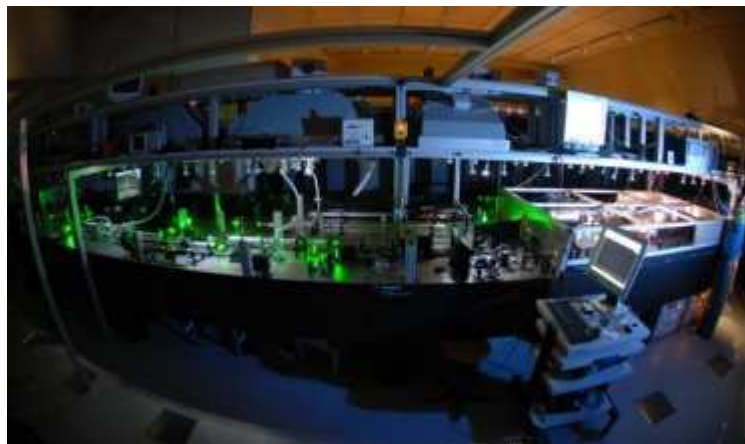

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NEWS

Jul 8, 2008

FROG reaches the attosecond scale

Sub-100 attosecond pulses can be characterized thanks to a new frequency-resolved optical gating algorithm.

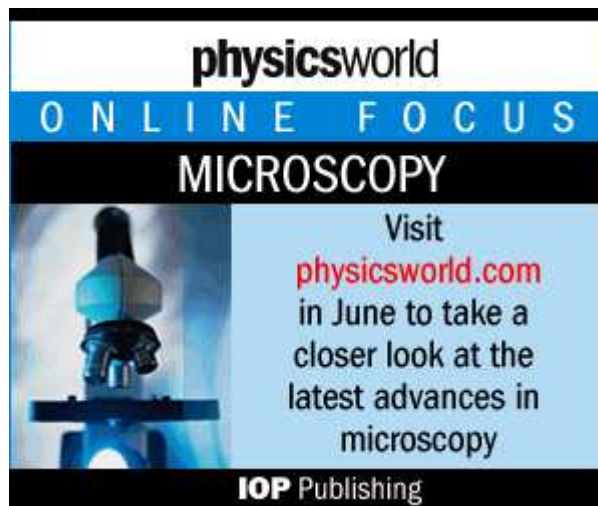


Attosecond FROG lab

Researchers in Germany have developed a new FROG retrieval method for characterizing the electric field of attosecond pulses. The technique works by analysing attosecond streaking measurements and could be used to probe numerous physical phenomena that occur on the attosecond timescale (*Applied Physics B* **92** 25).

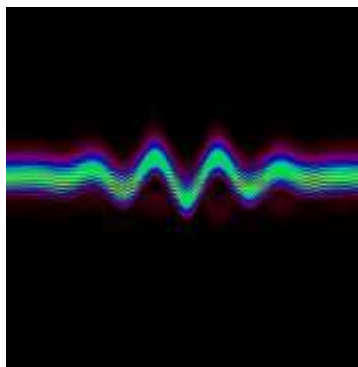
"Conventional FROG (frequency-resolved optical gating) algorithms lose their accuracy when we try to characterize shorter pulses," Justin Gagnon of the Max Planck Institute for Quantum Optics in Garching told *optics.org*. "But ours retains its accuracy and robustness no matter how short (or broadband) the XUV pulse."

No electronic device is fast enough to record the electric field of ultrashort attosecond (10^{-18} s) pulses. Researchers therefore rely on less direct techniques, such as attosecond streaking spectroscopy, to characterize these fields.



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Attosecond streaking spectroscopy measures streaked electron kinetic energy spectra by photoionizing an atom with an attosecond XUV pulse in the presence of an infrared laser field. By varying the delay between the XUV and IR pulses, a sequence of streaked spectra, known as a streaking spectrogram, is obtained.



Streaking spectrogram

This spectrogram contains complete phase and amplitude information about the XUV and IR field that can be extracted using FROG retrieval. "Extracting phase information from the spectrogram is an example of a 2D phase retrieval problem, known to possess a solution," explained Gagnon. "By applying alternating constraints between the frequency and time domains, the FROG retrieval algorithm can identify the XUV and IR pulses that reproduce the measured spectrum."

The new technique is able to characterize pulses that last just 80 as, compared with the 130 as achieved by previous researchers. Gagnon and co-workers have also optimized FROG retrieval and have established the range of experimental parameters for which this technique can be used.

Attosecond pulses are essential tools that will allow us to probe physical phenomena occurring on the attosecond timescale, said Gagnon. These include electron dynamics in atoms, molecules and metal surfaces, Auger decay and autoionization. Attosecond streaking spectroscopy can be used to glean information about electron wave packets in such processes because a streaking spectrogram contains information about the time-related behaviour of these wave packets – and therefore

time-related information about the attosecond process itself.

"We now hope to find new ways of 'decoding' these spectrograms," added Gagnon.

Author

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