even major cities like Shanghai and Lagos would face similar problems, as they also lie just six feet above present water levels.

6.2 Impact on Human Beings

Climate change due to greenhouse effect ought to bring severe and permanent alterations to our planet's geological, biological and ecological systems. The Intergovernmental Panel on Climate Change (IPCC) contended in 2014 that these changes have led to the emergence of large-scale environmental hazards to human health, food supply, economic growth, migration, security, societal change, and public goods, such as drinking water, than on the geophysical changes related to global warming such as extreme weather, ozone depletion, and loss of biodiversity. The World Health Organization (WHO) estimates that 160,000 deaths, since 1950, are directly attributable to climate change. Human impacts are both negative and positive. For e.g. - Climatic changes in Siberia are expected to improve food production and local economic activity, at least in the short to medium term. Numerous studies suggest, however, that the current and future impacts of climate change on human society are and will continue to be overwhelmingly negative. The majority of the adverse effects of climate change are experienced by poor and low-income communities around the world, who have much higher levels of vulnerability to environmental determinants of health, wealth and other factors, and much lower levels of capacity

available for coping with environmental change. A report on the global human impact of climate change published by the Global Humanitarian Forum in 2013, estimated more than 300,000 deaths and about $125 billion in economic losses each year, indicating that most climate change induced mortality is due to worsening floods and droughts in developing countries like India.

6.2.1 Effect On Coastal Areas - A major challenge for human settlements is sea-level rise. Estimates for 2100 are at least twice as large as previously estimated by IPCC, with an upper limit of about two meters. Depending on regional changes, increased precipitation patterns can cause more flooding or extended drought stresses water resources. For historical reasons to do with trade, many of the world's largest and most prosperous cities are on the coast. A study in the April 2010 issue of Environment and Urbanization reports that 634 million people live in coastal areas within 30 feet (9.1 m) of sea level. In developing countries, the poorest often live on floodplains, because it is the only available space, or fertile agricultural land. These settlements often lack infrastructure such as dykes and early warning systems. Poorer communities also tend to lack the insurance, savings, or access to credit needed to recover from disasters. By the 2080s, millions of people would experience floods every year due to sea level rise. The numbers affected were projected to be largest in the densely populated and low-lying mega-deltas of Asia and Africa; and smaller islands were judged to be especially vulnerable.

7.0 Observation

Already we have seen polar ice caps melting and sea levels rising, which could flood New England’s coastal communities, Caribbean’s and low lying coastal areas, Scientists also predict that some areas of the globe will see increased drought, and others will see heavier precipitation and accompanying floods. In the Northeast, summers are expected to be longer and hotter, putting a greater strain on water and electricity. Conservation Law Foundation, an NGO, has been deeply involved in a variety of policy measures and technology incentives to reduce our greenhouse gas emissions in certain selective regions to avoid the worst effects of climate change. These include the Regional Greenhouse Gas Initiative, the world’s first mandatory cap and trade program; a Low Carbon Fuel Standard and clean car initiatives that would reduce emissions from transportation vehicles; and Massachusetts’ wide-ranging Global Warming Solutions Act. However, all these efforts seem to be inadequate for the huge population subject to environmental change. Here is the point where we people have to take a stand and help ourselves and NGO’s all over the world to protect our globe. Below are some suggestions which will help us to reduce the excessive burden on mother earth and help her preserve herself for our future upcoming generations.

8.0 Conclusion

- **Drive Less and Drive Smart** - Burning fossil fuels such as natural gas, coal, oil and gasoline raises the level of carbon dioxide in the atmosphere, and carbon dioxide is a major contributor to the greenhouse effect and global warming. Less driving means fewer emissions. Besides saving gasoline, walking and biking are great forms of exercise.
- **Reduce, Reuse, Recycle** - Buying products with minimal packaging will help to reduce waste. By recycling half of your household waste, you can save 2,400 pounds of carbon dioxide annually.
- **Use less electrical and thermal energy** - Adding insulation to your walls and installing weather stripping or caulking around doors and windows can lower your heating costs more than 25 percent,

by reducing the amount of energy you need to heat and cool your home. Turn down the heat while you're sleeping at night or away during the day, and keep temperatures moderate at all times. Install a programmable thermostat because setting it just 2 degrees lower in winter and higher in summer could save about 2,000 pounds of carbon dioxide each year.

- **Use fluorescent bulb**s - Wherever practical, replace regular light bulbs with compact florescent light (CFL) bulbs. Replacing just one 60-watt incandescent light bulb with a CFL will save you $30 over the life of the bulb. CFLs also last 10 times longer than incandescent bulbs, use two-thirds less energy, and give off 70 percent less heat. If every Canadian family replaced one regular light bulb with a CFL, it would eliminate 90 billion pounds of greenhouse gases, the same as taking 7.5 million cars off the road.
- **Fuel efficient vehicles** - When you do drive, make sure your car is running efficiently. For example, keeping your tires properly inflated can improve your gas mileage by more than 3 percent. Every gallon of gas you save not only helps your budget, it also keeps 20 pounds of carbon dioxide out of the atmosphere.
- **Buy Energy-Efficient Products** - Home appliances now come in a range of energy-efficient models, and compact florescent bulbs are designed to provide more natural-looking light while using far less energy than standard light bulbs.
- **Use Less Hot Water** - Set your water heater at 120 degrees to save energy, and wrap it in an insulating blanket if it is more than 15 years old. Buy low-flow showerheads to save hot water and about 350 pounds of carbon dioxide yearly. Wash your clothes in warm or cold water to reduce your use of hot water and the energy required to produce it. That change alone can save at least 500 pounds of carbon dioxide annually in most households.
- **Use the "Off" Switch** - Save electricity and reduce global warming by turning off lights when you leave a room, and using only as much light as you need. And remember to turn off your television, stereo and computer when you're not using them. It's also a good idea to turn off the water when you're not using it. While brushing your teeth, shampooing the dog or washing your car, turn off the water until you actually need it for rinsing
- **Aforestation** - If you have the means to plant a tree, start digging. Trees absorb carbon dioxide and give off oxygen. A single tree will absorb approximately one ton of carbon dioxide during its lifetime.
- **Encourage Others to Conserve** - Share information about recycling and energy conservation with your friends, neighbors and co-workers, and take opportunities to encourage public officials to establish programs and policies that are good for the environment. These 10 steps will take you a long way toward reducing your energy use and saving you money. Less energy use means less dependence on the fossil fuels that create greenhouse gases and contribute to global warming.

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Vedic Mathematics for Faster Mental Calculations

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Abstract

Vedic mathematics is the name given to the ancient Indian system of mathematics that was rediscovered in the early twentieth century from ancient Indian sculptures (Vedas). We have studied some of their methods in details.

2. Introduction

Vedic mathematics is composed of sutras which have been formulated over many centuries by sages of India. The sutras which are in Sanskrit have been lost over the centuries due to neglect of future generations. Due to dedicated efforts of a few enthusiasts it is being revived to its previous glory. The pioneer in this field was Jagadguru Swami Sri Bharati Krishna Tirthaji Maharaja, who compiled sixteen sutras and unleashed this wonderful science to the world. He wrote sixteen volumes encompassing some of the greatest Vedic sutras but all were lost and he finally wrote one book explaining the sixteen sutras before he passed away from this world.

The ancient system of Vedic Mathematics was rediscovered from the Sanskrit texts known as the Vedas, between 1911 and 1918 by Sri Bharati Krishna Tirthaji (1884-1960). At the beginning of the twentieth century, when there was a great interest in the Sanskrit texts in Europe, Bharati Krishna tells us some scholars ridiculed certain texts which were headed 'Ganita Sutras'- which means mathematics. They could find no mathematics in the translation and dismissed the texts as rubbish. Bharati Krishna, who was himself a scholar of Sanskrit, Mathematics, History and Philosophy, studied these texts and after lengthy and careful investigation was able to reconstruct the mathematics of the Vedas. According to his research all of mathematics is based on sixteen Sutras, or word-formulae.

Bharati Krishna wrote sixteen volumes expounding the Vedic system but these were unaccountably lost and when the loss was confirmed in his final years he wrote a single book: Vedic Mathematics, currently available. It was published in 1965, five years after his death.

3. Implemented Algorithms

1. Multiplication using Urdhva Tiryakbhyam (Vertical & Crosswise)

Urdhva Triyakbhyam is the general formula applicable to all cases of multiplication and also in the division of a large number by another large number. It means vertically and crosswise.

This is the most powerful sutra when it comes to Vedic Multiplication.

Consider the following example:

37 * 33

Step 1: Write it as follows

37
33

Step 2: Multiply the left most column vertically and write it below.

Multiply 3 * 3 to get 9

37
33
9

Step 3: Next multiply diagonally and add

i.e. (3*3) + (3*7) = 9 + 21 = 30

Since 30 is a 2 digit number put the last digit (here '0') next to 9 and the other digits (here '3') below 9

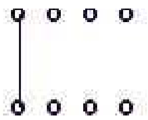
37
33
90
3

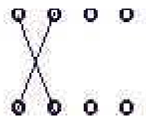
Step 4: Now multiply the RHS column and put it below and total to get the Answer.

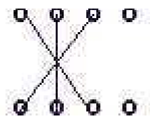
  37
  33
901
  32
1221

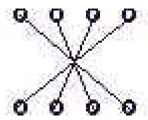
Hence 1221 is the Answer

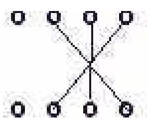
The Line Diagram for four digits is given below

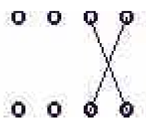
1) 

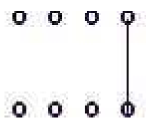
2) 

3) 

4) 

5) 

6) 

7) 

2. Squaring using Yaavadunam

Sutra: *Yaavadunam Taavaduunikruthya vargam cha yogayet*

Meaning: Whatever the extents of its deficiency lessen it further to that very extent; and also set up the square of that deficiency.

This sutra is a corollary of the **Nikhilam** sutra.

Consider a simple example 9^2

Step 1: Consider the nearest base (here 10).

Step 2: As 9 has a deficiency of 1 (10 - 9 = 1), we should decrease it further by 1, and set down our LHS of the Answer as '8'.

Step 3: On the RHS put the square of the deficiency (here 1).

We get $9^2 = 81$.

Now Consider 102

1) Base is 100

2) Deficiency is '-2' (100 - 102 = -2)

Therefore we subtract '-2' from 102

102 - (-2) = 104

This is our RHS

3) Our LHS now becomes $(-2)^2$ which is 4

Since the base is 100 we write it as '04', so that we get $102^2 = 10404$

If we have multiples or sub multiples of a base, we employ the same technique as in 'Aanurupyena'.

Consider 28^2

1) Let 20 be the Working Base and 10 as the Main Base.

Therefore x = (Main Base)/ (Working Base) = 10/20 = 1/2

2) Here the deficiency = 20 - 28 = -8

Therefore RHS = 28 - (-8) = 36

Divide by x i.e. by (1/2).

We get 36/ (1/2) = 72. This is the required RHS.

3) LHS = $(-8)^2 = 64$

Since Main Base is 10, we put only '4' on the LHS and carry over '6' to the RHS

Therefore we get

28^2 = 72+6 | 4 == 784

Some More Examples

$36^2 = 128 \,|_1 6 = 1296$ (Base = 40)

522 = 27 | 04 = 2704 (Base = 50)

9972 = 994 | 009 = 994009 (Base = 1000)

10042 = 1008 | 016 = 1008016 (Base =1000)

3. Squaring using Ekadhikena Purvena

Meaning: "By one more than the previous one"

This sutra is used exclusively for numbers ending with 5.

For numbers ending with 5 the LHS will be 25.

The RHS will be the product of the other digits with its *ekadhikena*.

Examples:

$25^2 = (2 * 3) \,|\, 25 = 625$

$35^2 = (3 * 4) \,|\, 25 = 1225$

$45^2 = (4 * 5) \,|\, 25 = 2025$

$55^2 = (5 * 6) \,|\, 25 = 3035$

$65^2 = (6 * 7) \,|\, 25 = 4225$

$75^2 = (7 * 8) \,|\, 25 = 5625$

$105^2 = (10 * 11) \,|\, 25 = 11025$

$125^2 = (12 * 13) \,|\, 25 = 15625$

$175^2 = (17 * 18) \,|\, 25 = 30625$

4. Square using Dwandwa Yoga

We have tried to explain squaring of any no using Dwandwa Yoga.

The Dwandwa Yoga or 'duplex combination' can be used for general purpose squaring.

To proceed further we need to know the Dwandwa of certain numbers.

$D(a) = a^2$

$D(ab) = 2ab$

$D(abc) = 2ac + b^2$

$D(abcd) = 2ad + 2bc$

$D(abcde) = 2ae + 2bd + c^2$

$D(abcdef) = 2af + 2be + 2cd$ and so on....

As we can see above, D of any number is the sum of square of the middle number and two times the product of the other pairs.

Square of a number is given by

$(ab)^2 = D(a) \mid D(ab) \mid D(b)$

$(abc)^2 = D(a) \mid D(ab) \mid D(abc) \mid D(bc) \mid D(c)$

$(abcd)^2 = D(a) \mid D(ab) \mid D(abc) \mid D(abcd) \mid D(bcd) \mid D(bc) \mid D(c)$

Example:

$(23)^2 = (ab)^2 = D(a) \mid D(ab) \mid D(b)$

$= 4 \mid 12 \mid 9$

Since Dwandwa must have only one digit, we carry over '1' of '12' to LHS.

Therefore it becomes $4 \mid_1 2 \mid 9$

Hence the answer is 529

Example 2:

$(527)^2 = (abc) 2$

$= D(a) \mid D(ab) \mid D(abc) \mid D(bc) \mid D(c)$

$= 25 \mid 20 \mid 74 \mid 28 \mid 49$

$= 25 \mid_2 0 \mid_7 4 \mid_2 8 \mid_4 9$

$= 277729$

5. Direct Cubing

This method is simple and easy.

If the number is (ab) its cube can be calculated as

$a^3 \quad a^2b \quad ab^2 \quad b^3$

$\quad 2a^2b \quad 2ab^2$

Sum them up taking care of the carryovers.

Consider $(16)^3$

Writing it as above

$$
\begin{array}{cccc}
1 & 6 & 36 & 216 \\
 & 12 & 72 & \\
\hline
1 & 18 & 108 & 216
\end{array}
$$

Considering the carryovers

```
1 0 0 0
1 8 0 0
1 0 8 0
  2 1 6
4 0 9 6
```

Therefore we get the answer as 4096

6. Cubing using Yaavadunam

This method is similar to squaring by Yaavadunam. It is just modified a bit, as we shall see in the next few examples.

Consider 13^3

Step 1: Consider nearest base (here 10).

Step 2: As 13 has an excess of '3' (13 - 10 = 3), we double the excess and add the original number (13) to it, and put it on the LHS.

Therefore we get 13 + 6 = 19

Step 3: Now find the new excess. In this case it is 19-10 = 9. Now multiply this with the original excess to get the middle part of the answer.

Therefore we get 9 * 3 = 27

Step 4: Now cube the original excess and put it as the last part

Carry over any big numbers and total to get the answer.

```
19  7  7
 2  2
--------
21  9  7
```

Therefore 133 = 2197

Now consider 47^3

As in 'Nikhilam' and Squaring, we use 'Aanurupyena' here.

1) Let the main base be 10 and the working base be 50 therefore the ratio

x = (Main Base)/ (Working Base) = 10/50 = 1/5

2) Excess is -3 (47 - 50 = -3). Double the excess and add the original number (here 47) to it.

We get 47 - 6 = 41.

The Base correction for this part is achieved by dividing by x2.

Therefore we get 41/ (1/25) = 41 * 25 = 1025

3) Excess in the new uncorrected number (41 - 50 = -9) is multiplied by the original excess (-3) to obtain the second part.

Therefore we get -9 * -3 = 27

The Base correction for this part is achieved by dividing by x.

Therefore we get 27 * 5 = 135

4) The third part is obtained by cubing the excess.

(-3)3 = -27

5) Carry over the extra numbers and total to obtain the final answer

1025	0	0
13	5	0
	-2	7
1038	2	3

Therefore the final answer is 103823

4. Conclusion

Vedic Math can undoubtedly make our life simpler by reducing everyday calculations. It is an ancient and extremely effective way to finish calculations mentally. It also is a salient part of our culture and our submissive heritage.

