

Space --- Mysteries Galore!

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The universe, estimated to be about 13.7 billion years old, is constantly expanding. The galaxies are racing away from one another, the farther away they are from us, the faster the velocity at which they are receding. What is it that makes the galaxies hurtle away from each other, rather than be attracted to one another by their gravitational forces? This is due to some very strange forces that we do not understand. Space is not one dark empty vacuum. Some strange and powerful forces lurk within space, and its amazing properties are just beginning to be understood. One mysterious force, "dark energy", accounts for roughly 71% of our universe while about 25% of the mass of the universe is made up of another mysterious substance that we call "dark matter". It is invisible ---- it does not emit or reflect light and cannot be observed directly through telescopes. However it can be recognized by the enormous pulling and twisting effects exerted by it on galaxies. This powerful invisible glue ---- dark matter ---- appears to be holding the galaxies together. Indeed it is remarkable that only 4.6% of the mass of the universe is accounted for by the "ordinary" visible matter made up of atoms ---the rest is due to dark matter and dark energy! The world's fastest computer "Roadrunner", developed through a collaboration between IBM and the Los Alamos National Laboratory, can perform 1000 trillion operations per second. It is being used to unravel some of these secrets through calculations at these amazing speeds! With every passing day the mystery of space becomes deeper. One day we will understand it better, as this is what research is all about.

Did you realize that while you may appear to be stationary, you are actually travelling across space at an amazing velocity, being carried on a giant spacecraft called "earth". Our planet earth and our solar system are presently hurtling across space, along with our galaxy, towards the enormous Virgo cluster of galaxies at some 120 miles per second! Moreover, if our galaxy is viewed from the side, it appears disc shaped. As our sun travels through our galaxy, it is bobbing up and down, rising above the disc, and then falling below it once every 62 million years. When it rises above the disc ("north" side, pointing towards the Virgo cluster of galaxies) the biodiversity on our planet is thought to drop sharply due to damaging cosmic radiations, resulting in mass extinction of species.

The stars, including our sun, produce huge amounts of light and heat through fusion reactions ---fusing of smaller atoms to afford larger atoms----that occur within them. Fusion of hydrogen atoms leads to helium and then to heavier elements. Carbon, nitrogen and heavier elements up to iron are formed in larger stars. The heavier

elements such as gold, nickel, uranium etc arise at higher energies when stars collapse (implode) before exploding in a supernova, producing huge bursts of radiation.

Our galaxy, the Milky Way, contains over 100 billion stars. As a result of exploration of the skies for planets where life could exist, some 340 worlds have been discovered revolving around their respective suns. Twenty of these planets have been named “super earths” as they are at the appropriate distances from their respective suns, to have suitable temperatures for life to exist. Meanwhile the Kepler space telescope launched last year is on a mission to discover new planets, by looking at the reduction in the brightness of stars as planets pass in front of them. Besides the right temperature, water must also be present for life, as we know it, to evolve. The Galileo space probe showed in the 1990s that Jupiter’s moon “Europa” has an ocean of liquid water below its frozen surface. More recently the spacecraft “Cassini” found geysers of water gushing out from the surface of Saturn’s small (300 mile wide) icy satellite, Enceladus. Water has also been discovered on our own moon, but as it does not have an atmosphere, life cannot exist on it. The credit for this exciting discovery goes to the collaborative effort between NASA and India Space Research Organisation. The water on the moon is bound to the rocks and dust on the lunar pole, and it should therefore be possible to extract it.

An interesting feature about our planet earth is that after a certain period of time its magnetic field undergoes a reversal so that north becomes south, and south becomes north. This occurs after a period that may vary from tens of thousands of years to a million years. It last occurred 780,000 years ago. The magnetic field is responsible for the “magnetosphere” that protects the earth from the damaging effects of cosmic rays. Life would not have existed in its present form without this protective effect.

Space will soon be used for passenger travel. The European Commission has funded a project of a “Spaceliner” being developed by the German space agency, DLR which will be capable of traveling at a speeds of 14,000 mph and carrying 50 passengers --- through space (!) --- it will be able to travel from New York to Sydney in less than 90 minutes. The spacecraft will travel at a height of 62 miles, the lower boundary of space. Japan meanwhile launched the first solar powered space craft, IKAROS, that uses mainly solar sail technology for propulsion. The solar sails were unfurled a few weeks after launch. They comprise very large ultra-thin mirrors made of polymeric materials. The spacecraft, powered by sunlight, is propelled forward due to two different forces: the stronger radiation pressure due to light particles (photons) and the weaker solar winds. It has travelled beyond the planet Venus, and is now proceeding to the far side of our sun to collect scientific data.

There are mysteries galore around us ---nature of matter, what space is composed of, how we may discover new ways to travel distant stars and explore new planets. The bright young men and women of Pakistan will Inshallah unravel some of these secrets.

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