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Low-Energy Electron Collisions with Biomolecules[1]

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Ionizing radiation generates copious quantities of secondary electrons as it penetrates condensed matter, and it has long been known that radiation damage in living tissue is largely caused by such secondary electrons. Those electrons with energies on the order of 10 to 100 eV can obviously cause damage through excitation and ionization channels. However, recent experimental work has demonstrated the surprising result that even electrons with insufficient energy to ionize or electronically excite biomolecules can cause significant damage, including DNA strand breaks and disruption of sulfur bridges in peptides. These low-energy damage mechanisms involve the temporary trapping of the incident electrons by resonances, and the nature of the resonant states involved is thus a key issue. Computational approaches have the potential to provide highly useful insights; however, obtaining accurate results for the large, asymmetric molecular targets relevant to biological applications is a challenge. In this talk I describe recent results from electron-molecule collision calculations on molecular systems relevant to the nucleic acids and to proteins, with emphasis on the characterization of low-energy resonances that may play a role in dissociative attachment and/or dissociative excitation.

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