We should respect our culture and take pride in learning this humble art of Vedic Math.

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Methods of Cryptography and Data Encryption

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Project Mentor :
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Abstract

Cryptography and encryption have been used for secure communication for thousands of years. Throughout history, military communication has had the greatest influence on encryption and the advancements thereof. The need for secure commercial and private communication has been led by the Information Age, which began in the 1980's. Although the Internet had been invented in the late 1960's, it did not gain a public face until the World Wide Web was invented in 1989. The World Wide Web is an electronic protocol which allows people to communicate mail, information, and commerce through a digital medium. This new method of information exchange has caused a tremendous need for information security. A thorough understanding of cryptography and encryption will help people develop better ways to protect valuable information as technology becomes faster and more efficient.

Introduction and Terminology

- **Cryptography:** Cryptography is the science or study of techniques of secret writing and message hiding (Dictionary.com 2009). Cryptography is as broad as formal linguistics which obscure the meaning from those without formal training. It is also as specific as modern encryption algorithms used to secure transactions made across digital networks. Cryptography constitutes any method in which someone attempts to hide a message, or the meaning thereof, in some medium.
- **Encryption:** Encryption is one specific element of cryptography in which one hides data or information by transforming it into an undecipherable code. Encryption typically uses a specified parameter or key to perform the data transformation. Some encryption algorithms require the key to be the same length as the message to be encoded, yet other encryption algorithms can operate on much smaller keys relative to the message. Decryption is often classified along with encryption as it's opposite. Decryption of encrypted data results in the original data.

Advantages of Encryption

Encryption is used in everyday modern life. Encryption is most used among transactions over insecure channels of communication, such as the internet. Encryption is also used to protect data being transferred between devices such as automatic teller machines (ATMs), mobile telephones, and many more. Encryption can be used to create digital signatures, which allow a message to be authenticated. When properly implemented, a digital signature gives the recipient of a message reason to believe the message was sent by the claimed sender. Digital signatures are very useful when sending sensitive email and other types of digital communication. This is relatively equivalent to traditional handwritten signatures, in that, a more complex signature carries a more complex method of forgery.

Cipher : A cipher is an algorithm, process, or method for performing encryption and decryption. A cipher has a set of well-defined steps that can be followed to encrypt and decrypt messages. The operation of a cipher usually depends largely on the use of an encryption key. The key may be any auxiliary information added to the cipher to produce certain outputs.

Plaintext vs. Ciphertext : Plaintext and ciphertext are typically opposites of each other. Plaintext is any information before it has been encrypted. Ciphertext is the output information of an encryption cipher. Many encryption systems carry many layers of encryption, in which the ciphertext output becomes the plaintext input to another encryption layer. The process of decryption takes ciphertext and transforms it back into the original plaintext.

Cryptanalysis : In efforts to remain secure, Governments have employed staff for studying encryption and the breaking thereof. Cryptanalysis is the procedures, processes, and methods used to translate or interpret secret writings or communication as codes and ciphers for which the key is unknown (Dictionary.com 2009). Even though the goal has been the same, the methods and techniques of cryptanalysis have changed drastically through time. These changes derive from an attempt to adapt to the increasing complexity of cryptography. Due to the tremendous advantage of knowing an enemies thoughts, war is the main driving force of cryptanalysis. Throughout history many governments have employed divisions solely for cryptanalysis during war time. Within the last century, governments have employed permanent divisions for this purpose.

Historical Cryptography

Ancient Egypt : The earliest known text containing components of cryptography originates in the Egyptian town Menet Khufu on the tomb of nobleman Khnumhotep II nearly 4,000 years ago. In about 1900 B.C. Khnumhotep's scribe drew his master's life in his tomb. As he drew the hieroglyphics he used a number of unusual symbols to obscure the meaning of the inscriptions. This method of encryption is an example of a substitution cipher, which is any cipher system which substitutes one symbol or character for another.

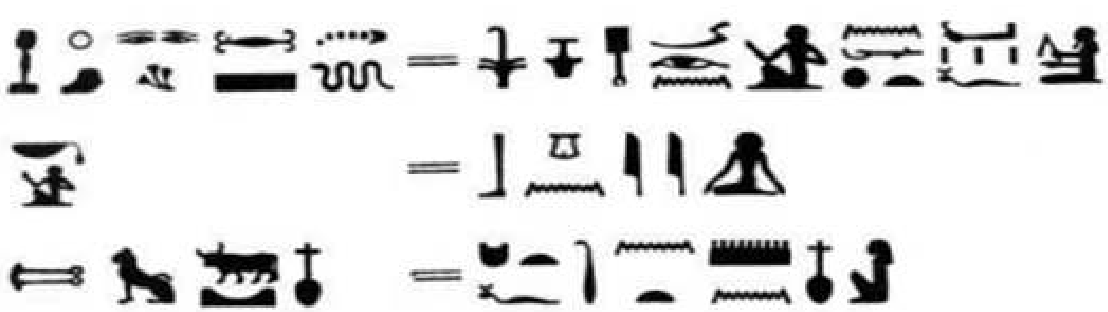


Figure 1. Symbols taken from the tomb of Khnumhotep II.

Greece : In about 500 B.C. the Spartans dev eloped a device called Scytale, which was used to send and receive secret messages. The device was a cylinder in which a narrow strip of parchment was wound. The message was then written length-wise on the parchment. Once it was unwound the message on the strip of parchment became unreadable. To receive the message an identical cylinder was needed. It was only then that the letters would line up resulting in the original message.

Figure 2. Scytale example

The Scytale is an example of a transposition cipher, which is any cipher system that changes the order of the characters rather than changing the characters themselves. In today's standards, t he Scytale would be very easy to decipher, however, 2,500 years ago the percent of people would could read and write was relatively small. The Scytale provided the Spartans a secure method of communication.

Rome : The earliest recorded military use of cryptography comes from Julius Caesar 2,000 years ago. Caesar, being commander of the Roman army, solved the problem of secure communication with his troops. The problem was that messengers of secret military messages were often overtaken by the enemy. Caesar developed a substitution cipher method in which he would substitute letters for different letters. Only those who knew the substitution used could decipher the secret messages. Now when the messengers were overtaken the secret messages were Unlike the example found in Figure, Caesar typically just shifted his letters by some predetermined number. This number was the cipher key of his algorithm. A randomized order of substitution yields a much larger amount of security due to the larger amount of possible orderings. not exposed. This gave the Ro man army a huge advantage during war.

Figure 3. Example of a substitution cipher

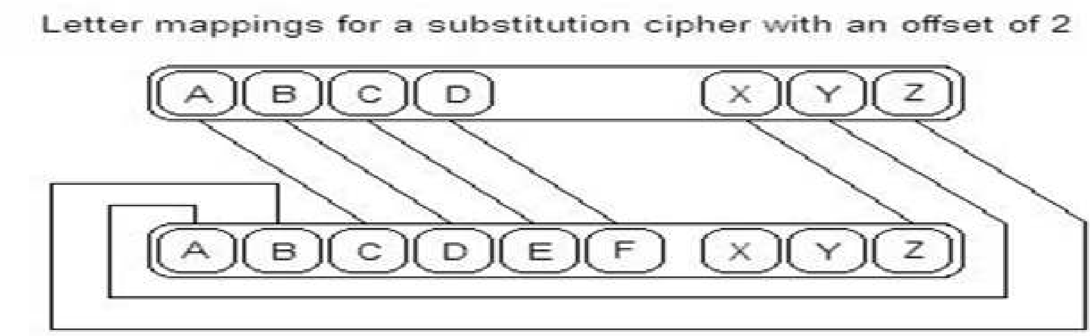


Figure : Example of a substitution cipher

Alberti-Vigenere Cipher: During the mid 1400's a man named Leon Battista Alberti invented an encryption system using a cipher disk. This was a mechanical device with sliding disks that allowed for many different methods of substitution. This is the base concept of a poly alphabetic cipher, which is an encryption method which switches through several substitution ciphers throughout encryption. In his book “The Codebreakers”, David Kahn calls Alberti “the father of western cryptography” (Kahn 1967). Alberti never developed his cipher disk concept.

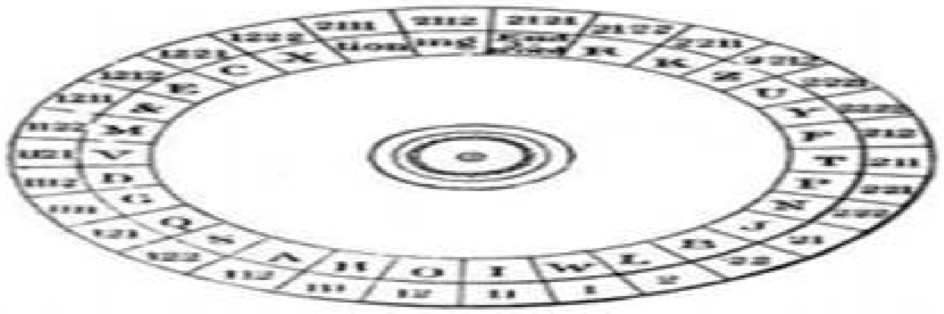


Figure 4. Cipher disk

In the 1500's Blaise De Vigenere, following Alberti’s poly alphabetic cipher style, created a cipher that came to be known as the Vigenere Cipher. The Vigenere Cipher works exactly like the Caesar except that it changes the key throughout the encryption process. The Vigenere Cipher uses a grid of letters that give the method of substitution. This grid is called a Vigenere Square or a Vigenere Table. The grid is made up of 26 alphabets offset from each other by one letter.

Figure 5. Vigenere Square

The method of changing from one key to another follows one simple pattern. The encryption key was chosen as a special secret word. The first character of the plaintext can be substituted using the table as follows: The substituted letter for the first plaintext character is found by lining up th e plaintext character on the x-axis and the first letter of the special secret word on the y-axis. The corresponding letter is then substituted for the plain text character. This method is repeated through all characters of the key word. After all characters of the key word are used, the word is just repeated.

Examples: For example, suppose that the plaintext to be encrypted is : ATTACKATDAWN

The person encrypting the message chooses a keyword and repeats it until its length matches the plaintext. For example "LEMON."

LEMONLEMONLE

The first letter of the plaintext is enciphered using the alphabet in row L, which is the first letter of the keyword. The substitution is made by finding the letter in row L and column A, which is L. Moving to the next letter, the substitution is made by finding the letter in row E and column T, which is X. This is repeated until each plaintext character has been substituted. The results are:

Plaintext: ATTACKATDAWN

Keyword: LEMONLEMONLE

Ciphertext: LXFOPVEFRNHR

The decryption algorithm is the exact same except that the person finds the column that corresponds to the ciphertext's character in the keyword's row.

Jefferson Wheel Cipher : In the late 1700's, Thomas Jefferson came up with a cipher system very similar to the Vigenere Cipher except with higher security. His invention was 26 wheels with the alphabet randomly scattered on each wheel. The wheels were numbered and ordered with a specified order. This order is the key to the encryption algorithm. To message to be encrypted is made on the wheels by lining up the wheels such that the message is present. The ciphertext is any other line besides the line containing the original message. The person decrypting the ciphertext must have the wheels in the proper order. As the ciphertext is made on the wheels, the plaintext is lined up somewhere else on the wheels. A visual scan can quickly result in finding the original text. There is an extremely small chance that two non-gibberish messages will emerge on the disk during decryption.

War Driven Cryptography - WWI

Zimmerman Telegram

In early 1917, during the early stages of World War I, British cryptographers encountered a German encoded telegram. This telegram is often referred to as the Zimmerman Telegram. These cryptographers were able to decipher the telegram, and in doing so they changed cryptanalysis history. Using this deciphered message, they were able to convince the United States to join the war.

The Zimmerman Telegram was a secret communication between the Foreign Secretary of the German Empire, Arthur Zimmerman, to the German ambassador in Mexico, Heinrich von Eckardt.

At the time when the telegram was sent, World War I was at its height. Until that point, the United States had attempted to remain neutral. British, and other allies, had begged for help from the U.S., and attitudes in the US were slowly shifting towards war. The British gave the U.S. the decoded telegram on February 24, 1917 and on April 6, 1917 the U.S. officially declared war against Germany and its allies.

Choctaw Codetalkers

As WWI went on, the United States had the continuing problem of the lack of secure communication. Almost every phone call made was intercepted by the Germans, leaving every move made by the allies known to the Germans. Army commander, Captain Lewis devised a plan that utilized American Indian languages. He found eight Choctaw men in the battalion and used them to talk to each other over radio and phone lines. Their language was valuable because ordinary codes and ciphers of a shared language can be broken, whereas codes based on a unique language must be studied extensively before beginning to decode them. Within 24 hours of using the Choctaw language as encryption, the advantage fell in favor of the United States. Within 72 hours, the Germans were retreating and the allies were in full attack.

War Driven Cryptography - WWII

Enigma Encryption Machine : At the end of World War I, Arthur Scherbius invented the Enigma, an electro-mechanic al machine that was used for encryption and decryption of secret messages. The Enigma had several rotors and gears that allowed up to 10^{114} possible configurations. Because of the numerous configurations, the Enigma was virtually unbreakable with brutte force methods. The finally commercially available versions were available in the 1920's. It wasn't until World War II that the Enigma gained it's fame. Due to the Enigma's statistical security, Nazi Germany became overconfident about their ability to encrypt secret messages. This overconfidence caused the downfall of the Enigma. Along with numerous German operator errors, the Enigma had several built in weaknesses that Allied cryptographers exploited. The major weakness was that it's substitution algorithm did not allow any letter to be mapped to itself. This allowed the Allied cryptographers to decrypt a vast number of ciphered messages sent by Nazi Germans.

Modern Encryption – Part 1

One-Time Pad : The "one-time pad" encryption algorithm was invented in the early 1900's, and has since been proven as unbreakable. The one-time pad algorithm is derived from a previous cipher called Vernam Cipher, named after Gilbert Vernam. The Vernam Cipher was a cipher that combined a message

Figure 11. Example of a One-Time Pad implementation using modular addition.

with a key read from a paper tape or pad. The Vernam Cipher was not unbreakable until Joseph Mauborgne recognized that if the key was completely random the cryptanalytic difficultly would be equal to attempting every possible key (Kahn 1996). Even when trying every possible key, one would still have to review each attempt at decipherment to see if the proper key was used. The one-time pad is typically implemented by using a modular addition (XOR) to combine plaintext elements with key elements. An example of this is shown in Figure 11. The key used for encryption is also used for decryption. Applying the same key to the ciphertext results back to the plaintext.

Pseudo-Random Number Generator : If any non-randomness occurs in the key of a one-time pad, the security is decreased and thus no more unbreakable. Numerous attempts have been made to create seemingly random numbers from a designated key. These number generators are called Pseudo-Random Number Generators (PRNGs) because they cannot give a completely random number stream. Even though the security of a PRNG is not 100% unbreakable, it can provide sufficient security when implemented correctly. PRNGs that have been designated secure for cryptographic use are called Cryptographically Secure Pseudo-Random Number Generators (CSPRNGs). CSPRNGs have qualities that other PRNGs do not. CSPRNGs must pass the "next-bit test" in that given the first k bits, there is no polynomial-time algorithm that can predict the (k+1)th bit with probability of success higher than 50% (Knuth 1981). CSPRNGs must also withstand "state compromises." In the event that part or all of its state is revealed, it should be impossible to reconstruct the stream of random numbers prior to the revelation.

Symmetric Key Encryption (Private-Key) : Up to this point in the discussion, every method of encryption requires a special secret key to be previously and securely established. This is the nature of symmetric key encryption. A symmetric key, sometimes called private-key, encryption cipher is any algorithm in which the key for encryption is trivially related to the key used for decryption. An analogy of this is a typical mechanical lock. The same key that engages the lock can disengage it. To protect anything valuable behind the lock, the key must be given to each member securely. If an unintended person obtains access to the key, he or she will have full access to what is being secured by the lock.

