**NDT 130: Radiation Safety**

**Ionizing Radiation Defined**

Ionizing radiation (ionizing radiation) is radiation that carries enough energy to liberate electrons from atoms or molecules, thereby ionizing them. Ionizing radiation is made up of energetic subatomic particles, ions or atoms moving at high speeds (usually greater than 1% of the speed of light), and electromagnetic waves on the high-energy end of the electromagnetic spectrum.

Gamma rays, X-rays, and the higher ultraviolet part of the electromagnetic spectrum are ionizing, whereas the lower ultraviolet part of the electromagnetic spectrum, and the lower part of the spectrum below UV, including visible light (including nearly all types of laser light), infrared, microwaves, and radio waves are all considered non-ionizing radiation. The boundary between ionizing and non-ionizing electromagnetic radiation that occurs in the ultraviolet is not sharply defined, since different molecules and atoms ionize at different energies. Conventional definition places the boundary at a photon energy between 10 eV and 33 eV in the ultraviolet (see definition boundary section below).

Typical ionizing subatomic particles from radioactivity include alpha particles, beta particles and neutrons. Almost all products of radioactive decay are ionizing because the energy of radioactive decay is typically far higher than that required to ionize. Other subatomic ionizing particles which occur naturally are muons, mesons, positrons, and other particles that constitute the secondary cosmic rays that are produced after primary cosmic rays interact with Earth's atmosphere.[1][2] Cosmic rays are generated by stars and certain celestial events such as supernova explosions. Cosmic rays may also produce radioisotopes on Earth (for example, carbon-14), which in turn decay and produce ionizing radiation. Cosmic rays and the decay of radioactive isotopes are the primary sources of natural ionizing radiation on Earth referred to as background radiation. Ionizing radiation can also be generated artificially using X-ray tubes, particle accelerators and any of the various methods that produce radioisotopes artificially.

Ionizing radiation is not detectable by human senses, so radiation detection instruments such as Geiger counters must be used to indicate its presence and measure it. However, high intensities can cause emission of visible light upon interaction with matter, such as in Cherenkov radiation and radio luminescence. Ionizing radiation is used in a wide variety of fields such as medicine, nuclear power, research, manufacturing, construction, and many other areas, but presents a health hazard if proper measures against undesired exposure are not followed. Exposure to ionizing radiation causes damage to living tissue, and can result in mutation, radiation sickness, cancer, and death.