Good essay on physics in everyday life

Environment, Disaster

Introduction

Physics is an abstract field of science that influences our lives in more ways than we can imagine. From waking up every morning, to the water we drink; from driving to work, to the music we listen to; from the internet, to the cell phones that we use so often, physics governs all their basic operating principles. Many natural phenomena throw questions whose answers lie deep in physics. Why are lightning flashes so spectacular? How long does it take for light from a star to reach us? How is a rainbow formed? What causes a boomerang to swirl back? Many of these questions are answered by scientists deeply rooted in physics. In this essay, I reflect on some daily events and processes which have strong physics backgrounds.

- The Human Body

Seldom do we come across a device everyday that uses some fundamental principles of physics as the human body does. The human body is just like an engine with a perpetually running motor. A complex set of mechanics involving the brain, the lungs, the heart, and many other vital organs of the body, are responsible for keeping the body alive. According to Jo Hermans (2012), on an average we eat food that contains 8 to 10 MJ of energy, i. e. 8000 to10, 000 Joules of energy, which is equivalent to a quarter of a litre of gas. Thus, the amount of energy the human body requires on a daily basis is barely enough to drive a car a few hundred metres down the road. We can try and estimate the complexity of this engine by understanding that this seemingly meagre amount of energy is sufficient to keep the heart pumping, sustain respiration, and perform all other involuntary activities. Just like any combustion process (as what happens inside any engine) releases energy in

the form of heat, the human body, too, releases heat.

- Going Mobile

The world has become a better and smaller place since the invention of the cellular phone by Martin Cooper of Motorola in 1983. However, it is interesting to know that the first wireless transmission of the human voice was made in 1900 in Washington DC. This feat was achieved Reginald Fessended, an inventor, transmitted his voice over radio waves across two radio towers. Radio waves are electromagnetic radiation having very low frequencies and hence, longer wavelengths. Thus according to Planck's equation E= hν, where h is Planck's constant and ν is the frequency, radio waves travel with low energy and consequently are able to travel larger distances with low losses in energy. Thus, radio waves become a very useful tool in long distance communication.

A cell phone is simply a two way radio device consisting of a transmitter and a receiver. When you speak into a cell phone microphone, your voice is converted into electrical signals which are then transmitted over radio waves to a cellular network tower. The towers relay the signal multiple times till it reaches the receiver phone where the receiver converts the signals back into audible audio waves. Because these waves are electromagnetic, they travel at the speed of light, thus making cellular communication quick, instant, and effective.

- Quantum of Solace

Quantum mechanics or quantum physics, as it is more popularly known as, is a fundamental branch of physics that usually has significant implications in the micro and nano-world. It is a very important and widely research filed of

physics dealing with uncertainties and predictions – a branch many believe were created by aliens! A deeper and closer look into quantum mechanics reveals that the basic principles of this branch of physics have profound implications in everyday life. The latest in television technology are the LED televisions. LEDs or Light Emitting Diodes are semiconductor devices which are activated when a voltage is applied across. The electron-hole pairs present in the semiconductor start getting excited and begin moving under the influence of the applied voltage. When an electron at a certain energy level combines with a hole of a certain energy level, energy is released in the form of photons. Depending upon the material used for fabrication, the light emitted can be UV, visible, or infrared radiation (Schubert 2005).

The concept of bands or the Band Theory of Solids is an essential consequence of the laws of quantum mechanics. The location of electron-hole pairs, the energy levels, the band-gap, etc. are all governed by principles quantum mechanics. Einstein defines a photon are light containing a discrete “ packet” or quantum of energy. Thus, the operation of LASERs, MRI scanning machines, computers, etc. all relies deeply on quantum mechanics. One of the foundations of quantum mechanics is the De Broglie Hypothesis where De Broglie gave the equation λ= hmv (h = Planck’s constant, m = mass of the object and v = its velocity) that suggested that all matter consisted of both particle and wave natures. This was subsequently proven by Davisson and Germer’s experiment for an electron wave. Thus light and all other electromagnetic radiation contain particle and wave properties, their particulate form being called “ photons”. One of the major factors in quantum mechanics is Planck’s constant h . In a way, it can be

summarized fairly accurately that everything we see around us is quantum mechanical and that classical physics is just a special case of quantum physics where h →0.