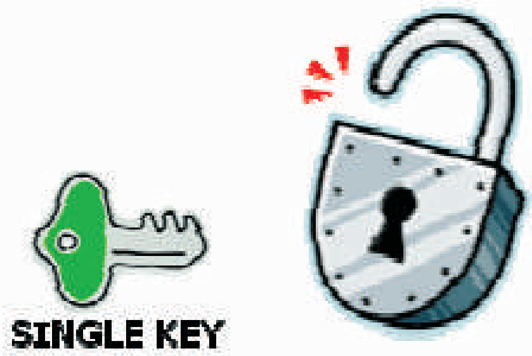


Figure 12. A lock that is engaged and disengaged by the same key.

Implementations of Symmetric Key Encryption : There are several modern algorith ms that implement a symmetric key encryption scheme. One method of symmetric key encryption is a st ream cipher, where a stream of random, or pseudo random, numbers are combined with the original mes sage. Specific stream ciphers include: One-Time Pa d, Linear Feedback Shift Register (LFSR), Line ar Congruential, and RC4. RC4 is the most widely-u sed stream cipher and is used in Secure Socket Layer (SSL) and Wired Equivalent Privacy (WEP).

Modern Encryption - Part 2

Asymmetric Key Encryption (Public-Key)

The digital era of the 1970's caused a need for an encryption system that would rely o n a predetermined key. Cryptographers of this era realized that in order to send a message securely with out previously meeting with the recipient, they would need a system that uses a different key for encryption than it does for decryption. In comparison with symmetric key encryption, this system would compare to a lock that has one key for engaging the lock and a different key for disengaging the lock.

Figure 13. A lock that is engaged and disengaged by different keys.

Diffie-Hellman Key Exchange : The Diffie-Hellman Key Exchange is a cryptographic protocol that allows two parties with no prior knowledge of each other to establish a shared secret key, which typically is used in a symmetric key cipher. The Diffie-Hellman Key Exchange was first published by Whitfield Diffie and Martin Hellman in 1976. The GCHQ, the British signal s intelligence, announced that this scheme had been invented by Malcolm Williamson years before Diffie and Hellman's publication, but was kept classified.

The Diffie-Hellman Key Exchange lies on exponential functions computing much faster than discrete logarithms. When used properly, t he Diffie-Hellman Key Exchange protocol gives two parties the same key without actually transmitting it. The strength of this algorithm depends on the time it takes to compute a discrete logarithm of th e public keys transmitted (Diffie, Hellman 1976).

RSA Encryption : Noticing the inability of the Diffie-Hellman Key Exchange to transmit a secret message, Ron Rivest, Adi Shamir, and Leonard Adleman developed a system similar to the Diffie-Hellman protocol except that a message could be embedded and transmitted.

Figure 15. Ron Rivest, Adi Shamir, and Leonard Adleman

RSA encryption, named for the surnames of the inventors, relies on multiplication and exponentiation being much faster than prime factorization. The entire protocol is built from two large prime numbers. These prime numbers are manipulated to give a public key and private key. Once these keys are generated they can be used many times. Typically one keeps the private key and publishes the public key. Anyone can then encrypt a message using the public key and sent it to the creator of the keys. This person then uses the private key to decrypt the message. Only the one possessing the private key can decrypt the message. One of the special numbers generated and used in RSA encryption is the modulus, which is the product of the two large primes. In order to break this system, one must compute the prime factorization of the modulus, which results in the two primes. The strength of RSA encryption depends on the difficultly to produce this prime factorization. RSA Encryption is the most widely used asymmetric key encryption system used for electronic commerce protocols.

Breaking RSA Keys : The patent holder of RSA Encryption, RSA Security or RSA Laboratories, issued a challenge to encourage research into the practical difficulty of factorizing large integers. The motivation behind the challenge was to credit RSA Encryption to be a super power in the cryptography field. In 2007, RSA Laboratories ended the challenge stating: "Now that the industry has a considerably more advanced understanding of the cryptanalytic strength of common symmetric-key and public-key algorithms, these challenges are no longer active" (RSA Laboratories 2007).

Steganography

Security Through Obscurity : Steganography is a form of cryptography that embeds data into other mediums in an unnoticeable way, instead of employing encryption. Mediums used for steganography are typically human viewable objects such as picture, audio, and video files. Other steganographic mediums can include web pages, communication protocols, data streams, and many more. A very simple implementation of steganography could be invisible ink written between visible lines of text in a document. Large scale steganography, performed with computers, is typically based on human undeterminable numbers.

Many people claim that the terrorist attack of September 11th 2001, among many, was planned using steganographic cryptography and the internet. Previous to the attack, USA Today said: "Lately, al-Qaeda operatives have been sending hundreds of encrypted messages that have been hidden in files on digital

photographs on the auction site eBay.com" (USA Today Feb. 5 2001). If this allegation is true, it seems it would be an effective way to hide secret information without more advanced countries discovering their work. Al-Qaeda would know that the U.S. could probably break any encryption they used, so the alternative method of steganography was a clever choice.

Figure 16 shows a sample top secret document that is wished to be hidden. Figure 17 is the original picture and Figure 18 shows that picture after is has been embedded with the top secret document. As can be seen, the picture looks exactly the same to the human eye. If an analysis of the pictures binary codes were compared, the differences would be seen. The inability to see precision in a given medium is the basis for steganography.

Future Methods of Encryption

Elliptic Curve Cryptography : Elliptic Curve Cryptography (ECC) has technically already been invented but is considered by the author to be a future technique of cryptography because its advantages and disadvantages are not yet fully understood. ECC is an approach to encryption that utilizes the

Steganographic Embedding

Figure 16. Sample secret document to be embedded into Figure 17.

Figure 17.Before embedding of Figure 15

Figure 18.After embedding of Figure 15

complex nature of elliptic curves in finite fields. ECC typically uses the same types of algorithms as that of Diffie-Hellman Key Exchange and RSA Encryption. The difference is that the numbers used are chosen from a finite field defined within an elliptic curve expression.

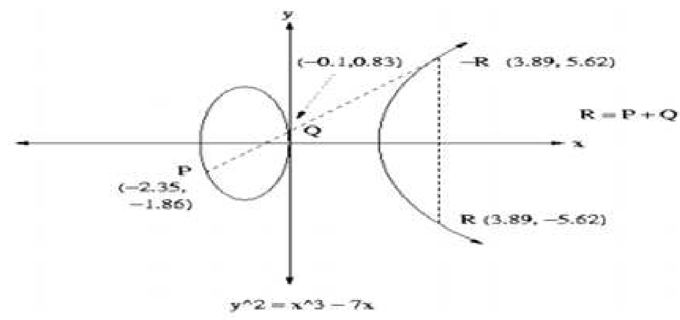


Figure 19. An elliptic curve graph

Figure 19 shows an example of an elliptic curve. This example could be used in conjunction with an RSA type algorithm in which two primes, "P" and "Q", are chosen. When the primes are chosen using a predefined elliptic curve in a finite field, the key sizes can be much smaller and still yield the same amount of security. This allows the time it takes to perform the encryption and decryption to be drastically reduced, thus allowing a higher amount of data to be passed with equal security. Just as other methods of encryption have, ECC must also be tested and proven secure before the it gets accepted for commercial, governmental, and private use.

Quantum Computation : Quantum computation is performed in a quantum computer or processor, which is a processor that makes use of quantum mechanical phenomena, such as quantum superposition and quantum entanglement. Modern computers store data using a binary format called a "bit" in which a "1" or a "0" can be stored. The computations in modern computers typically work in a bit by bit fashion. Quantum computers store data using a quantum superposition of multiple states. These multiple valued states are stored in "quantum bits" or "qubits." Depending on the quantum design, each qubit can store a set number values simultaneously (Jones 2009). This allows the computation of numbers to be several orders of magnitude faster than traditional transistor processors.

$$e^{\left[\left(\frac{64}{9}*b\right)^{\frac{1}{3}}(\log b\,)^{\frac{2}{3}}\right]}$$

Equation 1. GNFS algorithm time.

$$b^3$$

Equation 2. Shor's algorithm time.

Equation 1 shows the time it takes to run the fastest known algorithm (GNFS) to compute a prime factorization on a binary formatted processor. Equation 2 shows the algorithm discovered by Peter Shor that computes a prime factorization on a quantum computer. In both cases, "b" is the number of bits in the number. It's easily viewed that Shor's algorithm runs much faster. To comprehend the power of a theoretical quantum computer, consider the RSA numbers previously mentioned. RSA-640, a number with 193 digits, was factored by 80 2.2GHz computers over the span of 5 months. If this RSA number was applied to one quantum computer of equal size, Shor's algorithm shows that it would be factored in less than 17 seconds. Numbers that would typically takes billions of years to compute could only take a matter of hours or even minutes with a fully developed quantum computer.

Cryptography in Everyday Life

Authentication / Digital Signatures: Authentication and digital signatures are a very important application of public-key cryptography. For example, if you receive a message from me that I have encrypted with my private key and you are able to decrypt it using my public key, you should feel reasonably certain that the message did in fact come from me. If I think it necessary to keep the message secret, I may encrypt the message with my private key and then with your public key, that way only you can read the message, and you will know that the message came from me. The only requirement is that public keys are associated with their users by a trusted manner, for example a trusted directory. To address this weakness, the standards community has invented an object called a certificate. A certificate contains, the certificate issuer's name, the name of the subject for whom the certificate is being issued, the public key of the subject, and some time stamps. You know the public key is good, because the certificate issuer has a certificate too.

Time Stamping : Time stamping is a technique that can certify that a certain electronic document or communication existed or was delivered at a certain time. Time stamping uses an encryption model called a blind signature scheme. Blind signature schemes allow the sender to get a message receipted by another party without revealing any information about the message to the other party.Time stamping is very similar to sending a registered letter through the U.S. mail, but provides an additional level of proof. It can prove that a recipient received a specific document.

Electronic Money : The definition of electronic money (also called electronic cash or digital cash) is a term that is still evolving. It includes transactions carried out electronically with a net transfer of funds from one party to another, which may be either debit or credit and can be either anonymous or identified. There are both hardware and software implementations.

Anonymous applications do not reveal the identity of the customer and are based on blind signature schemes. (Digicash's Ecash) Identified spending schemes reveal the identity of the customer and are based on more general forms of signature schemes. Anonymous schemes are the electronic analog of cash, while identified schemes are the electronic analog of a debit or credit card. Encryption is used in electronic money schemes to protect conventional transaction data like account numbers and transaction amounts, digital signatures can replace handwritten signatures or a credit-card authorizations, and public-key encryption can provide confidentiality.

Secure Network Communications

Secure Socket Layer (SSL)

Netscape has developed a public-key protocol called Secure Socket Layer (SSL) for providing data security layered between TCP/IP (the foundation of Internet-based communications) and application protocols (such as HTTP, Telnet, NNTP, or FTP). SSL supports data encryption, server authentication, message integrity, and client authentication for TCP/IP connections.

The SSL Handshake Protocol authenticates each end of the connection (server and client), with the second or client authentication being optional. In phase 1, the client requests the server's certificate and its cipher preferences. When the client receives this information, it generates a master key and encrypts it with the server's public key, then sends the encrypted master key to the server. The server decrypts the master key with its private key, then authenticates itself to the client by returning a message encrypted with the master key. Following data is encrypted with keys derived from the master key. Phase 2, client authentication, is optional. The server challenges the client, and the client responds by returning the client's digital signature on the challenge with its public-key certificate.

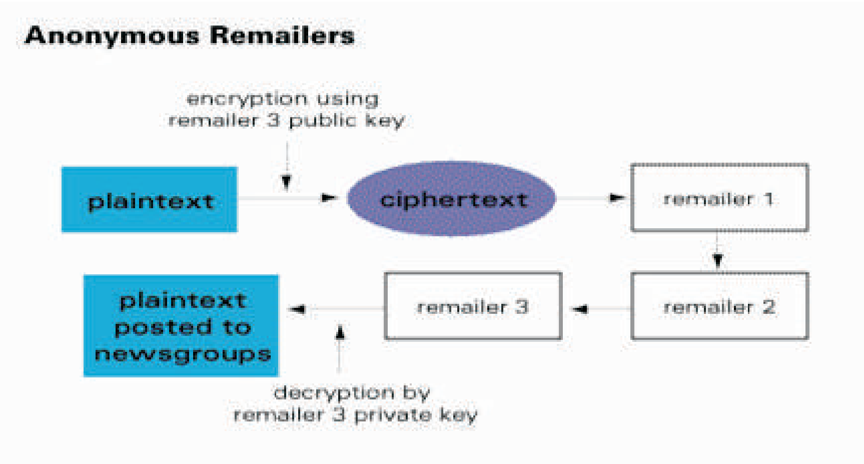
SSL uses the RSA public-key cryptosystem for the authentication steps. After the exchange of keys, a number of different cryptosystems are used, including RC2, RC4, IDEA, DES and triple-DES.

Kerberos : Kerberos is an authentication service developed by MIT which uses secret-key ciphers for encryption and authentication. Kerberos was designed to authenticate requests for network resources and does not authenticate authorship of documents. In a Kerberos system, there is a site on the network, called the Kerberos server, to perform centralized key management and administrative functions. The server maintains a key database with the secret keys of all users, authenticates the identities of users, and distributes session keys to users and servers who need to authenticate one another. Kerberos depends on a trusted third party, the Kerberos server, and if the server were compromised, the integrity of the whole system would be lost. Kerberos is generally used within an administrative domain (for example across a companies closed network); across domains (e.g., the Internet), the more robust functions and properties of public-key systems are often preferred.

Anonymous Remailers

A remailer is a free service that strips off the header information from an electronic message and passes along only the content. It's important to note that the remailer may retain your identity, and rather than trusting the operator, many users may relay their message through several anonymous remailers before sending it to its intended recipient. That way only the first remailer has your identity, and from the end point, it's nearly impossible to retrace.

Here's a typical scenario - the sender intends to post a message to a news group via three remailers (remailer 1, remailer 2, remailer 3). He encrypts the message with the last remailer's (remailer 3's) public key. He sends the encrypted message to remailer 1, which strips away his identity, then forwards it to remailer 2, which forwards it to remailer 3. Remailer 3 decrypts the message and then posts it to the intended newsgroup.



Disk Encryption

Disk encryption programs encrypt your entire hard disk so that you don't have to worry about leaving any traces of the unencrypted data on your disk.

PGP can also be used to encrypt files. In this case, PGP uses the user's private key along with a user-supplied password to encrypt the file using IDEA. The same password and key are used to unlock the file.

Conclusion

There has been a historical pattern that shows the country with the strongest encryption has been a leader in military power. By studying cryptography and encryption, a country could strengthen its defenses and have the necessary means to survive in a hostile world. An understanding of encryption can also help individuals with securing private data and information. Even though it is severely unethical, our communication with one another is constantly being monitored. Those who monitor our communication can include governments, internet service providers, hackers, identity thieves, and more. By learning to use cryptography for secure communication, we can safe guard ourselves from being compromised by those who could steal our information. Cryptography is illegal in many countries because the local government wishes to be able to read any transmission sent. Many people speculate that the United States does not need these laws because the NSA has developed methods of cryptanalysis that break all encryption methods currently known.

Life Cycle of a Star

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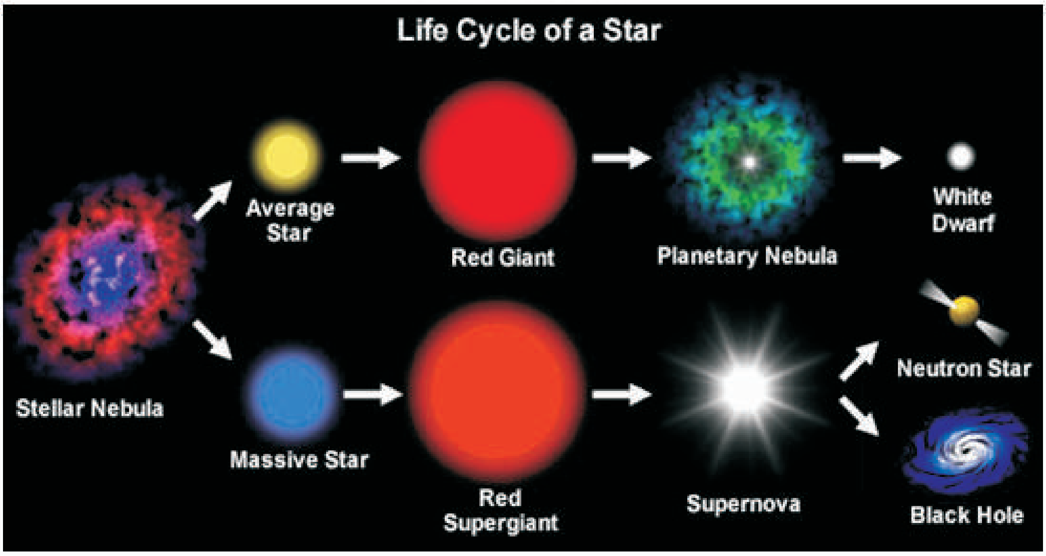
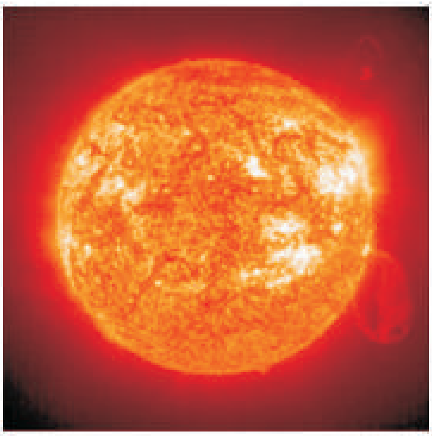
Stars live for a very long time compared to human lifetimes. Even though stellar life spans are enormous we know how stars are born, live and die.



