Microdosimetry of a 25 keV Electron Microbeam

W. E. Wilson[1], D. J. Lynch[1], K. Wei1, and L. A. Braby[2]

[1]Washington State University Tri-cities, Richland, WA 99352; [2]Texas A&M University, College Station, TX 778843

Electron microbeam experiments are planned or under way to explore in part the question regarding whether the bystander effect is a general phenomenon or is restricted to high-LET radiation. Since low-LET radiations scatter more readily compared to high-LET radiations, identifying bystander cells and assessing the potential dose that they may receive will be crucial to the interpretation of radiobiological results. This paper reports on initial calculations of the basic information needed for a stochastic model of the penetration of energetic electrons in tissue-like matter; the model will be used to predict doses delivered to adjacent regions in which bystander cells may reside. Results are presented of calculations of the stochastics of energy deposition by 25 keV electrons slowing down in a homogeneous water medium. Energy deposition distributions were scored for 1-um spheres located at various penetration and radial distances up to 10um from the point of original. The energy of 25 keV was selected because experiments are planned for energy. At 25 keV there is a high probability that the entire electron track will be contained within a typical mammalian cell. Individual tracks are scored because of their primacy; data for higher doses can by obtained by convoluting single-track distributions. The event frequency decreases approximately exponentially after the first micrometer to 1% at about 8 um of penetration. Radially, the 1% contour extends to 3.5 um at a penetration of 5.5 up. The frequency-mean energy deposited decreases from 1.5 to 1 keV/up at a penetration of 3.5 um, then increases back to about 1.5 at a penetration of 6.5 um. The mean energy increases to about 3 keV/um at a radial distance of 8.5 um.

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