# Identifying biomolecule fragments in ionising radiation

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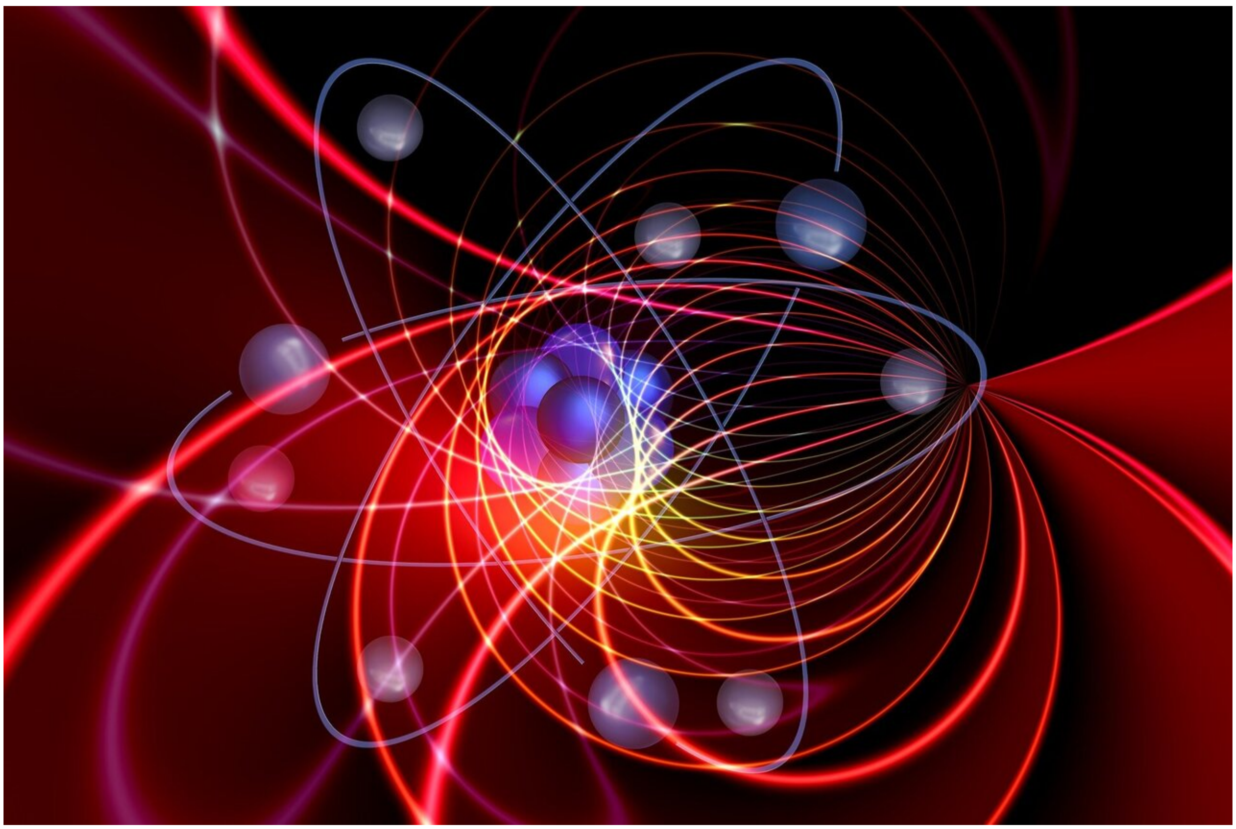

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When living cells are bombarded with fast, heavy ions, their interactions with water molecules can produce randomly scattered 'secondary' electrons with a wide range of energies. These electrons can then go on to trigger potentially damaging reactions in nearby biological molecules, producing electrically charged fragments. So far, however, researchers have yet to determine the precise energies at which secondary electrons produce certain fragments. In a new study published in *EPJ D*, researchers in Japan led by Hidetsugu Tsuchida at Kyoto University define for the first time the precise exact ranges in which positively and negatively charged fragments can be produced.

Through a better understanding of how biomolecules such as DNA are damaged by ionizing radiation, researchers could make important new advances towards more effective cancer therapies. Like molecular bullets, heavy ions will leave behind nanometre-scale tracks as they pass through water; scattering secondary electrons as they deposit their energy. These electrons may then either attach themselves to nearby molecules if they have lower energies, potentially causing them to fragment afterwards; or they may trigger more direct fragmentation if they have higher energies. Since water comprises 70% of all molecules in living cells, this effect is particularly pronounced in biological tissues.

In their previous research, Tsuchida's team bombarded liquid droplets containing the amino acid glycine with fast, heavy carbon ions, then identified the resulting fragments using mass spectrometry. Drawing on these results, the researchers have now used computer models incorporating random sampling methods to simulate secondary electron scattering along a carbon ion's water track. This allowed them to calculate the precise energy spectra of secondary electrons produced during ion bombardment; revealing how they related to the different types of glycine fragment produced. Through this approach, Tsuchida and colleagues showed that while electrons with energies lower 13 electronvolts (eV) went on to produce negatively charged fragments including ionized cyanide and formate, those in the range between 13eV and 100eV created positive fragments such as methylene amine.

**More information:** Hidetsugu Tsuchida et al, Relation between biomolecular dissociation and energy of secondary electrons generated in liquid water by fast heavy ions, *The European Physical Journal D* (2020).
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