Above show is the Life cycle of star. The picture shows two pathways possible for the formation of the star.

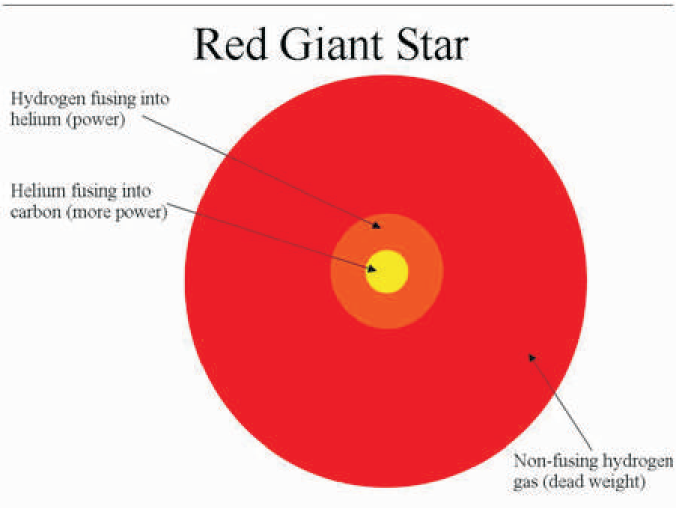
The first cycle follow the order: Stellar Nebula – Average Star – Red Giant – Planetary Nebula - White Dwarf.



Average Star

A star is a massive, luminous sphere of plasma held together by its own gravity. The nearest star to Earth is the Sun, which is the source of most of the planet's energy. Other stars are visible from Earth during the night, appearing as a multitude of fixed luminous points due to their immense distance. Historically, the most prominent stars were grouped into constellations and asterisms, and the brightest stars gained proper names.

Red Giants



All through the long main sequence stage, the restless compression of gravity is balanced by the outward pressure from the nuclear fusion reaction in its core (region where temperature is above 15 million degrees Kelvin). Hydrogen in the core is all converted to helium and nuclear reactions stop. Gravity takes over and the core shrinks. The layer outside the core collapses too and the closer to the centre collapse quicker than the one near the surface. As the layer compress, the gas heats up. Eventually layer outside the core called "shell" layer also gets heated up and dense enough for fusion to start. The fusion in layer is just outside the core is called shell burning. The fusion is very rapid because the shell layer is still compressing and increasing the temperature. Luminosity increases.

As the star begins to expand it becomes a sub giant and then a red giant.

Planetary Nebula

A planetary nebula is a nebula that is made up of gas and plasma. They are made by certain types of stars when they die. They are named this because they look like planets through small optical telescopes. They do not last for very long compared to a star, only tens of thousands of years.

At the end of a normal-sized star's life, in the red giant phase, the outside layers of a star are disposed of. Because the outside is gone, the star shines brightly and is very hot. The ultraviolet radiation given off by the center of the star ionizes the gas and plasma that was thrown out from the star. This is what causes a planetary nebula to look like it does.

Planetary nebulae are very special objects because they can help make more stars. When a star dies, the metals that were in the core of the star are sent to other places in the universe. The only place that these metals form is in stars. This is called nucleosynthesis.

Planetary nebulas are not very bright. None of them are bright enough to see without a telescope. The first one discovered was the Dumbbell Nebula. To early astronomers they looked like gas giants. This is why people called them 'planetary nebula'. Astronomers did not know what these objects were until the first spectroscopic experiments were done in the 1800's. William Huggins used a prism to look at galaxies. He noticed that they looked a lot like stars.

White Dwarfs

White dwarfs are degenerate stars i.e. their material is packed as closely together as is possible. White dwarfs still emit light, but they are slowly running out of energy and cooling. This energy source is no longer nuclear fuel, not gravity, but their own "thermal energy".

Composed mostly of electron-degenerate matter, they are very dense and its mass is comparable to that of Sun and its volume is comparable to that of earth, the material in a white dwarf no longer undergoes fusion reaction so the star has no source of energy.

White dwarf is very hot when formed but since it has no energy it will gradually radiate away its energy and cool.

The stars can also form from: Massive Star – Red Supergiant – Supernova. After the supernova stage reaches it can either form into Neutron Star or Black hole.

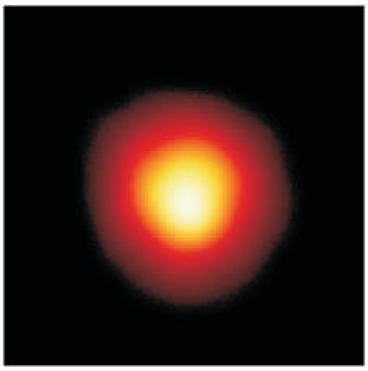
Thus this comes to an end of one possible life cycle of the star. Now, there is another possible cycle which is: Stellar Nebula- Massive star- Red Supergiant- Supernova- Neutron Star or Black hole.

Massive Star

Any star which is larger than 8 solar masses during its regular main sequence lifetime is considered a massive star. They typically have a quick main sequence phase, a short red supergiant phase, and a spectacular death via a supernova explosion.

Massive stars are born, just like average stars, out of clouds of dust called nebulae. When a nebula collects enough mass, it begins to collapse under its own gravity. The internal pressure created by this collapse is enough to trigger fusion of hydrogen deep in its core. When nuclear fusion begins, a star is born. If the cloud of dust is large, it will create a massive star. A star is considered massive if it is at least 8 times more massive that our sun!

Red Supergiant



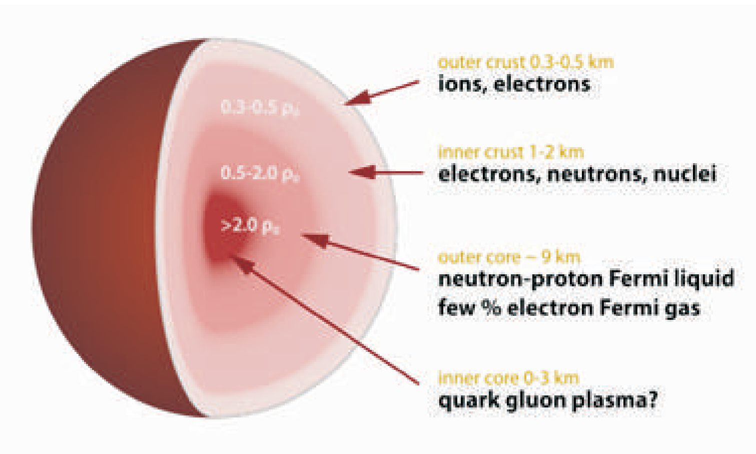
A red supergiant is an aging giant star which has consumed its core's supply of hydrogen fuel. Helium has accumulated in the core, and hydrogen is now undergoing nuclear fusion in the outer shells. These shells then expand, and the now cooler star takes on a red color. They are the largest known stars.

As stars age, they go through various phases of their lives. These phases are so diverse that it is hard to believe that they are all just the same star (much like an infant, a teenager, and an elderly human seem quite different). At various points in a star's life, different things will happen depending on the size of the star. Only large stars with a mass of about 10 solar units will go on to become red supergiant. The famous star, Betelgeuse is a red supergiant star in the constellation Orion.

Supernova

A supernova is a stellar explosion that briefly outshines an entire galaxy, radiating as much energy as the Sun or any ordinary star is expected to emit over its entire life span, before fading from view over several weeks or months. The extremely luminous burst of radiation expels much or all of a star's material at a velocity of up to 30,000 km/s (10% of the speed of light), driving a shock wave into the surrounding interstellar medium. This shock wave sweeps up an expanding shell of gas and dust called a supernova remnant. A great proportion of primary cosmic rays come from supernovae. Supernovae can be triggered in one of two ways: by the sudden reigniting of nuclear fusion in a degenerate star; or by the gravitational collapse of the core of a massive star. In the first case, a degenerate white dwarf may accumulate sufficient material from a companion, either through accretion or via a merger, to raise its core temperature, ignite carbon fusion, and trigger runaway nuclear fusion, completely disrupting the star. In the second case, the core of a massive star may undergo sudden gravitational collapse, releasing gravitational potential energy that can create a supernova explosion

Neutron Star



It is a type of a stellar remnant that can result from the gravitational collapse of massive star. They are born from the explosive deaths of the massive stars. They are said to have reached the end of their evolutionary journey through space and time. Despite their small diameters, neutron stars boast nearly 1.5 times the mass of our Sun and are incredibly dense. They pack an extremely strong gravitational pull, much greater than Earth. When they are formed, they rotate in space. The composition of their core is unknown, but they consist of some neutron super fluid or unknown state of matter.

Neutron stars are composed almost entirely of neutrons, which are subatomic particles without net electrical charge and with slightly larger mass than protons. Neutron stars are very hot and are supported against further collapse due to the phenomenon described by the Pauli Exclusion Principle. This principle states that no two neutrons (or any other sermonic particles) can occupy the same place and quantum state simultaneously. The surface is made up of iron..

Black Hole

A black hole is a region of space time from which gravity prevents anything, including light, from escaping. The theory of general relativity predicts that a sufficiently compact mass will deform space time to form a black hole. The boundary of the region from which no escape is possible is called the event horizon. Although crossing the event horizon has enormous effect on the fate of the object crossing it, it appears to have no locally detectable features. In many ways a black hole acts like an ideal black body, as it reflects no light. This temperature is on the order of billionths of a Kelvin for black holes of stellar mass, making it all but impossible to observe.

Black holes of stellar mass are expected to form when very massive stars collapse at the end of their life cycle. After a black hole has formed, it can continue to grow by absorbing mass from its surroundings. By absorbing other stars and merging with other black holes, super massive black holes of millions of solar masses may form. There is general consensus that super massive black holes exist in the centers of most galaxies.

Despite its invisible interior, the presence of a black hole can be inferred through its interaction with other matter and with electromagnetic radiation such as light. Matter falling onto a black hole can form an accretion disk heated by friction, forming some of the brightest objects in the universe. If there are other stars orbiting a black hole, their orbit can be used to determine its mass and location. Such observations can be used to exclude possible alternatives (such as neutron stars). In this way, astronomers have identified numerous stellar black hole candidates in binary systems, and established that the core of the Milky Way contains a super massive black hole of about 4.3 million solar masses. The simplest static black holes have mass but neither electric charge nor angular momentum.

Reference

www.wikipedia.co.in

Laser and its Application

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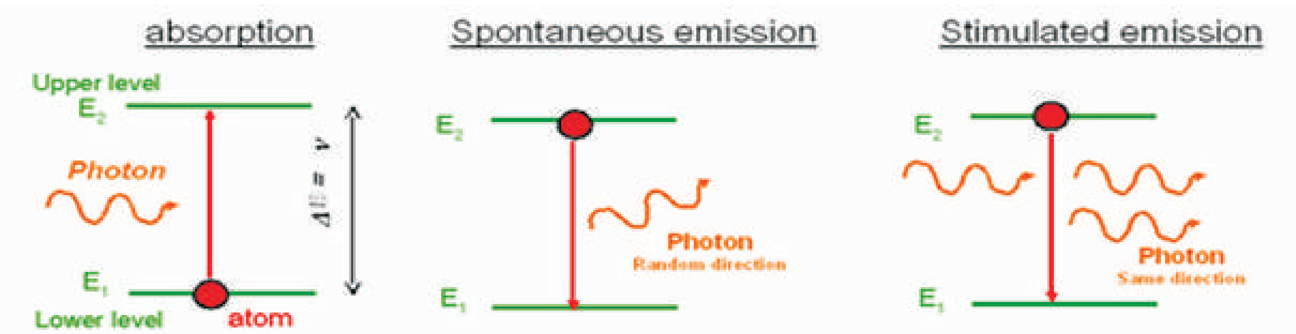
Laser is one of the most important inventions of the 20th century both from the point of view of physics and its wide range applications. Laser is an abbreviation of *Light Amplification by Stimulated Emission of Radiation*. Maiman of the Hughes Research Laboratory, California, was the first scientist who experimentally demonstrated laser by flashing light through a ruby crystal, in 1960. The basic principle involved in lasing action is Stimulated emission which was predicted by Einstein in 1917 which is fundamental to light amplification. Laser is a powerful source of light with unique properties like high degree of directionality (can travel long distance with a small divergence), monochromatic (same color or wavelength), coherent (same phase) and very high intensity which make it different from normal light. These unique characteristics of laser have made it an important tool in various applications. Laser finds applications in the fields of communication, industry, medicine, military operations, scientific research, etc. Besides, laser has already brought great benefits in surgery, photography, holography, engineering and data storage.

Laser Principle

An atom in a lower level absorbs a photon of energy hν and moves to an upper level. An atom in the excited state can stay for a very short time and then make a transition to a lower energy state through the emission of radiation in two different ways: (1) Spontaneous emission (2) Stimulated emission as shown in figure.

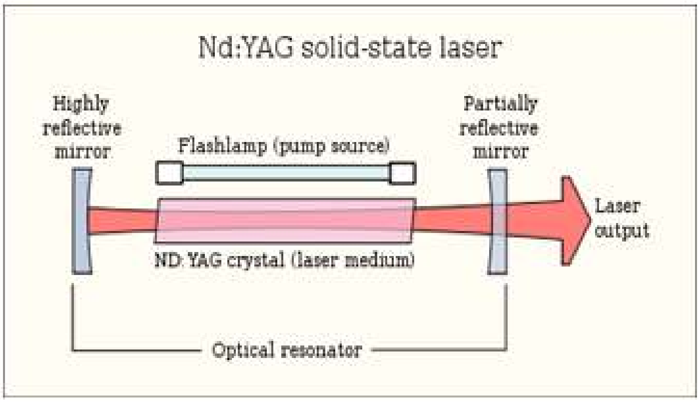


In spontaneous emission an atom in an exited state can decay spontaneously to the lower energy level and emit a photon of frequency ν . This photon has a direction and phase. In Stimulated emission an incident photon of appropriate frequency causes an atom in an excited state to decay, emitting a stimulated photon whose properties are identical to those of the incident photon. The rate of stimulated emission depends both on the intensity of the incident radiation and also on the number of atoms in the upper state.

Laser Components and How it Works

The three main components of any laser device are

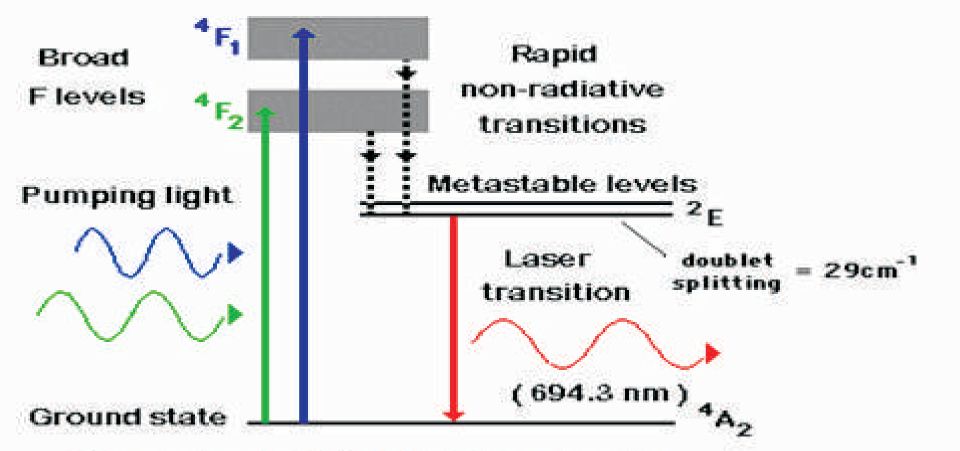
1. Active medium
2. Pumping Source
3. Optical resonator



The active medium consists of atoms, molecules or ions in solid, liquid and gaseous form which is capable of amplifying light waves by stimulated emission of radiation. Normally there is large number of atoms in the low energy state than in the excited energy state.

