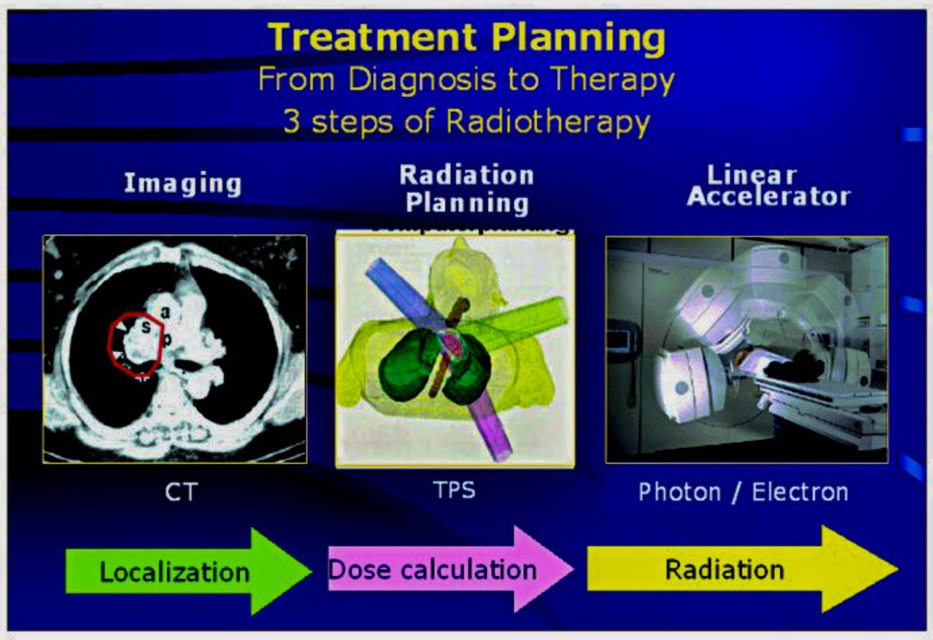
Physics of Medicine

DR. HASIN ANUPAMA AZHARI



MEDICAL physics is the application of physical methods and concepts in diagnosis (examination), therapy (treatment) and prevention of human disease and disability which is associated with the practice of medicine. The traditional areas of medical physics have been obviously shown? in radiotherapy, radio- diagnostic, nuclear medicine and in health physics, but with the recent rapid translation of new physical techniques into medical sciences, the work of physicists is getting essential in many clinical areas, e.g. magnetic resonance imaging (MRI), ultrasound, measurement of the body's electric and magnetic fields, positron emission tomography, pulmonary, physiology, cardiology, neurology, ophthalmology and biomedical sensors and implants.

A medical physicist shall have a degree in a discipline of physical science or MBBS with additional M.Sc. degree in medical physics from a recognized university. The responsibilities of a medical physicist usually include clinical service and consultation, research development and teaching. In a survey (2002) done by the American Association of Physicists in Medicine (AAPM) it was observed that the majority portion (76%) of medical physicists works in radiotherapy, 15% in imaging physics, 3% in nuclear medicine, 4% in health physics, 1% in engineering and 1% in administration. The primary responsibility of medical physicist is clinical (78%), academic (8%), research (5%), administrative (3%), in regulatory (4%) and in product development (2%).

Cancer can be treated in three ways: surgery, chemotherapy and radiotherapy. Surgery is the art, practice or work of treating tumor by operative procedures. Chemotherapy is the treatment with drugs that kill cancer cells or make them less active. Radiotherapy is the use of high energy radiation to treat cancer. Out of these three techniques radiotherapy is the cheapest and most curative and palliative ways for various types of cancer. Usually combined therapy is mostly implemented in certain types and stages of cancer.

In clinical radiotherapy practice, medical physics deals with the therapeutic applications of x-ray, gamma ray, neutron, electron, charged-particle beams and radiation from sealed radionuclide sources on the human body. It is also involved with the associated equipment responsible for their production, use, measurement and evaluation. Another important subject in this field is the image quality in the diagnostic area with its entire production methodology and radiation source. Medical physicists are the partners of radiation oncologists or radiologists in cancer treatment or examination respectively.

