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Brief Overview on Electromagnetic Waves in Fundamentals of Physics

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Commentary

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ABOUT THE STUDY

An electromagnetic wave is a type of wave (a wave carries energy through a medium-though electromagnetic waves seemingly need no medium as propagate through vacuums) that moves at speed c, or the speed of light (the speed of light ≈ 300,000 km/s in free space). It is composed of two fields, oriented at right angles to each other- the electric field and the magnetic field. This disturbance carries energy through space.

They vary in wavelength (in theory they could be any wavelength), and each wavelength can correspond to a different type of wave, though truly all waves on the electromagnetic spectrum are the same thing- a moving disturbance in the electric and magnetic fields. The different types of the waves on the spectrum include (moving from longest to shortest wavelength), radio, microwave, infrared, visible light, ultraviolet, X-Rays, and Gamma rays. As wavelength decreases, frequency increases. This is illustrated mathematically with the following equation: $f=300/\lambda$ where λ is the wavelength of a wave in meters, and f is the frequency of the wave, in Megahertz, or millions of cycles per second. The energy of a wave also increases with frequency, and this is illustrated with the formula: $E=hf$, where E is the energy of the wave, f is the frequency, and h is Planck's constant.

This type of wave is widely used by mankind, for a variety of reasons. Radio waves are used (obviously) for communication, as are microwaves (they are of course used for cooking as well). Infrared likely keeps your chips

warm at your favorite restaurant, X-Rays are used in imaging, and the list goes on. Some electromagnetic waves have been proven harmful to the body, specifically those that have enough energy to ionize materials. The process of ionization by electromagnetic waves includes the wave "knocking" an electron off of an atom, putting it in a state of electrical imbalance, and it is called an ion. Electromagnetic waves that can ionize include Ultraviolet Radiation (which causes sunburns), X Rays, and Gamma Rays. Extreme quantities of ionizing radiation can be extremely carcinogenic, and sometimes lethally poisonous. This is why great safety precautions must be taken when working with such things as X Rays and Gamma Rays. Remember also that any type of electromagnetic wave that is less powerful than UV light cannot ionize, and this is obvious to see in the equation E=hf. The only factor that dictates whether it will ionize is the frequency. Nonetheless, even high powered radio signals can cause burns and microwaves can cause blindness if your proximity is too close to a high powered antenna. Light can also cause blindness, such as looking directly at the sun. Caution should be exercised when working with this type of wave, especially near man-made sources. Nonetheless despite the (generally somewhat minor) risk, humans have made much use of this powerful force of nature, and they have proven an invaluable tool. However, according to Quantum Field Theory, they may be a ripple in a quantum field that fills all of Space-time. When the electromagnetic field is disturbed, the result is the production of photons of electromagnetic energy.