In order to have amplification **population inversion** of the medium is essential. When the population of the upper energy level exceeds that of the lower level, which is a reversal of the normal occupancy, the process is called population inversion. The pumping mechanism provides energy to excite the ground level atom of the gain medium to the higher energy level for obtaining such a state of population inversion between a pair of energy levels of the system. There are different techniques of achieving population inversion in a laser system. Some commonly used methods are *Optical pumping (solid state laser), electrical discharge (gas laser), Collision, Chemical pumping (chemical laser), Thermal Pumping (Gas Dynamic laser), Molecular Dissociation* and others.

A medium with population inversion is capable of amplification by stimulated emission of radiation but to construct a source which can supply light energy it is necessary to construct an oscillator. In order to act as an oscillator a part of the output energy is fed back to the medium by placing the active medium between two mirrors facing each other which reflect most of the output energy back to the system. The sides of the cavity are usually open and hence such a system of two mirrors represents open resonator. To obtain an output beam one of the mirrors may be made partially reflecting. Optical resonator can have different configuration. The stimulated radiation multiplies by bouncing back and forth many times between the two carefully aligned mirrors and passing through the laser medium. And the laser light comes out in the form of a narrow pencil beam through the semi-transparent mirror. In an actual laser, the modes (one can visualize a mode as a wave having a well defined transverse amplitude distribution which forms a standing wave pattern) that keep oscillating are those for which the gain provided by the laser medium compensates for the losses (losses are due to scattering from medium, absorption and diffraction at mirrors). Since the gain provided by the medium depends on the extent of population inversion, for each mode there is a critical value of population inversion called threshold population inversion below which that particular mode will cease to oscillate.



Energy levels of chromium ions in ruby

The simplest functional energy-level structure for laser operation is a three-level system, which is illustrated in the above figure. In this system, the ground state is the lower laser level, and a population inversion is created between this level and a higher-energy metastable state. Most of the atoms or molecules are initially excited to a short-lived high-energy state that is higher than the metastable level. From this state they quickly decay to the intermediate metastable level, which has a much longer lifetime than the higher energy state (often on the order of 1000 times longer). Because each atom's residence time in the metastable state is relatively long, the population tends to increase and leads to a population inversion between the metastable state and the lower ground state (which is continuously being depopulated to the highest level). Stimulated emission results from the fact that more atoms are available in the upper excited (metastable) state than in the lower state where absorption of light would most likely occur.

Basically, there are two types of lasers-the continuous wave (CW) laser and the pulsed beam laser. In the CW laser, the light is emitted as a, steady continuous beam, generally, with less intensity. Gas lasers belong to this category. On the other hand, the pulsed lasers produce powerful bursts of light of short duration. Crystals, glass and liquid types of lasers belong to this category.

Laser Properties

- **Monochromatic:** The light emitted from a laser is monochromatic, that is, it is of one wavelength (color). In contrast, ordinary white light is a combination of many different wavelengths (colors).
- **Directional:** Lasers emit light that is highly directional. Laser light is emitted as a relatively narrow beam in a specific direction. Ordinary light, such as coming from the sun, a light bulb, or a candle, is emitted in many directions away from the source.
- **Coherent:** The light from a laser is said to be coherent, which means the wavelengths of the laser light are in phase in space and time. This makes laser light so narrow.

- **Extremely high intensity:** the intensity remaining almost constant over long distances because of low divergence.

These unique characteristics of laser have made it an important tool in various applications and hazardous than ordinary light.

Important Laser Types and Applications

The numerous types and designs of lasers are steadily increasing and can be broadly classified according to their production techniques. The broad categories are:

- Solid-State Lasers, optically pumped e.g. the ruby or neodymium-YAG (yttrium aluminum garnet) lasers.
- Gas Lasers, pumping source electrical discharge, He-Ne and CO2 are the most common gas lasers.
- Excimer Lasers use reactive gases such as chlorine and fluorine mixed with inert gases such as argon, krypton, or xenon and electrically stimulated.
- Semiconductor Lasers, electrical current is used for pump source of these lasers.
- Chemical Lasers are used as directed-energy weapons, COIL (Chemical Oxygen Iodine Laser) uses chemical reaction as pumping source.
- Free Electron Lasers.
- X-ray Lasers.

There is an endless list of use of lasers. Lasers found their first use in the 1970s in local grocery stores, in the product scanner. The next major accomplishment for laser technology was the CD player. Today, uses span from hospitals to battlefields, to electronics, to factories. Here are some examples:

- In medicine: surgical treatment, vision treatment, laser surgery, LASIK, kidney stone treatment, dentistry, hair removal, skin treatment, tattoo removal, etc.
- In the military: missile guidance, radar replacement, target guidance, LIDAR etc.
- In electronics: CDs, DVDs, laser printers, holograms, barcode scanners, etc.
- Factories: cutting, welding, heating materials, laser cooling etc.
- In communications: laser communications have been utilized for mass communications including telephone conversations and even television channel, Remote atmospheric sensing.
- New inventions: virtual laser keyboard for tablets, smart Phones, laptops and PCs.
- In Entertainment: Laser show.

In short, engineers and scientists have determined a way to stimulate high-energy release and guide its output toward accomplishing productive and useful tasks.

Different applications need lasers with different output powers

Current Applications of Laser Communications
Defense and Sensitive Areas

Laser Defense systems established across the world can detect enemy ships and missiles while at the same time disabling them.

Airport Runways

Laser communication systems on airport runways can send signals back to headquarters letting officers know when and what planes have landed

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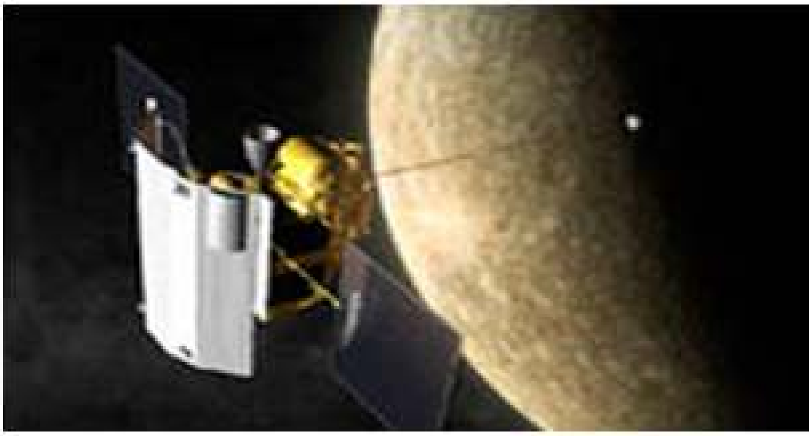
Satellite-to-Satellite

NASA has also developed Satellite-to-Satellite communications using laser communications.

NASA



NASA has created lots of different technologies which include laser communications. One recent NASA accomplishment was a successful exchange of laser pulses with the MESSENGER spacecraft and an Earth-based observatory which set a new record for laser transmission in space.

Conclusion

The laser is one of the remarkable inventions of all time. Lasers are fascinating devices that are becoming more and more popular every year. New applications of lasers in the various fields are announced almost every day. They have been used in various fields such as geology, medicine, optometry, supermarkets, optical networks, mechanics, scientific research, industry and communication. The laser helps make life easier by transmitting information, reducing errors, and by making precise measurements. Lasers will continue to be around us for the following years.

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Thermal Radiation

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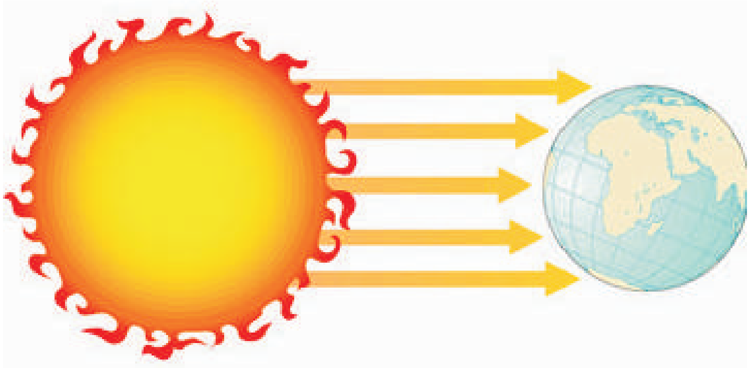
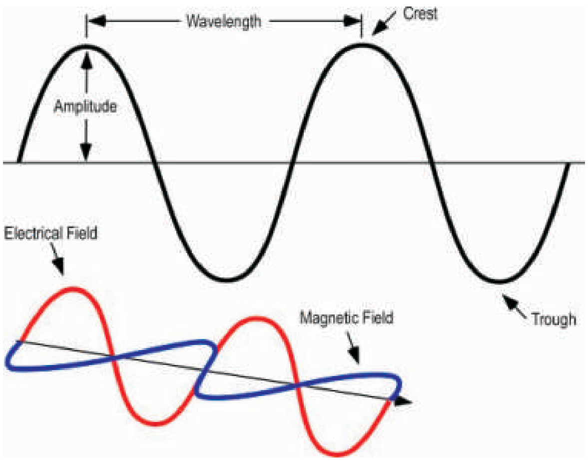


Electromagnetic Radiation

The term radiation is used to describe many different types of rays ranging from visible light, infrared light, and ionizing radiation such as x ray or gamma rays. Each of these is an example of radiation as an electromagnetic wave produced by the motion of electrically charged particles. Electromagnetic radiation can travel through empty space and air. Radiation can also penetrate through other materials depending on the characteristics of the material and the radiation energy.

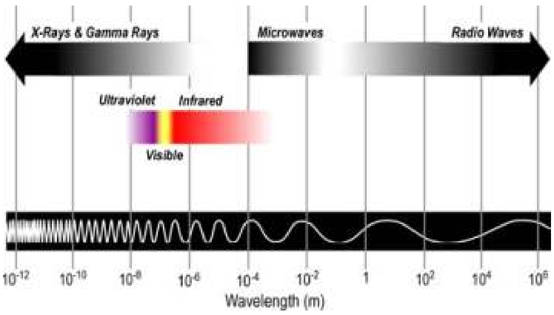
As illustrated in Figure 1, electromagnetic waves can be described in terms of their wavelength, amplitude, frequency, and energy.

Fig.1. Electromagnetic Wave



From longest to shortest wavelengths, the spectrum is usually divided into the following sections: radio, microwave, infrared, visible, ultraviolet, x-ray, and gamma-ray radiation. Humans can only see a narrow band of visible light, which is a small fraction of the electromagnetic spectrum. We perceive this radiation as the colors of the rainbow ranging from red to violet, with reds having longer wavelengths and violet having shorter wavelengths

Fig:2 Electromagnetic spectrum



Thermal Radiation

Thermal radiation is electromagnetic radiation generated by the thermal motion of charged particles in matter. All matter with a temperature greater than absolute zero emits thermal radiation. When the temperature of the body is greater than absolute zero, interatomic collisions cause the kinetic energy of the atoms or molecules to change. This results in charge-acceleration and dipole-oscillation. This results in the electrodynamic generation of coupled electric and magnetic fields, resulting in the emission of photons, radiating energy away from the body through its surface boundary. Electromagnetic radiation, including light, does not require the presence of matter to propagate and travels in the vacuum of space infinitely far if unobstructed.

Examples of thermal radiation include the visible light and infrared light emitted by an incandescent light bulb, the infrared radiation emitted by animals and detectable with an infrared camera, and the cosmic microwave background radiation. Thermal radiation is one of the fundamental mechanisms of heat transfer, but it is different from thermal convection and thermal conduction—a person near a raging bonfire feels radiant heating from the fire, even if the surrounding air is very cold.

Thermal radiation in visible light can be seen on this hot metalwork. Its emission in the infrared is invisible to the human eye and the camera the image was taken with, but an infrared camera could show it.

Solar Radiation

Sunlight is part of thermal radiation generated by the hot plasma of the Sun. In the process of thermal radiation no particles are involved, unlike in the processes of conduction and convection. This is why we can still feel the heat of the Sun, although it is 150 million km away from the Earth. The Earth also emits thermal radiation, but at a much lower intensity and different spectral distribution (infrared rather than visible) because it is cooler. The Earth's absorption of solar radiation, followed by its outgoing thermal radiation are the two most Important processes that determine the temperature and climate of the Earth.

Some characteristics of thermal radiation

- The characteristics of thermal radiation depend on the temperature of the body and various properties of the surface such as its spectral absorptivity and spectral emissive power. When radiation of a particular wavelength falls on matter, it may partly reflected , partly absorbed and partly transmitted. If r be the fraction of the total energy reflected, a the fraction absorbed and t the fraction transmitted then we can tell that $r + a + t = 1$. If $r = t = 0$ and $a = 1$ for all wavelength, the body is said to be a perfectly black body. No body or surface satisfies this condition, but for lampblack absorptivity is almost unity. A black body is a theoretical object that completely absorbs all incoming radiant energy and is also a perfect emitter of radiant energy. Emissivity is the relative ability of the surface of a material to emit radiant energy. It is the ratio of energy radiated by a particular material to energy radiated by a black body at the same temperature as expressed by Kirchoff's law. Emissivity of a black body would be 1.0 with the emissivity of actual materials ranging from approximately 0.1 for highly reflective materials (e.g., polished silver) to 0.97 for fairly efficient absorbers and emitters of radiant energy (e.g., carbon particulate).
- According to Prevost's theory of heat exchange the rate of radiation emitted by a body depends on the nature of its surface and its temperature and the rate of radiation absorbed depends on nature of the surface and the temperature of the surrounding. There is continuous exchange of radiation between a body and its surroundings and its rise or fall in temperature is a consequence of this exchange. In equilibrium state the exchange of radiation does not cease but each body radiate as much heat as it absorbs. Thus if two bodies at different temperatures kept in a enclosure, it is not that hotter body will selectively radiate heat to cooler one. When we stand near a block of ice, we receive less energy from ice as it is at lower temperature than our body but loose more heat from our body by radiation and we feel cold near ice block.

• Thermal radiation emitted by a black body at any temperature consists of a wide range of frequencies. The frequency distribution is given by Planck's law of black-body radiation for an idealized emitter as shown in the diagram given below.

Fig: 3

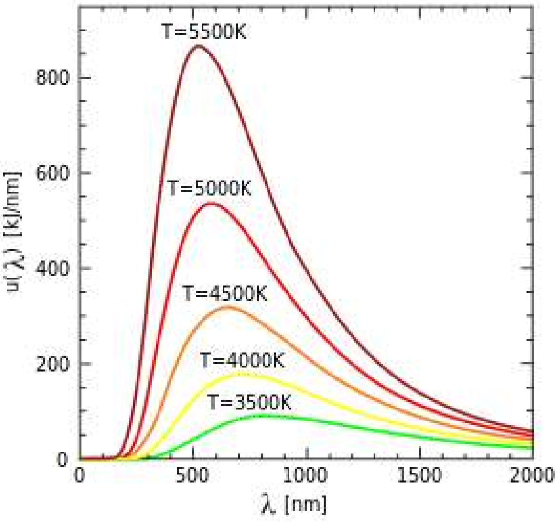
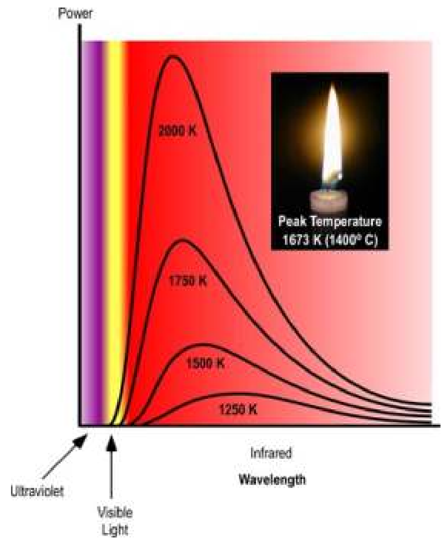


Fig:4



These diagrams show how the peak wavelength and total radiated amount vary with temperature according to Wien's displacement law. Although this plot shows relatively high temperatures, the same relationships hold true for any temperature down to absolute zero. Visible light is between 380 and 750 nm.