The main aim of radiotherapy (RT) is to deliver doses of radiation to eradicate a tumor, while nearby tissues or normal structures should be spared as far as possible. Usually, radiotherapy is based on delivering a uniform radiation doses to all target volumes (Tumor). The uniform dose approach describes the best possible tumor control for the case in which all regions of the tumor have exactly the same biological characteristics and sensitivity to radiation. In the radiotherapy technique a team consisting of a radiation oncologist, a medical physicist, a radiotherapy technician and a medical dosimetrist work together for the treatment of cancer. Out of this team, the main jobs of a medical physicist are planning the calculation and treatment of the prescribed patient dose, planning of the high specialized treatment procedure and maintaining the overall quality assurance for patients and the staff.

Comparing all disciplines of medical physics between other countries and Bangladesh, medical physicists are working mainly in radiation oncology physics and diagnostic imaging physics. Medical physicists hold professional appointments in radiotherapy and diagnostic departments in hospitals and medical centers.

The number of cancer patients is growing day by day worldwide as well as in Bangladesh. The complexity in the radiation therapy treatment of this disease requires more qualified medical physicists. So for a better future for the cancer treatment in Bangladesh, we have to put more emphasis on this subject as soon as possible. We hope that the number of medical physicists will increase in the near future as well as the professional level of competence within the coming 5-10 years.

In Bangladesh the number of cancer patients equals 2000 out of 1,000,000 inhabitants per year. That number of cancer cases needs up to 2 teletherapy machines (e.g. a linear accelerator Linac per 1 million people).According to WHO for 160 million Bangladeshi inhabitants we need approx. 320 megavoltage teletherapy machines, 160 radiotherapy facilities are needed to cover an optimal standard in radiotherapy treatment. This means a minimum of 500 qualified medical physicists are required in the future to satisfy the demand of the country. Until now Gono University has been the only university offering B.Sc and M.Sc courses in Medical Physics and in Biomedical Engineering in Bangladesh.

The writer is Head, Dept of Medical Physics and Biomedical Engineering, Gono Bishwabidyalay.

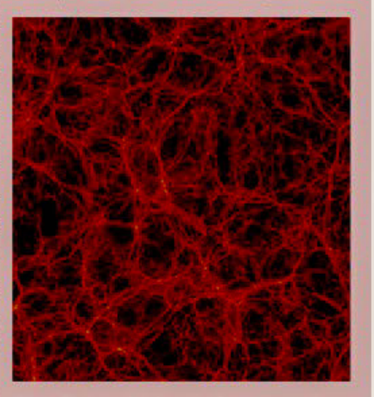
COSMIC MODEL

Simulated Universe!

The Bolshoi supercomputer simulation, the most accurate and detailed large cosmological simulation run to date, gives physicists and astronomers a powerful new tool for understanding such cosmic mysteries as galaxy formation, dark matter, and dark energy.

The simulation traces the evolution of the large-scale structure of the universe, including the evolution and distribution of the dark matter halos in which galaxies coalesced and grew. Initial studies show good agreement between the simulation's predictions and astronomers' observations.

"In one sense, you might think the initial results are a little boring, because they basically show that our standard cosmological model works," said Joel Primack, distinguished professor of physics at the University of California, Santa Cruz. "What's exciting is that we now have this highly accurate simulation that will provide the basis for lots of important new studies in the months and years to come."



The Bolshoi simulation reveals a cosmic web of dark matter that underlies the large-scale structure of the universe.

Primack and Anatoly Klypin, professor of astronomy at New Mexico State University, lead the team that produced the Bolshoi simulation. Klypin wrote the computer code for the simulation, which was run on the Pleiades supercomputer at NASA Ames Research Center. "These huge cosmological simulations are essential for interpreting the results of ongoing astronomical observations and for planning the new large surveys of the universe that are expected to help determine the nature of the mysterious dark energy," Klypin said.

Primack, who directs the University of California High-Performance Astrocomputing Center (UC-HIPACC), said the initial release of data from the Bolshoi simulation began in early September.

SOURCE: **SCIENCE DAILY**

BOOK INAUGURATION

Life science in Bangla

The first ever elaborately written Bengali book on genetic engineering and heredity was launched on Saturday, 01 October 2011. The inauguration ceremony of this book titled "Bongshogotibiddar mulkotha o gene prokoushol" carrying the meaning "Principles of heredity and genetic engineering" was held at the conference room of the Center of Excellence, University of Dhaka. Professor AAMS Arefin Siddique, Vice Chancellor, University of Dhaka was present as the chief guest.

