'Attosecond' science breakthrough

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Scientists from Queen's University Belfast have been involved in a groundbreaking discovery in the area of experimental physics that has implications for understanding how radiotherapy kills cancer cells, among other things.

Dr Jason Greenwood from Queen's Centre for Plasma Physics collaborated with academics from Italy and Spain on the work on electrons, which has been published in the international journal *Science*.

Using some of the shortest laser pulses in the world, the researchers used strobe lighting to track the ultra-fast movement of the electrons within a nanometer-sized molecule of amino acid. The resulting oscillations – lasting for 4,300 attoseconds (billion-billionths of a second) – amount to the fastest process ever observed in a biological structure.

Dr Greenwood said: "Explaining how electrons move on the nanoscale is crucial for the understanding of a range of processes in matter as it is this charge which initiates many biological, chemical and electrical processes. For instance, the charge produced from the interaction of ionizing radiation with DNA and its subsequent ultra-fast movement can lead to damage of the DNA and cell death which is exploited in radiotherapy to treat cancer. This knowledge is therefore important for understanding the action of radiotherapy beams in cancer treatment.

"Being able to describe how light interacts with electrons on these timescales could also lead to improvements in how light is converted into electricity in solar cells or faster microprocessors which use light rather

than electrical signals for switching transistors.

"This research will hopefully open up the emerging field of attosecond science which seeks to understand how ultrafast electrons play a key role in chemistry, biology and nanotechnology. This is very early research but this new field of ultrafast light-induced electronics is likely to have an impact in biology, chemistry and materials in the next five to ten years. Practical applications down the line may include improvements in cancer radiotherapy, highly efficient solar cells and much faster computer processors."

More information: *Science*, www.sciencemag.org/content/346/6207/336.abstract

Provided by Queen's University Belfast