Subjective color to the eye of a black body thermal radiator

°C (°F)	Subjective colour
480 °C (896 °F)	faint red glow
580 °C (1,076 °F)	dark red
730 °C (1,350 °F)	bright red, slightly orange
930 °C (1,710 °F)	bright orange
1,100 °C (2,010 °F)	pale yellowish orange
1,300 °C (2,370 °F)	yellowish white
> 1,400 °C (2,550 °F)	white (yellowish if seen from a distance through atmosphere)

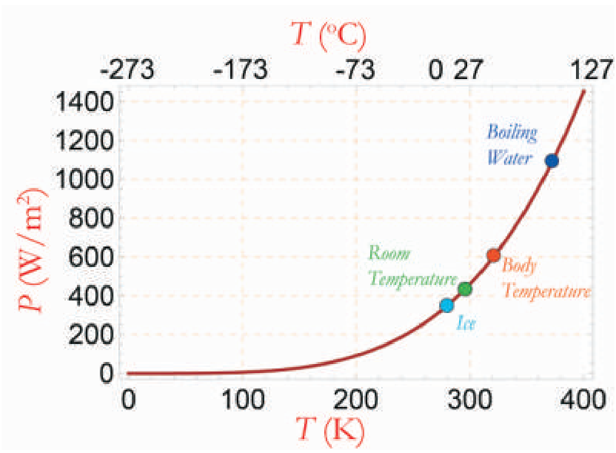
The dominant frequency (or color) range of the emitted radiation shifts to higher frequencies as the temperature of the emitter increases. For example, a *red hot* object radiates mainly in the long wavelengths (red and orange) of the visible band. If it is heated further, it also begins to emit discernible amounts of green and blue light, and the spread of frequencies in the entire visible range cause it to appear white to the human eye; it is *white hot*. However, even at a white-hot temperature of 2000 K, 99% of the energy of the radiation is still in the infrared as shown in the Fig:4. This is determined by Wien's displacement law. In the diagram the peak value for each curve moves to the left as the temperature increases.

The table below shows some objects, their normal temperatures, and the wavelengths where they emit the most light.

Object	Temperature (K)	Peak Wavelength	Region
Cosmic Background	3	1mm	Microwave (IR-Radio)
Molecular Cloud	10	300μm	Infrared
Humans	310	9.7μm	Infrared
Incandescent Light Bulb	3000	1μm 10,000Å	IR/Visible
Sun	6000	5000Å	Visible
Hot Star	30,000	1000Å	Ultraviolet
Intra-Cluster Gas	108	0.3Å	X-Ray

- An object at the temperature of a kitchen oven, about twice the room temperature on the absolute temperature scale (600 K vs. 300 K) radiates 16 times as much power per unit area. An object at the temperature of the filament in an incandescent light bulb—roughly 3000 K, or 10 times room temperature—radiates 10,000 times as much energy per unit area. The total radiative intensity of a black body rises as the fourth power of the absolute temperature, as expressed by the Stefan–Boltzmann law. In the plot, the area under each curve grows rapidly as the temperature increases.

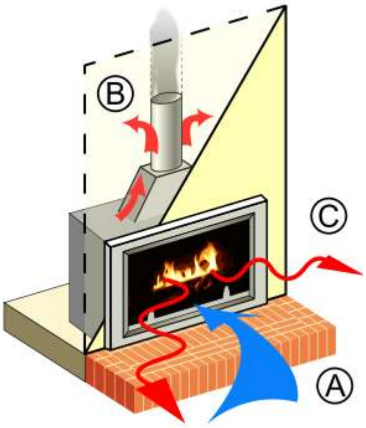
The Fig:5 below shows Power emitted by a black body plotted against the temperature based on the Stefan–Boltzmann law



The rate of electromagnetic radiation emitted at a given frequency is proportional to the amount of absorption that it would experience by the source. Thus, a surface that absorbs more red light thermally radiates more red light. This principle applies to all properties of the wave, including wavelength (color), direction, polarization, and even coherence, so that it is quite possible to have thermal radiation which is polarized, coherent, and directional, though polarized and coherent forms are fairly rare in nature far from sources (in terms of wavelength.

- Like light radiant heat suffers reflection, refraction diffraction and polarization. It also exerts pressure on any surface it falls.
- Radiant intensity decreases with distance. According to Inverse Square Law, for point sources, intensity of the radiation varies inversely with the square of the distance from the source. Doubling the distance reduces intensity of the radiation by a factor of four (1/4 of its original value).

Some Applications of Thermal Radiation



Radiant heating

A fireplace provides radiant heating, but also draws in cold air. A: Air for the combustion, in draughty rooms pulled from the outdoors. B: Hot exhaust gas heats building by convection as it leaves by chimney. C: Radiant heat, mostly from the high temperature flame, heats as it is absorbed

Radiant heating is a technology for heating indoor and outdoor areas. Heating by radiant energy is observed every day, the warmth of the sunshine being the most commonly observed example. Radiant heating is the method of intentionally using the principles of radiant heat to transfer radiant energy from an emitting heat source to an object.

Indoors (radiant heating)

This picture shows Caldarium from the Roman Baths at Bath, England. The floor has been removed to reveal the pillars of the hypocaust. The Romans were the first people to use underfloor radiant heating systems

Radiant heating heats a building through radiant heat, rather than conventional methods such as radiators (mostly convection heating). The technology has existed since the Roman use of hypocaust heating. Underfloor radiant heating has long been widespread in China and Korea. Another example is the Austrian/German Kachelofen or masonry heater. The heat energy is emitted from a warm element, such as a floor, wall or overhead panel, and warms people and other objects in rooms rather than directly heating the air. The internal air temperature for radiant heated buildings may be lower than for a conventionally heated building to achieve the same level of body comfort, when adjusted so the perceived temperature is actually the same. One of the key advantages of radiant heating systems is a much decreased circulation of air inside the room and the corresponding spreading of airborne particles.

The indoor radiant heating systems can be divided into:

- Underfloor heating systems—electric or hydronic
- Wall heating systems
- Radiant ceiling panels

Outdoors (radiant heating)

In the case of heating outdoor areas, the surrounding air is constantly moving. Relying on convection heating is in most cases impractical. The reason being, that once you heat the outside air, it will blow away with air movement. Even in a no-wind condition, the buoyance effects will carry away the hot air. Outdoor radiant heaters allow specific spaces within a outdoor area to be targeted, warming only the people and objects in their path.

The outdoor heating systems can be divided into

- Trace heating- Gutter and Roof De-icing
- Snowmelt system- Electric or Hydronic
- Overhead natural gas-fired radiant heaters.

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An Introductory View on Astronomy

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Abstract

The project is intended as an introductory view on astronomy. The subject matter is presented in a concise and easy to understand way. Emphasis is given on astronomies advancement from its ancient period to the modern astronomy. The project starts with some important introduction and some of the other topics are also covered in the project are milestone in astronomy, Keplerian revolution, Newtonian astronomy and Einstein's ideas which help in the advancement of modern astronomy.

Introduction

Astronomy is a space science that applies scientific laws to explain the birth, life and death of stars, planets, galaxies and other objects in the universe. Their emissions are examined across all parts of the electromagnetic spectrum, and the properties examined include luminosity, density, temperature, and chemical composition. This space science apply many disciplines of physics, including mechanics, electromagnetism, statistical mechanics, thermodynamics, quantum mechanics, relativity, nuclear and particle physics, and atomic and molecular physics. In the most rigid sense:

- Astronomy measures positions, luminosities, motions and other characteristics
- Astrophysics creates physical theories of small to medium-size structures in the universe
- Cosmology does this for the largest structures, and the universe as a whole.

It began with Newton

While astronomy is one of the oldest sciences, theoretical astrophysics began with Isaac Newton. Prior to Newton, astronomers described the motions of heavenly bodies using complex mathematical models without a physical basis. Newton showed that a single theory simultaneously explains the orbits of moons and planets in space and the trajectory of a cannonball on Earth.

Perhaps what most completely separated Newton's model from previous ones is that it is predictive as well as descriptive.

Milestone in astronomy

The only way we interact with distant objects is by observing the radiation they emit, much of astrophysics has to do with deducing theories that explain the mechanisms that produce this radiation, and provide ideas for how to extract the most information from it. Early spectroscopy provided the first evidence that stars contain substances also present on Earth. Spectroscopy revealed that some nebulae are purely gaseous, while some contain stars. This later helped cement the idea that some nebulae were not nebulae at all — they were other galaxies!

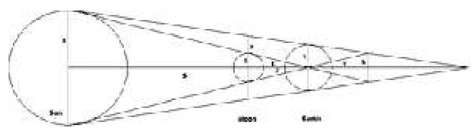
In the early 1920s, Cecilia Payne discovered that stars are predominantly hydrogen. Applying the Doppler Shift to the spectra of stars also allowed astrophysicists to determine the speed at which they move toward or away from Earth. In the 1930s, by combining the Doppler shift and Einstein's theory of general relativity, Edwin Hubble provided solid evidence that the universe is expanding.

Also in the mid-19th century, the physicists Lord Kelvin and Gustav Von Helmholtz speculated that gravitational collapse could power the sun, but eventually realized that energy produced this way would only last 100,000 years. Fifty years later, Einstein's famous $E=mc^2$ equation gave astrophysicists the first clue to what the true source of energy might be. As nuclear physics, quantum mechanics and particle physics grew in the first half of the 20th century, it became possible to formulate theories for how nuclear fusion could power stars. These theories describe how stars form, live and die, and successfully explain the observed distribution of types of stars, their spectra, luminosities, ages, and other features.

According to the Big Bang Theory, the first stars were almost entirely hydrogen. The nuclear fusion process that energizes them smashes together hydrogen atoms to form the heavier element helium. It is only in the final stages of the lives of more recent stars that the elements making up the Earth, such as iron (32.1 percent), oxygen (30.1 percent), silicon (15.1 percent), are produced. Another of these elements is carbon, which together with oxygen, make up the bulk of the mass of all living things including us. Thus, astrophysics tells us that, while we are not all stars, we are all stardust.

Ancient Astronomy

Hipparchus (190-120 BCE)



Geometric construction used by Hipparchus in his determination of the distances to the sun and moon

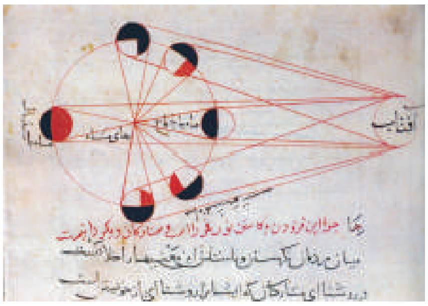
Hipparchus was a Greek astronomer, geographer, and mathematician. Hipparchus is considered the greatest ancient astronomical observer. He was the first whose quantitative and accurate models for the motion of the Sun and Moon survive.

Aryabhata (476-560 CE)

He correctly insisted that the earth rotates about its axis daily, and that the apparent movement of the stars is a relative motion caused by the rotation of the earth. This is indicated in the first chapter of the Aryabhatiya.

Solar and lunar eclipses were also scientifically explained by Aryabhata. He states that the Moon and planets shine by reflected sunlight. Instead of the prevailing cosmogony in which eclipses were caused by pseudo-planetary demons Rahu and Ketu, he explains eclipses in terms of shadows cast by and falling on Earth.

Abu Rayhan Al-Biruni (973-1048 AD)



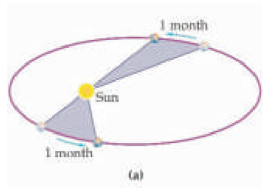
Al-Biruni is regarded as one of the greatest scholars of the medieval Islamic era. He also made contributions to Earth sciences, and is regarded as the "father of geodesy" for his important contributions to that field, along with his significant contributions to geography.95 of 146 books known to have been written by Biruni, were devoted to astronomy, mathematics, and related subjects.

He claims to have resolved the matter of Earth's rotation in a work on astronomy that is no longer extant, his Miftah-ilm-alhai'a.

The Keplerian Revolution

Johannes Kepler (December 27, 1571 – November 15, 1630) was a German mathematician, astronomer, and astrologer. A key figure in the 17th century scientific revolution, he is best known for his laws of planetary motion. The foundation of modern cosmology was started 400 years ago by Kepler with the discovery of the laws of planetary motion.

Kepler`s laws



1st Law : Every planet moves in an elliptical orbit with the sun at one of its foci.

2nd Law : The joining the sun and a planet, sweeps out equal area in equal interval of time.

3rd Law : Square of the time period of revolution of a planet is directly proportional to the cube of the length of semi major axis of its elliptic orbit.

Most planetary orbits are almost circles, and careful observation and calculation is required in order to establish that they are actually ellipses. Calculations of the orbit of the planet Mars first indicated to Kepler its elliptical shape, and he inferred that other heavenly bodies, including those farther away from the Sun, also have elliptical orbits.

Kepler's laws were not immediately accepted. Several major figures such as Galileo and René Descartes completely ignored Kepler's Astronomia nova. Many astronomers, objected to Kepler's introduction of physics into his astronomy. Some adopted compromise positions. Ismael Boulliau accepted elliptical orbits but replaced Kepler's area law with uniform motion in respect to the empty focus of the ellipse.

Kepler is often said to have shown that the planets orbit the way they do, and Newton why. The most common versions of this distinction maintain that Kepler was able to discover some of the regularities of planetary motion, and that these regularities would only later be explained in terms of Newtonian universal gravity.

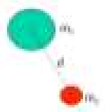
Newtonian Astronomy

Since ancient times, scientist have been extremely curious to learn more about stars and planets. Nicolaus Copernicus was the first to state that the sun is stationary and the earth moves round the sun. German scientist Johannes Kepler discovered the three laws related to movement of planets round the sun. Sir Isaac Newton, analysed these laws of planetary motion and formulated the nature of force between the sun and planets to be attractive. This force of attraction is called gravitation.

Newtons Law of Gravitation

"Any two bodies in the universe attract each other with a force that is directly proportional to the product of their masses and inversely proportional to the square of the distance between them"

$$F_g = \frac{Gm_1m_2}{d^2}$$



This effectively removed the last doubts about the validity of the heliocentric model of the cosmos which argued that the Sun (not the Earth) was at the center of the planetary system.

But then came Albert Einstein, who realized that Newton's law of gravity while right most of the time, was incorrect when talking about very large and very distant objects. Einstein revised Newton's laws of gravity to make them more accurate. We call what he developed the theory of relativity. This theory states that it is impossible to determine whether or not you are moving unless you can look at another object.

Albert Einstein & Modern Astronomy

The development of modern astronomy from the old astronomy was a long process with multiple steps. It begins with the introduction of the Sun-centered Solar System by Copernicus, and concludes with Newton's synthesis of the laws of motion in the heavens and the Earth, and Einstein's revision of Newton's ideas in the Relativity Theory.

In the early decades of the 20th century, Albert Einstein published the theory of relativity and changed the face of physics and astronomy forever. The theory of relativity is perhaps the most successful development in the history of science in terms of its agreement with experimental results and its ability to predict new phenomena.

Einstein's theory immediately explained some of the major problems in the physics and astronomy of his day, and it has continued to explain new developments that were not even hinted at 90 years ago, including the existence of black holes and recent observations in cosmology.

Modern Astronomy

Astronomy has come a long way in the past 100 years, with revelations from Einstein, Bohr, Hubble and other great astronomers, physicists, and scientists. While certainly some of the greatest discoveries in astronomy of all time include the discovery of the other planets of the solar system, the true relation of the Earth to the Sun, and the mathematical calculations for planetary orbits by Kepler and universal gravitation by Newton, more shocking discoveries have been made in modern astronomy than in times past, and shows us just how cool our universe actually is.

