Search for the greater potential of Auger electrons

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Auger electrons and characteristic X–rays, collectively named as atomic radiation, are emitted following atomic ionization. Radionuclides that emit Auger electrons have been of particular interest as therapeutic agents. This is primarily due to its short range in tissue, controlled linear paths, and high linear energy transfer of these particles. Their biological effects are very localized thus making Auger–electron emitters ideal for precise targeting of cancer cells. On the other hand, Auger electrons can also damage healthy cells. Accurate knowledge of Auger yields is needed both to evaluate the dose to healthy cells, when radioisotopes are administered for diagnostics, and to design radioisotope use in targeted cancer therapy.

A pilot computational model, based on the Monte Carlo method and using up–to–date nuclear input data, has been developed at the ANU. Details of the model and results for ^{99m}Tc and ^{111}In have been published [1]. *Ab initio* calculations of atomic transition energies are performed at every propagation step of the Auger cascade using the relativistic Dirac–Fock method. This approach has never been used by existing calculations and it effectively eliminates energetically forbidden transitions. An important result of the pilot model is that deduced total yield of Auger electrons per nuclear decay for ^{99m}Tc is 3.55, reasonably consistent with the calculation of Pomplun [2]. We have begun to calculate the charge distribution after electron capture, and to simulate experimental spectra. These results will be presented. They are in good agreement with the experimental data. In addition, future plans to refine the pilot model will also be discussed.

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[2] E. Pomplun, Int. J. of Radiation Biology, **88** (2012) 108.