The lead author of this book, Professor Ahmad Shamsul Islam, is one of the leading biotechnologists and ex-professor of Botany at the University of Dhaka. Another twelve writers including some young scientists wrote different chapters of the 42 chapters it contains. The book created an excellent example of bringing the scientists from three generations together in unison. The book is divided into three major parts: heredity and molecular biology, genetic engineering and modern biotechnology and genetic engineering: Bangladesh perspective.

This book has been written considering the present scarcity of Bengali book in the higher education in life science. It can be offered as a reference book in national colleges and universities for the students to better understand the scientific phenomena in native language.

Along with the lead author, who also was the lead editor of the book, three other writers worked as co editors: Mr. Mustak Ibn Ayub, Ms. Sabrina Moriom Elias, and Ms. Sumaiya Farah Khan. In the discussion session on the book, Professor Anwarul Azim Akhand of Department of genetic engineering and biotechnology expressed his opinion on the inside illustrations of the book and told that it could be even better. Professor Anwar Hossain of the Department of biochemistry and molecular biology suggested keeping some terms as they are in English to make it a better standard. The book will be available in selected libraries countrywide.

Reported by Md. Riajul Hossain, Lecturer in Biotechnology, BRAC University.

THE GREAT JOURNEY

Sun's path in Milky Way

SYED GOUSEUZZAMAN HAIDERI ALI

ALL the celestial bodies in the universe are moving around another body. This is called orbiting. Moon is moving around the Earth. Again Earth and other planets are moving around the Sun. Is the Sun the centre of the Universe? The answer is certainly 'no'. Sun is also moving around some bigger object. Sun is orbiting the centre of the Milky Way Galaxy. We do not know exactly, what is at the centre of the Milky Way Galaxy. Perhaps there is one Micro-Quasar with a super massive Black Hole.

Sun's Location in the Milky Way

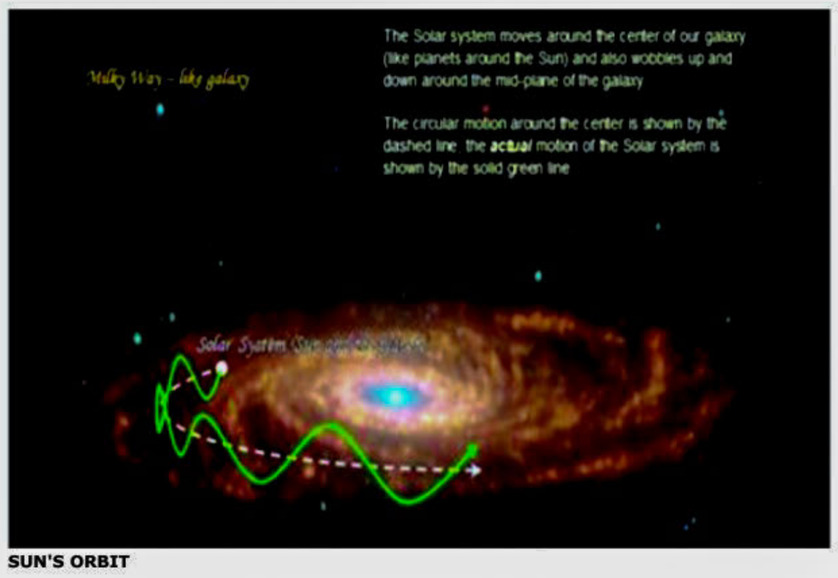
Sun is one of the stars in the Milky Way. There are about 300 billion stars in this Galaxy. Sun is situated in this Galaxy more than 1/2 way away from the centre towards the edge or end of the Galaxy.

The Milky Way Galaxy is our home galaxy in the universe. It contains the Solar System. It is a barred spiral galaxy and is 13.2 billion years old or as old as the universe itself. The Milky Way is a part of the Local Group of galaxies.

Milky Way Galaxy is 100,000 light years in diameter.50, 000 light years in radius.1000 light years thick.

Sun's Orbit

Sun is situated about 26,000 to 30,000 light years from the galactic centre. Circumference of the of the Sun's orbit is about 150,000 light years. Sun is moving at the speed of 782,000 km/hour or 486,000 m/hour. Sun completes one orbit in 225 to 250 million years. This is known as one Galactic year or one cosmic year. Sun is about 5 billion years old. So it has completed about 20 to 22 orbit from its birth. Sun's orbit around the Galactic Centre is roughly elliptical with the additional perturbations due to the galactic spiral arms and non uniform mass distributions. In addition, the Sun oscillates up and down relative to the galactic plane approximately 2.7 times per orbit. In its motion through the Milky Way, Sun is moving in the general direction of the Star Vega.