Dark Energy : It has been discovered using the Hubble constant and measurements of supernovae of distant stars that the universe is not contracting, nor is it static, but instead, the universe is expanding, and the expansion is speeding up. To account for this, a hypothetical form of energy known as Dark Energy has been proposed and is being investigated by leading astrophysicists and cosmologists.

Dark Matter : Dark matter is a type of matter that has been proposed to exist to explain gravitational effects within galaxies. When astronomers were able to measure the mass of galaxies and the orbital speed of stars within a galaxy, they noticed discrepancies between the expected results and the calculated results. Thus, a new type of matter was classified as dark matter.

Exo-Planets : By analyzing the light spectra coming from distant stars, and also their brightness plotted over time, astronomers have been able to discover a large number of planets with the discovery of several planets orbiting a pulsar.

Black Holes : Black holes, are a region of space where nothing, not even light, can escape, due to the massive gravitational pull from a single point in space with infinite density, known as a singularity. Astrophysicists believe that black holes form as the result of larger stars collapsing and the electron and neutron degeneracy pressure cannot hold even atoms intact. Astrophysicists now believe that super-massive black holes exist at the center of most spiral galaxies and most galaxies in general.

From the ancient to the modern astronomy scientist have discovered many phenomena and other things in our universe that we were not known about before, but one thing is still not known to us yet *'Is there is life on other planets.'*

Benefits

There are a few technological developments which have come about because of astronomy and then turned out to be useful in other areas.

Today, millions of people across the world are affected by advances in astronomy.

Aerospace

— Global Positioning System satellites rely on astronomical objects — quasars and distant galaxies —

to determine accurate positions.

Energy

— Technology gained from imaging X-rays is now used to monitor fusion where two atomic nu- clei combine to form a heavier nucleus — that may prove to be our answer for clean energy.

Medicine

—Magnetic resonance imaging utilizes aperture synthesis – first an astronomical technique and now a medical technique

Humankind

Every advance in astronomy moves society closer to being able to answer these questions

--How was the universe created?
--Where did we come from?
--Are there other intelligent life forms?" –Measuring time?
--About the changing constellation?
--How far are the celestial bodies?
--About the milky way and beyond? & so on...

Conclusion

With the advancement of the astronomy from the ancient astronomy to the modern astronomy and larger ground and space-based telescopes we have peered into the distant, early universe, we have searched for habitable worlds, and we have come to the conclusion that we, ourselves, are stardust.

"Astronomy constantly reminds people of two seemingly contradictory things. First that the universe is infinite and we are of but the tiniest fraction of importance. And second that life is rare and precious. A home as beautiful and unique as earth does not come often. We must protect it."

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The Majestic Sun

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The subject of astronomy, astrophysics and cosmology stand as a concrete pillar of mankind's endless fascination and a symbol for man's ceaseless endeavour to known the unknown, to visualize the unseen and to understand the origin, structure and evolution of the physical universe of which we are a negligibly small part. The tremendous advancements in technology have enable us to build extremely sophisticated instruments, telescopes, detectors and computers to observe more vividly the celestial bodies that make up the tapestry of the sky above and also to probe deeply into the space in search of objects that are yet unknown to us.

Now we all shall embark on a fantastic space-voyage where we will come to know about some fascinating events that are taking place in the universe!!

ONE THING WE SHOULD SURELY KEEP IN OUR MIND IS THAT THE VASTNESS OF SPACE IS SO ENORMOUSLY LARGE THAT WE ARE ABLE TO MAKE THIS JOURNEY_USING THE SO FAR ACQUIRED KNOWLEDGE OF CENTURIES AS OUR ONLY MODE OF TRANPORTATION!!

In our outstanding voyage, we will first visiting our very galaxy which is commonly called the 'Milky Way' or 'Akash Ganga' which hosts an enormous number of stars- 250 billion and has a spiral structure with spiral arms coming out of the central region (nucleus) which is like a humongous galactic furnace_ with tremendous activity taking place- new stars being born –gas clouds being ejected and whole stellar systems moving around in great speed. It is our considerable luck that our solar system is quite far from the galactic centre otherwise the physical conditions could have been too violent for us to survive!!

When at night we look up at the sky with our very own naked eyes, we doesn't see a complete dark sky instead we see numerous dots in the sky which in actuality makes the very portray of the night sky. The dots which we see are mostly the different kinds of stars and we have also got our own satellite, the moon. In reality the dots that we see are the light of the stars that are still travelling to us from its very source. The scenario that we see at night makes us very calm and peaceful ,makes us feel safe as it seems that we are all alone in this universe. This is all about the night sky.

Our Milky Way galaxy

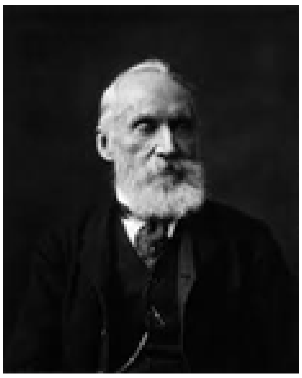
The Night Sky

But at the daytime, the scenario totally changes. We don't see any dots or even our moon instead we are able to see only a white bright disk which is commonly known to us as the sun.

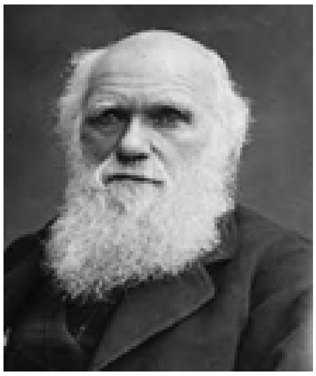
Now let us take a peek into our nearest star, which is our life support, our ultimate backbone to be exact....yes the glorious sun!!

Throughout history, humans have been aware of the importance of the sun for life on earth. Its supports mostly every life forms on earth!! The sunlight and other solar activities affect the earth's climate. The earliest observation of the sun was carried out by Galileo Galilee, the Italian astronomer who turned his newly invented small telescope towards the sun which amazed him greatly. Since then mankind has led various expeditions to reveal the absolute identity of the enormously beautiful sun. Since time immemorial there aroused numerous questions like how does it shine? What fuels it? What is its energy source? And many more not only among physicists and astronomers, but among geologists and biologists as well which posed severe challenge to them. In the nineteenth century, physicist believed that gravitation could fuel the sun. In 1854, Hermann von Helmholtz proposed that the gravitational contraction could cause the sun's energy. Lord Kelvin estimated the age of the Sun from its gravitational contraction, and by implication the Earth, to be 30 million years. In 1859, Charles Darwin estimated the age of the earth about 300 million years from geological activity on the earth. While physicists focused on the origin of the radiated energy, geologists and biologists considered the effects of the Sun's radiation. This was the story about the sun in the nineteenth century, now let us take a deep insight into our present day Sun.

Hermann von Helmholtz



Lord Kelvin



Charles Darwin

Far out there, the sun appears to be a calm, serene and unchanging beacon of light in the sky. But is it really so? No, say the astronomers. The flat bright disk hides another sun ,active, ever changing with violent eruptions that blaze forward in all possible directions and some reaching our lovable earth too!!

Then what is the actual nature of the Sun that we see every day??

Astronomers tells that the sun is essentially a huge mass of gas, about 330,000 times heavier than earth ,its volume is 1.3 million times that of earth and a radius of 700000 kilometers!! simply marvellous, isn't it?? It contains mostly hydrogen(74%),helium(25%) and the remaining one percent filled up by other

The Sun as it looks to us

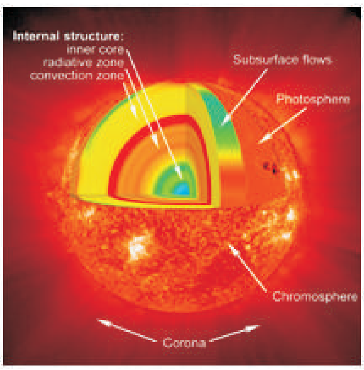
chemical elements.The sun has no solid surface, unlike earth or moon. However, because of its huge mass it, it has tremendous gravity, which keeps the gas from escaping. As the gravitational force pulls the outer layers of a towards its centre ,the pressure inside the sun increases with depth and so does the temperature. Right at the centre of the sun, called the core, the pressure is more than 200 billion times the earth's atmospheric pressure at the sea level and the density goes up to 151300 kg per metre cube about 150 times the density of water!! And the temperature of the gas reaches 5 million o K. Under these conditions, the hydrogen and helium react which produces unbelievably huge amount of energy.The energy released in one second is surprisingly more than what mankind has used since the dawn of civilization. The total amount of energy radiated by the sun since its birth is approximately the product of the present rate of energy emission (called solar luminosity,3.85 '1026 W) and the age of the sun. The older the Sun, the greater will be the total amount of its radiated energy. Just unimaginable, right?

Now as mentioned previously that the sun may look to us as a calm body from our earth but in actuality the sun is very much violent. The internal metabolism of the Sun is not just a passive lump of gas. The interior is made of a hard core functioning as a nuclear furnace. A misty radiation zone envelops the core and the energy produced in the core is slowly diffused out to the next layer of convection zone. The atmosphere of the Sun is divided mainly into three regions_ photosphere, chromospheres and corona. It is in these zones that some of the most remarkable and astonishing events occur.

Description of Measurement	Data
Diameter	1,392,539 km
Inclination of equator to ecliptic	7°.25
Mean axial rotation period (sidereal)	25.38 d
Mean density	1.41 g/cm^3
Mass	1.989 x 10^{30} kg
Luminosity	3.85 x 10^{26} W
Volume (Earth = 1)	1.3 x 10^6
Escape velocity	617.3 km/s

Photosphere

All the light and heat and other forms of radiations we receive from the Sun come from the top of the convective zone, about 500 km (*if, compared with the rest of the Sun, it is thinner than the skin of an apple*) thick, known as photosphere. The temperature over here ranges from 4400 ^{0}K at the top of the solar atmosphere to 7500 ^{0}K at its base. In actuality it acts as a blanket of cooler gas which absorbs and re-emits radiation from the warmer regions below.



Layers of the Sun

Chromosphere

Above the photosphere is the chromosphere which has got a thickness of about 10,000 km and temperature ranging from 5000 K near the boundary with the photosphere to several hundred thousand ^{0}K at the upper boundary. The chromosphere is much fainter than the photosphere and is only visible during solar eclipses appearing mostly pinkish in colour. There are also regions of active magnetic field which appear bright and dark. Material is ejected from the chromosphere into the corona by eruptions called spicules in which gas is forced upward, along the magnetic field lines. In these zone, solar wind blows at tremendous speed that can reach upto 965 km/ hour. These winds are geomagnetic storms that take place in the space. If earth falls in the path of these geomagnetic storms then earth could have disastrous effects.

Corona

The last region is the corona which is visible during total solar eclipse. Here temperatures is probably the maximum, reaching upto a mouth staggering 20,00,000 ^{0}K.

But these immensely high temperatures have puzzled the scientists to a great extent, posing them their biggest of all questions that is what is exactly the fuel source of this gigantic Sun? Well, at first the physicists thought it must be due to radioactive phenomena but subsequent astronomical observations showed that the Sun hardly contains radioactive materials. This is how the scientists came to a much narrated answer, they realised that if it's not radioactivity, then it has to be the hydrogen that is present in the maximum percentage, not only in similar stars but also in our universe.

In 1938, Hans Bethe worked out the basic nuclear processes by which hydrogen is fused into helium in stellar interiors. He analysed different possibilities and selected two processes. One was the *Proton chain* (p-p chain) , which builds helium out of hydrogen. This is the dominant energy source in the Sun-like stars. Every completion of the p-p chain results in the release of energy as a consequence of Einstein's famous relation $E=mc^2$ which makes the sun shine. Now, we believed that the fuel of the sun must be due to the burning of hydrogen into helium. But it was beyond our wildest dreams to look inside the Sun to test the hydrogen burning hypothesis. As it takes for the light about millions of years to leak out from the centre of the Sun to its surface. Nevertheless scientists strongly believed that there is a way of seeing into the Sun's interior with sub-atomic particle known as neutrinos, similar to the way the doctor uses x-rays or ultra-sound to diagnose what happens inside our bodies from the outside only. The measurement of neutrinos allows us to look inside the Sun.

Neutrinos are unique sub-atomic particles that are produced in stars when hydrogen nuclei are burnt into helium nuclei. They travel at the speed of light and have no electrical charge, and interact weakly with matter. They are of three types: electron neutrinos, muon neutrinos and tau neutrinos. The process by which the Sun-like stars generate energy is :

Chemical Reaction:

2 neutrons +2 protons $\longrightarrow$ Helium + light

The above reactions also produce neutrinos but because of their weak interactions, they are hard to detect. But gradually with the passage of time and obviously with the advancement of science, the neutrinos produced in the centre of the Sun have finally been detected. This confirmed that the Sun has been shining because of the fusion of hydrogen nuclei in the Sun's interior. This finally settled the nineteenth century debate between physicists, geologists and biologists.

But, just when we thought we had unravelled Nature, results from all these scientific experiments firmly revealed the detection of fewer neutrinos than were actually predicted. This could be the reason why on the very beginning of our quest, we mentioned to you that our journey is going to be an unending one. Well this indeed satisfies the famous quote of John Bahcall *"Science is unpredictable and fun."*

What do you say?

Maybe someday the actual mystery behind the mysteries Sun, would come into the grasp of the common man.

The concept of Red Giant (sun engulfing the planets of our solar system)

In fine, we would like to bring to your kind attention that is science has also revealed a dark secret on its voyage to conquer the unknown. The physicists and astronomers predict that when our Sun has used up all its hydrogen and helium present in its core, it will blow up in size to what they call a *'red giant.'*

It will be so huge that it will engulf all the planets in the solar system, including our loving earth. Well every one of us know that what can begin, it can end too rather it has got an end. But astronomers assure that it may not happen in our lifetime or even in the lifetime of our great, great,...... grand children.

Until then let us enjoy the Sun, the sunshine and off course our precious life!!

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Parallax: An Introductory View

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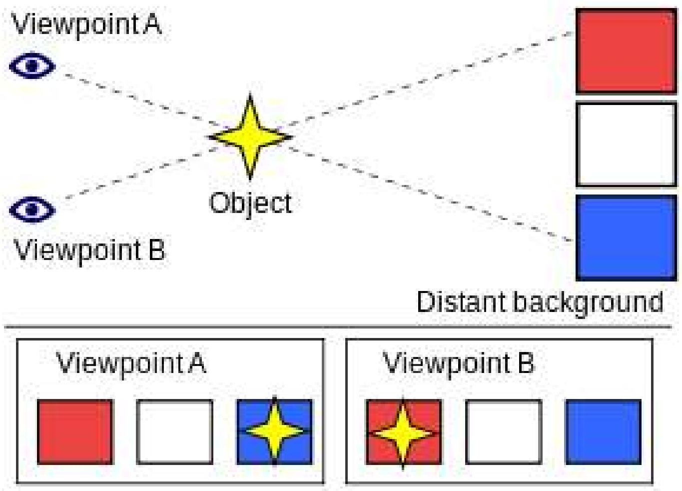
Introduction

Parallax is defined as the apparent displacement of an observed object due to a change in the position of the observer. From the astronomy point of view, Parallax is an apparent shift in the position of an object such as a star, caused by a change in the observer's position that provides a new line of sight.



The parallax of nearby stars caused by observing them from opposite points in Earth's orbit around the Sun is used in estimating the stars distance from Earth through triangulation. Parallax also affects optical instruments such as rifle scopes, binoculars , microscopes, and twin-lens reflex cameras that view objects from slightly different angles. Many animals, including humans, have two eyes with overlapping visual fields that use parallax to gain depth perception; this process is known as stereopsis. In computer vision the effect is used for computer stereo vision, and there is a device called a parallax rangefinder that uses it to find range, and in some variations also altitude to a target.

