Electrons used to control ultrashort laser pulses

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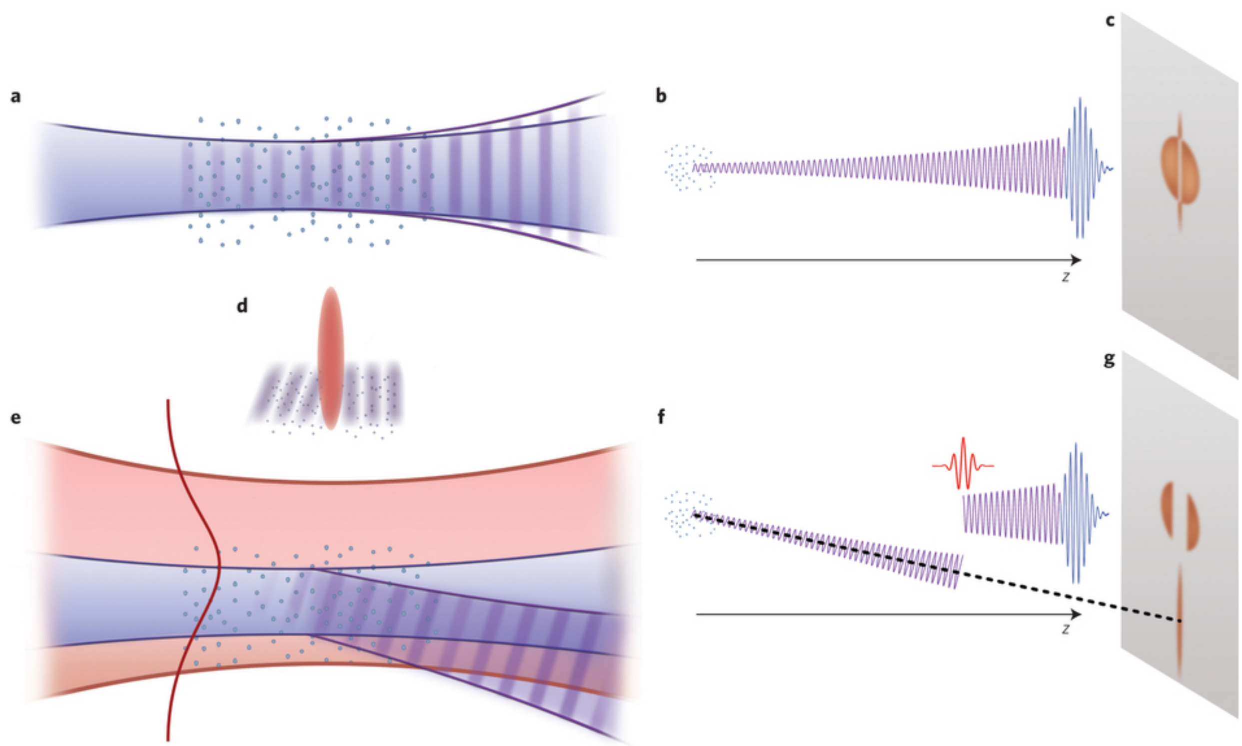

Schematic illustration of XFID radiation control. Credit: *Nature Photonics* (2017). DOI: 10.1038/nphoton.2017.30

We may soon get better insight into the microcosm and the world of electrons. Researchers at Lund University and Louisiana State University have developed a tool that makes it possible to control extreme UV light - light with much shorter wavelengths than visible light. The new method uses strong laser pulses to direct the short bursts of light.

Something very exciting happens when light hits electrons: they start to move, and when they do that they reemit the light again. The electron, which is very small, can easily follow the fast light oscillations. However, reemitting the light takes some time, and during that time the electrons can be controlled so that they emit the light in a different direction.

"This means we can control the properties of the light, for instance change the direction, change the pulse duration, split the light or focus it, " says Johan Mauritsson.

Since he and his colleagues control the electrons with another laser pulse, is it possible to precisely control the timing between the two pulses - and set it to exactly what they want it to be.

"What makes this field of research so interesting is that we still do not know exactly what happens when light hits a material. What is, for example, the first thing that happens when sunlight hits a flower? We do not know all the details", says Johan Mauritsson, researcher in the field of attosecond science at Lund University in Sweden.

Yet it isn't that strange that many details are still unknown. You cannot probe shorter time intervals than the time it takes for the light to make one oscillation. This makes it impossible to use visible light to follow electron dynamics, since one oscillation takes about 2 femtoseconds, or 10-15 seconds. During that time, the electron circles the nuclei more than 13 times. We therefore need light that oscillates much faster, i.e. with shorter wavelengths.

This technique to control the light is new and there is still a lot to improve.

"Right now we are working on improving the time resolution with various experiments with XUV light, for instance for free electron lasers . However, our main focus is developing the technique so we can learn more about the light/electron interaction. But who knows, in 50 years we may all be using ultrafast optics in our everyday lives", concludes Samuel Bengtsson, PhD student in atomic physics.

More information: S. Bengtsson et al. Space–time control of free induction decay in the extreme ultraviolet, *Nature Photonics* (2017). DOI: 10.1038/nphoton.2017.30

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