SUN'S ORBIT

Sun's movement through the Milky Way regularly sends comets hurtling into the inner solar system. Sun bounces up and down through the plane of the Galaxy and dislodges comets from their paths. Some of them collide with the Earth. Scientists believe that comets' collision with the Earth may have caused mass extinction of life on Earth. Dinosaurs may have been extinct due to the same cause about 65 million years ago. Our present position in the Galaxy suggests that we are now very close to another such period.

There is a hypothesis that while "Bounce" effect may have caused extinction of life in one place, it may also have helped in the spread of life in another place. The impact of comets' collision may have thrown debris containing micro-organisms out into space across the universe.

The writer is an Advocate of the Supreme Court.

NUCLEAR HOPE DASHED!

A fallen dream

Nuclear power is no magic solution, argues Pervez Hoodbhoy it's not safe, or cheap, and it leads to weapons programmes.

A Fukushima-type incident could be more serious in developing countries

A string of energy-starved developing countries have looked at nuclear power as the magic solution. No oil, no gas, no coal needed it's a fuel with zero air pollution or carbon dioxide emissions. High-tech and prestigious, it was seen as relatively safe.

But then Fukushima came along. The disaster's global psychological impact exceeded Chernobyl's, and left a world that's now unsure if nuclear electricity is the answer.

The fire that followed the failure of emergency generators at the Daiichi nuclear complex raised the terrifying prospect of radiation leaking and spreading. The core of the Unit 1 reactor melted, and spent nuclear fuel, stored under pools of water, sprang to life as cooling pumps stopped.

Fukushima's nuclear reactors had been built to withstand the worst, including earthquakes and tsunamis. Sensors successfully shut down the reactors, but when a wall of water 30 feet high crashed over the 20-foot protective concrete walls, electrical power, essential for cooling, was lost.

The plume of radiation reached as far as Canada. Closer, it was far worse. Japan knows that swathes of its territory will be contaminated, perhaps uninhabitable, for the rest of the century. In July, for example, beef, vegetables, and ocean fish sold in supermarkets were found to have radioactive caesium in doses several times the safe level.

SOURCE: **SCIDEV.NET**

IT'S THE BUDGET

Farewell, Tevatron

One of the world's most powerful atom smashers, the Tevatron, shut down Friday (Sept. 30), with the event streaming live online.

The atom smasher is located at the Fermilab physics laboratory in Batavia, Ill. Inside the accelerator, particles are ramped up to near light speed as they zip around a 4-mile (6.3-kilometer) ring. When two particles collide, they disintegrate into other exotic particles in a powerful outpouring of energy.

While it was once the most powerful atom smasher, the Tevatron has recently been surpassed by the new Large Hadron Collider at CERN in Geneva, Switzerland. The Tevatron is shutting down for budget reasons. [Twisted Physics: 7 Mind-Blowing Findings]

The CDF detector

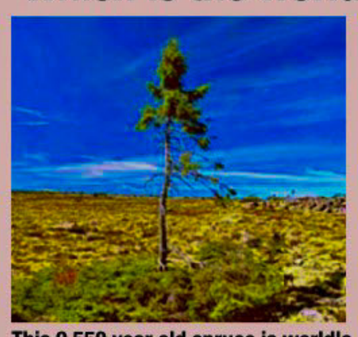
Tevatron's end came a little after 3:30 p.m. ET, as Fermilab physicist Helen Edwards pushed two specially-constructed buttons, one red and one blue. The red button shut down the collision of protons and anti-protons in the Tevatron. The blue button shut off the electrical current to the accelerator.

That one, Edwards had to push twice. "It didn't want to give up so easy," said Bob Mau, the head of the accelerator division operation department at Fermilab, who was leading the live-streamed shutdown.

SOURCE: **LIVE SCIENCE**

DID YOU KNOW?

Which is the world's oldest living tree?



This 9,550 year old spruce is world's oldest living tree

World's Oldest Living Tree -- 9550 Years Old -- Discovered In Sweden

The world's oldest recorded tree is a 9,550 year old spruce in the Dalarna province of Sweden. The spruce tree has shown to be a tenacious survivor that has endured by growing between erect trees and smaller bushes in pace with the dramatic climate changes over time. For many years the spruce tree has been regarded as a relative newcomer in the Swedish mountain region. "Our results have shown the complete opposite, that the spruce is one of the oldest known trees in the mountain range," says Leif Kullman, Professor of Physical Geography at Umeå University.