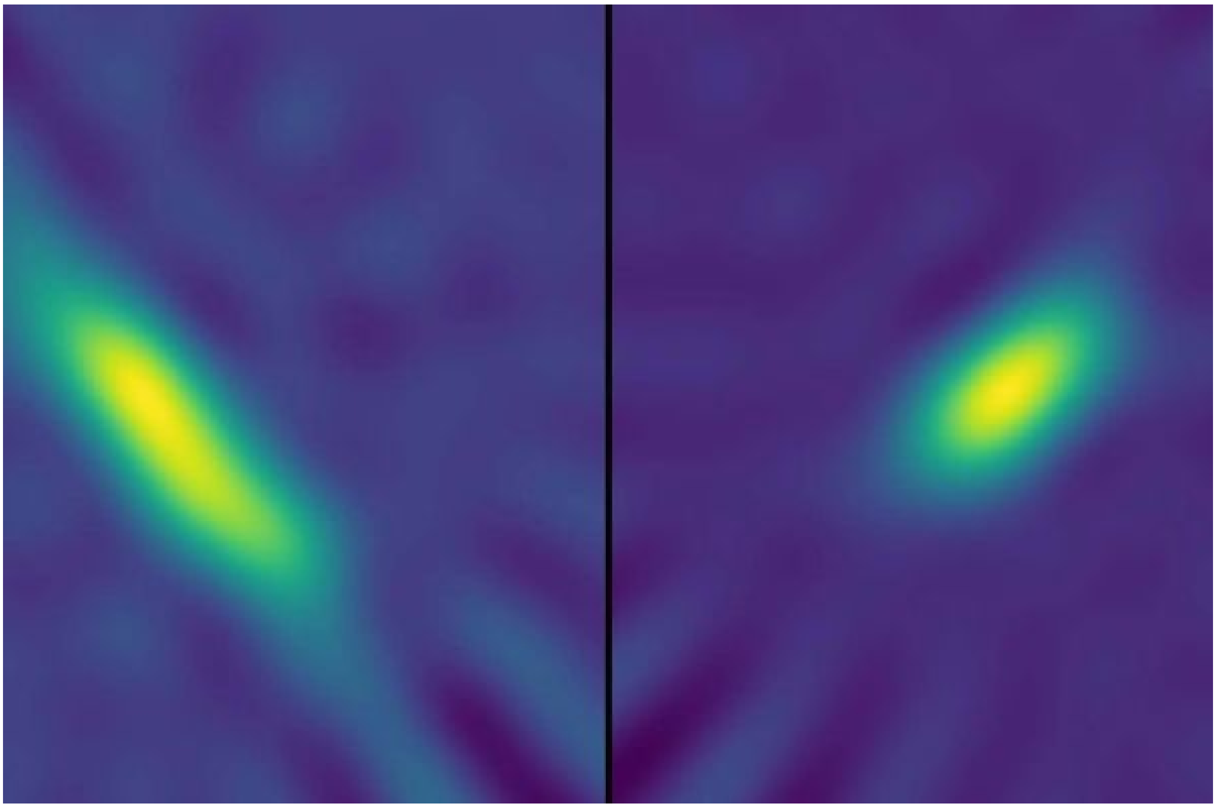

Shaping and reconstructing quantum harmonics

Researchers at ICFO have proposed a novel protocol called Attosecond Quantum Interferometry (AQI) to both tune and reconstruct the quantum features of light emitted through high harmonic generation, even in regimes where conventional methods reach their limitations. The protocol, recently published in Reports on Progress in Physics, performs in-situ attosecond measurements of quantum properties of light, further bridging the fields of attoscience and quantum optics.

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High harmonic generation (HHG), a highly non-linear phenomenon in which a system (for example, an atom) absorbs many photons from an incoming laser and emits a single photon of much higher energy (a harmonic of the absorbed photons), was long thought to only produce classical light. Recent discoveries, in contrast, have shown that it is also possible to produce photons with quantum features, such as squeezing and entanglement. Yet controlling and analyzing these remains far from trivial.

Researchers at ICFO, **Dr. Javier Rivera-Dean**, **Lidija Petrovic**, **Prof. Dr. Maciej Lewenstein**, and **Philipp Stammer**, have introduced a new approach to control the quantum state of light in the process of high-harmonic generation. Published in Reports on Progress in Physics, the proposed scheme allows researchers to extract and tune the quantum characteristics of the harmonics in the XUV regime, where conventional methods reach their limitations. ?
The approach drives the high-harmonic generation by mixing a strong laser field with quantum (instead of the traditional classical) light source that exhibits squeezing. By varyin the phase delay between the laser and the quantum source, the researchers can shape th quantum signatures of the emitted harmonics. The same technique can also be used t reconstruct their quantum state (a process known as quantum state tomography), recoverin the quantum imprints on the harmonics; an approach they have named ï¿½attosec
nd quantum tomographyï¿½ (
QT). This discovery could be applied in scenarios where conventional tomography schemes ail, such as when the generated harmonics have XUV frequencies. ï¿½This is because in s andard tomography the experiment is limited by the wavelength and intensity of the stat to be reconstructed, so the short wavelength of XUV light becomes a big limitation,ï¿½ explains Philipp Stammer, lead researcher of the article. ï¿½In AQT, there is no strict limit ecause the reconstruction is done in a fundamentally different way, using the non-linear H G dynamics
itself.ï¿½ This conceptually new approach, which completely merges HHG with quantum ptics, could help combine attosecond temporal resolution with genuinely non-classical l

Reference:
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