# Ultrashort light pulse blazes new paths for science, industry

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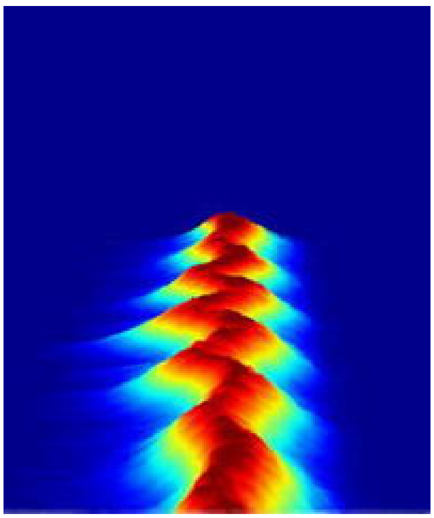

Light pulses lasting just 130 attoseconds offer possibilities for unlocking secrets of atoms and molecules. Credit: National Laboratory for Ultrafast and Ultraintense Optical Science in Milan, Italy

Researchers in Italy have created an ultrashort light pulse—a single isolated burst of extreme-ultraviolet light that lasts for only 130 attoseconds. Their achievement currently represents the shortest artificial light pulse that has been reported in a refereed journal.

Shining this ultrashort light pulse on atoms and molecules can reveal new details of their inner workings—providing benefits to fundamental science as well as potential industrial applications such as better controlling chemical reactions.

Working at Italy's National Laboratory for Ultrafast and Ultraintense Optical Science in Milan (as well as laboratories in Padua and Naples), the researchers believe that their current technique will allow them to create even shorter pulses well below 100 attoseconds. Results will be presented in Baltimore at CLEO/QELS, May 6 – May 11.

Whereas humans perceive the world in terms of seconds and minutes, the electrons in atoms and molecules often perform actions on attosecond time scales. How short is this? 130 attoseconds is to one second as a second is to approximately 243 million years—roughly the time that has passed since the first dinosaurs walked the Earth. Aiming a human-made attosecond-scale light pulse on atoms and molecules can trigger new effects in electrons—which are responsible for all chemical reactions—and provide new details on how they work.

In previous experiments, longer pulses, in the higher hundreds of attoseconds, have been created, and the general process is the same. An intense infrared laser strikes a jet of gas, usually argon or neon. The laser’s powerful electric fields rock the electrons back and forth, causing them to release a train of attosecond pulses consisting of high-energy photons in the extreme ultraviolet or soft x-ray part of the spectrum.

Creating a single isolated attosecond pulse, rather than a train of them, is more complex. To do this, the researchers employ their previously developed technique for delivering intense short (5 femtoseconds, or millionths of a billionth of a second) laser pulses to an argon gas target. They use additional optical techniques (including ones borrowed from the research that won the 2005 Nobel Prize in Physics) for creating and shaping a single attosecond pulse.

These isolated attosecond pulses promise to probe electron phenomena such as "wavepackets"—specially tailored electron waves inside atoms and molecules that may help scientists use lasers to change the course of chemical reactions for scientific and practical uses, such as controlling the breaking of bonds in complex molecules for medical and pharmaceutical applications.

Source: Optical Society of America

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