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Description of Radiation

The term “radiation” is frightening to some people. As with many frightening subjects, learning and understanding more about the particular subject makes it less frightening and intimidating.

The two basic types of radiation, (radiant energy), are electromagnetic waves (EM waves) and energetic particles. Let us first consider electromagnetic waves, which are classified according to their wavelengths and corresponding energies. These waves move through space at the speed of light 186,000 miles per second (300 X 10^6 meters per second).

Their range of wavelengths is enormous, from hundreds of meters to the size of atoms. Their energies are inversely related to their wavelengths, the long wavelengths have the smallest energies whereas the short wavelengths have the highest energies. AM, FM and TV broadcasting utilize the longer EM wavelengths. As an example, the wavelength of a typical FM radio broadcast at 100 MHz is 3 meters. Cellular telephones utilize even shorter wavelength EM waves, of about 30 centimeters. Radar wavelengths are about a centimeter, microwave oven’s are about 12 centimeters. Moving to even shorter wavelength EM waves we come to the infrared region of the spectrum. These EM waves produce the sensation of warmth in our skin. When their intensity is sufficiently great burning may result. At still even shorter wavelengths our eyes become sensitive to a range, called the “visible” portion of the spectrum. The longer waves in this range produce the sensation of red whereas the shorter produce violet. The wavelengths in the middle of this range produce the sensation of green, which is the color our eyes are most sensitive to.

The energy of EM waves is measured in “electron volts”, abbreviated eV, and the energy of green light is 2 eV. The next range of shorter wavelengths, beyond the visible, is called “ultraviolet”, with corresponding energies from 5 to 100 eV. It is common practice to describe these very short wavelength EM waves by their energy and to identify 10 eV as the point above which EM waves can produce ionization in matter. The remaining two ranges of EM waves are the X-ray, with energies from 100 to 100,000 eV (0.1 to 100 keV), and the gamma ray, with energies above 100 keV, commonly measured in millions of eV (MeV). X-rays are produced in X-ray machines and some radioactive substances; gamma rays are produced in some radioactive substances and from cosmic rays that originate in deep space.

There are three sources of radiation due to energetic particles: accelerators used in physics research, radioactive substances, and cosmic rays. Their energies range from thousands to millions of eV, (keV to MeV).