

## The fast show

### *Extremely short laser pulses can illuminate electrons in motion*

ON THE atomic scale, things move mind-bogglingly quickly. Electrons jump between orbits or escape the nucleus altogether in attoseconds—that is, million, million, millionths of a second. Indeed, one attosecond is to one second what one second is to the age of the universe. Seeing such acrobatics takes wit and ingenuity, but it is possible. Moreover, if such processes could be manipulated—and the early signs are that they can be—then it would have applications in fields as far apart as computing and medicine.

5 A report just drafted by America's National Research Council, "Controlling the Quantum World", outlines how scientists might manipulate the inner workings of a molecule.

10 Two researchers have been able to create pulses a few hundred attoseconds long. Then, they fired their laser at a molecule of deuterium (or heavy hydrogen). The sample became positively charged because zapping it with the laser removed one of the electrons. The molecule then separated into a deuterium atom and a deuterium ion.

15 Using conventional laser pulses causes atoms and ions to be ejected to the right and left at random. Using ultrafast laser pulses, though, makes the atoms fly off to the right and the ions to the left. The researchers were thus able to separate atoms and ions.

20 Exactly how this works is complicated but the ability to manipulate electrons in this way is important because electron-sharing is essential to chemical bonding. Ultrafast lasers could thus be used to change the outcome of chemical reactions. The motion of electrons is the fundamental basis of chemistry. Watching the steps in the dance of the electrons will help chemists work out why some atoms bind when others do not, why reactions take the time that they do, and why some molecules bend one way and not the other.

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### Vocabulary :

- Mind-bogglingly quickly : moves so quickly it cannot be understood by humans minds
- At random : without definite purpose
- Outcome : result

### Questions:

1. Present the text, and sum it up in your own words.
2. With your own words, explain what a "*molecule of deuterium*" is (line 10) and its behavior when it is submitted to the ultra-fast laser pulse.
3. How do you understand the sentence "*because electron-sharing is essential to chemical bonding*" (line 17) and "*The motion of electrons is the fundamental basis of chemistry*" (lines 18/19)
4. Is it important to know "*why reactions take the time that they do*" (lines 20/21) ? How do we call this part of chemistry ? What did you learn about it ?
5. Do you like Chemistry ?