Visual Perception

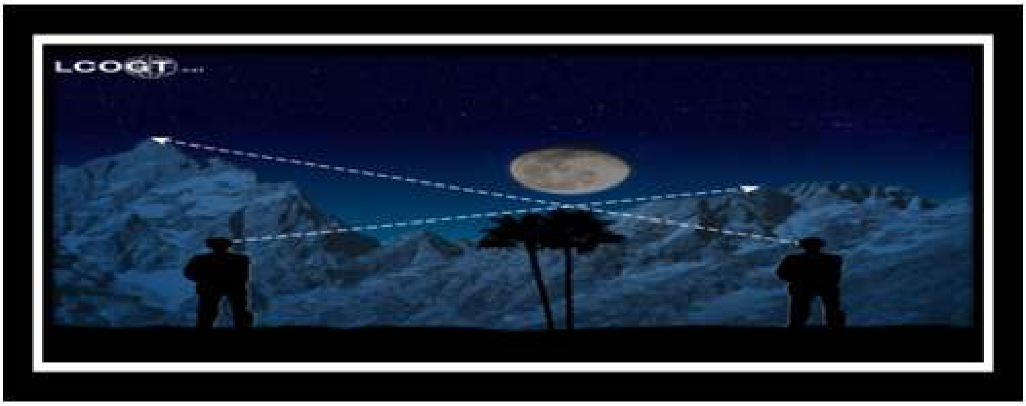
As the eyes of humans and other animals are in different positions on the head, they present different views simultaneously. This is the basis of stereopsis, the process by which the brain exploits the parallax due to the different views from the eye to gain depth perception and estimate distances to objects.

This image demonstrates parallax. The Sun is visible above the streetlight. The reflection in the water is a virtual image of the Sun and the streetlight. The location of the virtual image is below the surface of the water, offering a different vantage point of the streetlight, which appears to be shifted relative to the more distant Sun.

Animals also use motion parallax, in which the animals (or just the head) move to gain different viewpoints. For example, pigeons (whose eyes do not have overlapping fields of view and thus cannot use stereopsis) bob their heads up and down to see depth.

The motion parallax is exploited also in wiggle stereoscopy, computer graphics which provide depth cues through viewpoint-shifting animation rather than through binocular vision.

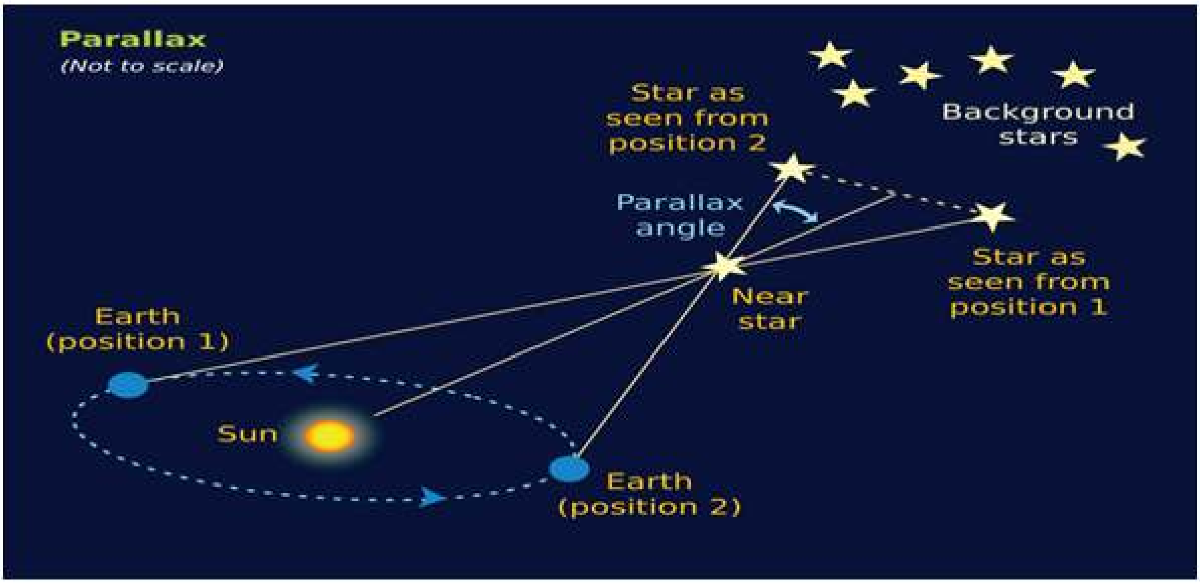
If we assume that the earth moves, that is, that it rotates daily and revolves annually around the sun, one might reasonably expect the apparent position of a star to shift its relative position with other stars. Put differently, if the earth were fixed and stable at the center of the cosmos, then its distance to the stars would remain fixed and unchanged. But if the earth in fact moved (if the diameter of its annual orbit around the sun was many millions of miles) then the apparent position of stars might be expected to change. Other conclusions follow from the same assumption. For example, a close star would have a large apparent shift in relative position (it would have a large angle of parallax) while a more distant star would have a smaller angle of



parallax. But what could this mean? A number of reasonable inferences seem to follow. If there was no observable semi-annual stellar parallax, would it be reasonable to conclude that the stars are disproportionately further away than the planets? Would it be reasonable to infer that the earth did not move? Historically, as it happens, the absence of observable stellar parallax was a strong argument against the motion of the earth. Quite simply, putting the earth in motion caused a thousand inconveniences. The absence of stellar parallax seemed good evidence that the earth did not move. As it turns out, stellar parallax was not observed until 1838. It required a superior telescope. The angle of stellar parallax observed about 150 years ago was extremely small, about one-half of one minute. The button below will take you to two illustrations of Stellar Parallax. One shows the large parallax angle for a nearby star, the second shows a small parallax angle for a star further away.

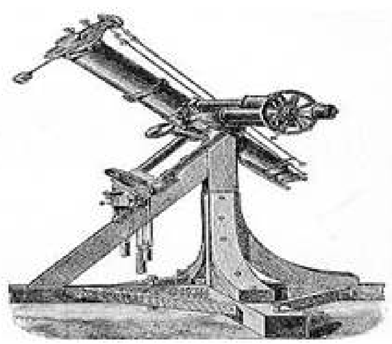
Parallax in Astronomy

In 1989, the satellite Hipparcos was launched primarily for obtaining improved parallaxes and proper motions for over 100,000 nearby stars, increasing the reach of the method tenfold. Even so, Hipparcos is only able to measure parallax angles for stars up to about 1,600 light-years away, a little more than one percent of the diameter of the Milky Way Galaxy. The European Space Agency's Gaia mission, launched in December 2013, will be able to measure parallax angles to an accuracy of 10 microarcseconds, thus mapping nearby stars (and potentially planets) up to a distance of tens of thousands of light-years from Earth. In April 2014, NASA astronomers reported that the Hubble Space Telescope, by using spatial scanning, can now precisely measure distances up to 10,000 light-years away, a ten-fold improvement over earlier measurements.



Stellar Parallax

Stellar parallax created by the relative motion between the Earth and a star can be seen, in the Copernican model, as arising from the orbit of the Earth around the Sun: the star only appears to move relative to more distant objects in the sky. In a geostatic model, the movement of the star would have to be taken as real with the star oscillating across the sky with respect to the background stars.19th and 20th century: Stellar parallax is most often measured using annual parallax, defined as the difference in position of a star as seen from the Earth and Sun, i.e. the angle subtended at a star by the mean radius of the Earth's orbit around the Sun. The parsec (3.26 light-years) is defined as the distance for which the annual parallax is 1 arcsecond. Annual parallax is normally measured by observing the position of a star at different times of the year as the Earth moves through its orbit. Measurement of annual parallax was the first reliable way to determine the distances to the closest stars. The first successful measurements of stellar parallax were made by Friedrich Bessel in 1838 for the star 61 Cygni using aheliometer.



Being very difficult to measure, only about 60 stellar parallaxes had been obtained by the end of the 19th century, mostly by use of the filar micrometer. Astrographs using astronomical photographic plates sped the process in the early 20th century. Automated plate-measuring machines and more sophisticated computer technology of the 1960s allowed more efficient compilation of star catalogues. In the 1980s, charge-coupled devices (CCDs) replaced photographic plates and reduced optical uncertainties to one milliarcsecond.

Types of Parallax

1. Diurnal parallax

Diurnal parallax is a parallax that varies with rotation of the Earth or with difference of location on the Earth. The Moon and to a smaller extent the terrestrial planets or asteroids seen from different viewing positions on the Earth (at one given moment) can appear differently placed against the background of fixed stars

2. Lunar parallax

Lunar parallax (often short for lunar horizontal parallax or lunar equatorial horizontal parallax), is a special case of (diurnal) parallax: the Moon, being the nearest celestial body, has by far the largest maximum parallax of any celestial body The lunar horizontal parallax at any time depends on the linear distance of the Moon from the Earth. The Earth-Moon linear distance varies continuously as the Moon follows its perturbed and approximately elliptical orbit around the Earth. The range of the variation in linear distance is from about 56 to 63.7 earth-radii, corresponding to horizontal parallax of about a degree of arc, but ranging from about 61.4' to about 54' The Astronomical Almanac and similar publications tabulate the lunar horizontal parallax and/or the linear distance of the Moon from the Earth on a periodical e.g. daily basis for the convenience of astronomers (and formerly, of navigators), and the study of the way in which this coordinate varies with time forms part of lunar theory. One way to determine the lunar parallax from one location is by using a lunar eclipse

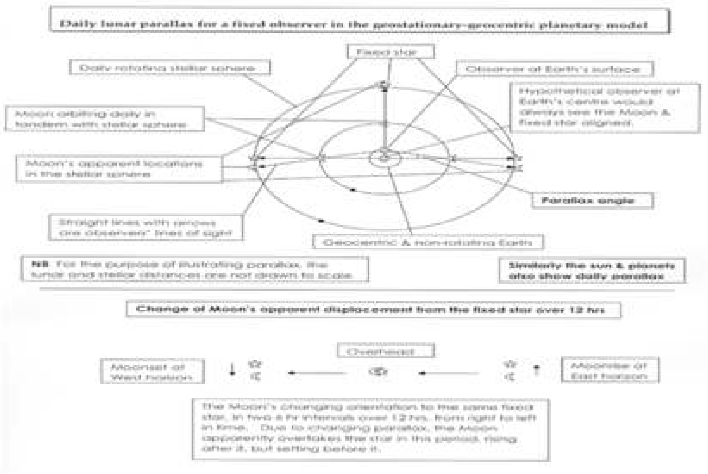
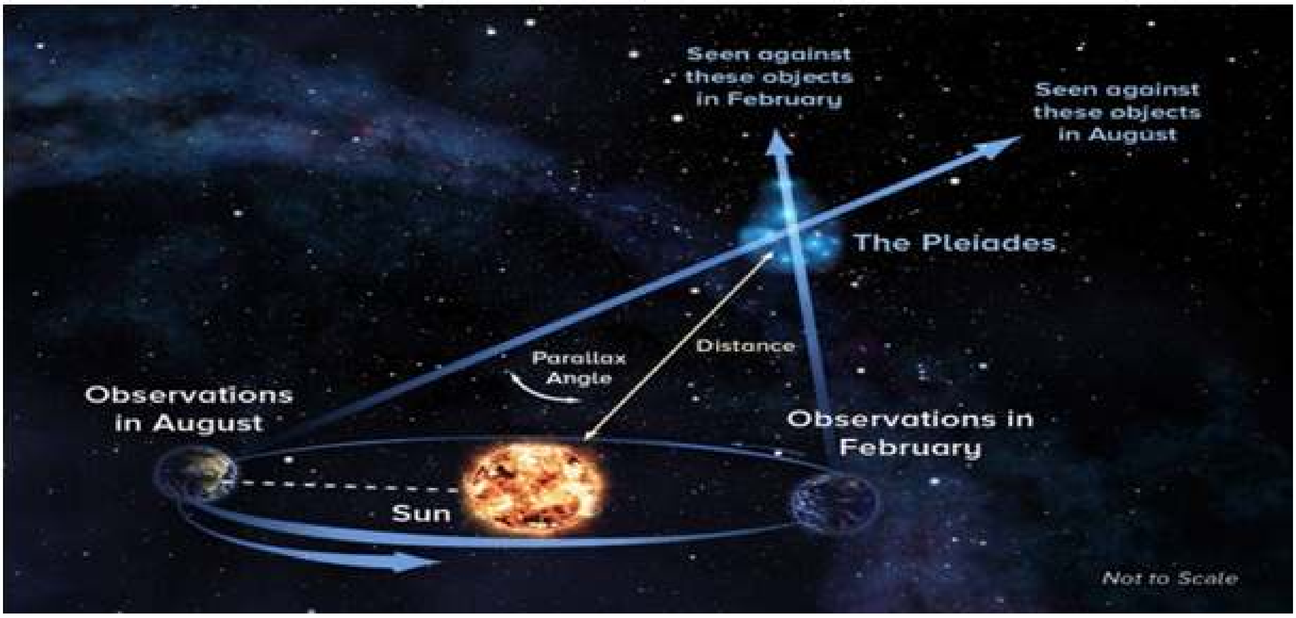


Diagram of daily lunar parallax

study of the way in which this coordinate varies with time forms part of lunar theory. One way to determine the lunar parallax from one location is by using a lunar eclipse.

3. Solar parallax

After Copernicus proposed his heliocentric system, with the Earth in revolution around the Sun, it was possible to build a model of the whole solar system without scale. To ascertain the scale, it is necessary only to measure one distance within the solar system, e.g., the mean distance from the Earth to the Sun (now called an astronomical unit, or AU). When found by triangulation, this is referred to as the solar parallax, the difference in position of the Sun as seen from the Earth's centre and a point one Earth radius away, i. e., the angle subtended at the Sun by the Earth's mean radius. Knowing the solar parallax and the mean Earth radius allows one to calculate the AU, the first, small step on the long road of establishing the size and expansion age of the visible Universe.



4. Dynamic or moving-cluster parallax

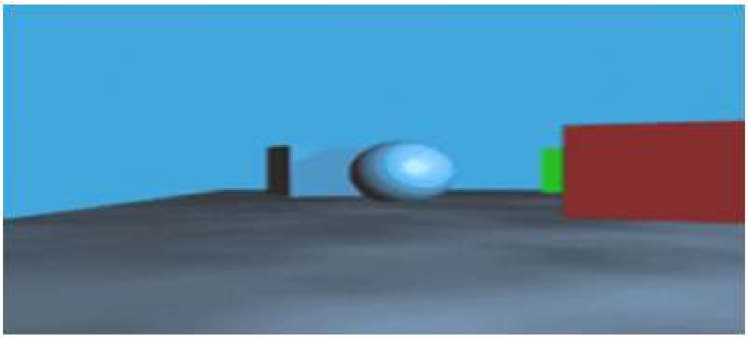
The open stellar cluster Hyades in Taurus extends over such a large part of the sky, 20 degrees, that the proper motions as Derived from astrometry appear to converge with some precision to a perspective point north of Orion. Combining the observed apparent (angular) proper motion in seconds of arc with the also observed true (absolute) receding motion as witnessed by the Doppler redshift of the stellar spectral lines, allows estimation of the distance to the cluster (151 light-years) and its member stars in much the same way as using annual parallax.

Dynamic parallax has sometimes also been used to determine the distance to a supernova, when the optical wave front of the outburst is seen to propagate through the surrounding dust clouds at an apparent angular velocity, while its true propagation velocity is known to be the speed of light.

Uses of Parallax

Parallax in sights

Parallax affects sights in many ways. On sights fitted to small arms, bows in archery, etc. the distance between the sighting mechanism and the weapon's bore or axis can introduce significant errors when firing at close range, particularly when firing at small targets. This difference is generally referred to as "sight height" and is compensated for (when needed) via calculations that also take in other variables such as bullet drop, windage, and the distance at which the target is expected to be



This animation is an example of parallax. As the viewpoint moves side to side, the objects in the distance appear to move more slowly than the objects close to the camera.

Artillery gunfire

Because of the position of field or naval artillery guns, each one has a slightly different perspective of the target relative to the location of the fire-control system itself .Therefore, when aiming its guns at the target, the fire-control system must compensate for parallax in order to assure that fire from each gun converges on the target.

Parallax is also used in optical instruments such as telescopes, microscopes, scopes for Shotguns and muzzleloader, etc.

Some Discussions

For years, astronomers have used a method known as stellar parallax to determine the relative distance of stars.. Parallax is the apparent change in the position of a nearby object relative to a distant object when the observer moves to a new position. Astronomers use the opposite sides of the earth's orbit as the observation points, when measuring the relative distance of two stars. Through the land based experiment it is proved that the concept astronomers use to calculate how far real stars are away from the earth is accurate. This project is to construct an entirely land based experiment to test and prove that stellar parallax theory is an accurate method to measure the relative distance of stars from earth.

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