- Burn!

There is a difference when we touch an iron rod that was kept half inside a furnace and when we sit in a room with the thermostat turned on. In one case we feel the heat almost instantly, while in the other there is a gradual build up over time. The reason we observe this is the mode of heat transport. Heat travels through three modes of transport: 1) conduction 2) convection and 3) radiation.

When heat, a form of energy, is applied to a good conductor of heat such as iron, the energy supplied excites the atoms present in the material and they begin to vibrate with an increase in frequency. Once the excitation limit of an atom is reached, it passes on the energy to the neighbouring atoms. This process goes on until all the atoms vibrate with the same frequency and this mode of heat transport is conduction. In convection, as in the case of a thermostat, the molecules of air close to the heating duct get heated up first. When air gets hot, it expands, becomes lighter and floats up while cooler and heavier air gets drawn down. Now the cooler air gets heated, expands, and rises up and this cycle continues until the entire room is heated. The final mode of heat transfer is radiation. This happens when heat radiation travels through vacuum and causes heating effects on bodies which it irradiates. For instance, the infrared radiation of sunlight can travel through space and fall on earth and heat up the earth’s surface. The principle behind microwaves also involves heat transfer through radiation.

Now we are in a position to understand how a hot air balloon works. The air near the burners gets heated and rises up into the space under the envelope while the cooler air is pushed down. Now, this cool air gets heated and that, too, rises up into the envelope. Soon, the envelope is at its maximum capacity and any more hot air rising up will only push the balloon into a slow ascent. Thus the concept of convection heating is applied in the flight of a hot air balloon. However, to manoeuvre the balloon to the left or right, the pilot usually propels the balloon up or down so that different wind currents are caught that can navigate the balloon.

- Stargazing

At first glance, it is difficult to comprehend how a star that is many hundreds or thousands of light years away can have any impact on our daily lives. But, in some ways, these stars, planets and other cosmic bodies influence us directly, and in other ways they influence us indirectly. The position of the sun, the moon, and the planets are what helped ancient civilizations calculate time and form the calendar as we know it now. The lunar cycle and its effects on the tides are well known and well established. Ancient and medieval navigators depended heavily on the location of the Polaris or the Pole Star to give them directions during their voyages.

Many of the modern technological devices and gadgets owe its inception to astronomy. For instance, the wireless LAN technology that is used by over a billion users worldwide was the brainchild of John O’Sullivan. The WiFi, as it is more popularly known as, was invented by Australian astronomers as a method to enhance images obtained from radio telescopes. The same technology that is used by radio astronomers is implemented in WiFi’s

(Hameker, et al. 1977). X-Ray observatories were developed to observe stars that belonged to the early universe. The same principle is applied in X-Ray inspection systems installed at airports, bus stations etc. a device known as a gas chromatograph was developed to identify elements on the surface of Mars. This same gas chromatograph is used in baggage survey for drugs and concealed weapons. Many astronomers are software developers themselves. Software developed to analyse radio and X-ray telescope images are now used in medicine for complex procedures such as brain mapping and instruments used to monitor temperature fluctuations of certain sensitive systems are now implemented in neonatal care.

It is evident from the examples that science and especially physics touches us everyday in more ways than we anticipate. From curing dreadful diseases through radio-isotopes to activities as mundane as driving a car; from architectural excavations and determining the age of fossils to listening to music, physics governs our lives in a number of ways. With the onset of the Information Age and the advances in the semiconductor industry, computing is only going to get swifter, smarter, and smaller and as this happens, the influence of physics is only going to increase. The focus of many research groups today is the efficient and effective harnessing of sustainable sources of energy such as wind and solar energy. The principles behind extracting and harnessing these forms of energy lie rooted in physics. Even today, the power we receive are due to hydroelectric power plants which convert potential energy of water stored in dam into electrical energy or nuclear power which involves the splitting of a nucleus to extract the surplus energy stored in it, shows that physics is all around us. It is not necessary to

understand how everything works in great detail unless there is an interest in the subject; however, it is necessary to acknowledge the influence of physics in our daily lives.

References:

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