ATTOSECOND CLOCKING AND CONTROL OF STRONG FIELD QUANTUM TRAJECTORIES

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Nearly thirty years ago, a simple and intuitive unified view of intense laser-atom interactions was introduced. The model is based on a semi-classical description where a bound electron is tunnel ionized by the strong optical field, followed by propagation under the influence of the strong field and finally driven back to interact with the core. This simple view has become known as the three-step or rescattering model and is responsible for the production of high energy electron & photons, multiple ionization and the formation of attosecond light pulses. The coherent process is defined by initial conditions set by tunnel ionization which defines the physical observables for the subsequent steps.

Feynman has taught us that the outcome of a quantum process is dictated by the sum over all the quantum trajectories that contribute to it. Naturally, when analyzing experiments, we often refer to these individual trajectories even though they have not been measured individually. In this talk, we introduce a Quantum Trajectory Selector (QTS) method capable of resolving individual quantum orbits responsible for strong-field phenomena in real time. Using an attosecond XUV pulse, we select the moment of ionization and measure the rate for both rescattered electron emission and double ionization driven by a phase locked near infrared field. We show that there is an intensity-dependent shift in the ionization time associated with double ionization, and we clock this shift as it varies by 250 as. The QTS provides a new attosecond paradigm for expanding our understanding of recollision-driven physics.

Biography

Louis F. DiMauro is Professor of Physics and Hagenlocker Chair at the Ohio State University. He received his BA (1975) from Hunter College, CUNY and his Ph.D. from University of Connecticut in 1980 and was a postdoctoral fellow at SUNY at Stony Brook before arriving at AT&T Bell Laboratories in 1981. He joined the staff at Brookhaven National Laboratory in 1988 rising to the rank of senior scientist. In 2004 he joined the faculty at The Ohio State University.

He was awarded 2004 BNL/BSA Science & Technology Prize, 2012 OSU Distinguish Scholar Award, the 2013 OSA Meggers Prize and the 2017 APS Schawlow Prize in Laser Science. He is a Fellow of the American Physical Society, the Optical Society of American and the American Association for the Advancement of Science. He is currently the Director of the Institute for Optical Science and co-Director of the NSF NeXUS facility and the OSU Chemical Physics graduate program. He has served on numerous national and international committees, government panels, served as the 2010 APS DAMOP chair, vice-chair of the NAS CAMOS committee and currently serves on the NAS Board of Physics and Astronomy. His research interest is in experimental ultra-fast and strong-field physics. In 1993, he and his collaborators introduced the widely accepted semi-classical model in strong-field physics. His current work is focused on the generation, measurement, and application of attosecond x-ray pulses, study of fundamental scaling of strong field physics and application of x-ray free electron lasers.