

Low LET Physics Topics

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This presentation is intended to provide a discussion about the sources and properties of low LET radiation which are used as the reference standards for understanding the unique properties of high LET charged particles. First the origins and properties of gamma rays and X-rays are compared in terms of monoenergetic gamma rays originating from nuclear transitions vs. distributions of Bremsstrahlung photons from electronic sources. Examples of gamma irradiators are provided. Then the exponential attenuation of photons in materials is described in terms of the mass attenuation coefficient and half-value layers and the concepts of build-up and charged particle equilibrium are introduced. Practical issues originating with scattering are considered in terms of parameters used in medical physics - e.g. tissue to air ratios. Next the production of X-rays is discussed along with the configuration and operation of X-ray tubes and the use of filters to manipulate the X-ray spectrum.

A short discussion of proton radiation is provided as protons are sometimes categorized as either low or high LET based on the value of LET rather than notions of track structure. The pitfalls of considering only the LET are illustrated as are the dramatic differences of the depth-dose profiles of protons vs. photons. Finally, aspects of track structure and nuclear fragmentation as functions of primary particle energy are illustrated to provide perspective on the complexity of energy deposition and absorption by particles.

Tables of mass attenuation coefficients and gamma ray flux to dose rate conversions are provided for practical calculations.