

The Center for Advanced Photonics Research

LASER SCIENCE SEMINAR SERIES

"Visualizing and Controlling Picometric Quantum Ripples in Molecules"

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The wave-particle duality is at the heart of the quantum world. The quantum world is, however, not yet fully understood, and considerable potential for its application still exists. We are trying to control completely the quantum waves in atoms and molecules with light to better understand the quantum world. Improved understanding of the quantum world will result in the development of novel quantum technologies such as single-molecule information processing and ultrahigh-precision bond-selective chemistry. We have so far developed a high-precision quantum interferometer by exquisitely tuning the oscillations of two quantum waves on the attosecond time scale (atto = 10⁻¹⁸) [1-3]. We have also succeeded in visualizing such quantum interference with picometer and femtosecond spatiotemporal resolutions (pico = 10⁻¹²; femto = 10⁻¹⁵) [4]. Our high-precision quantum interferometer has been applied to the tests of quantum theory and molecule-based information processing [1, 2, 5].

[1] H. Katsuki, K. Hosaka, H. Chiba and K. Ohmori, "READ and WRITE Amplitude and Phase Information by Using High-Precision Molecular Wave-Packet Interferometry", Phys. Rev. A 76, 013403 (2007).

[2] K. Ohmori, H. Katsuki, H. Chiba et al., "Real-Time Observation of Phase-Controlled Molecular Wave-Packet Interference", Phys. Rev. Lett. 96, 093002 (2006).

[3] K. Ohmori, Y. Sato, E.E. Nikitin, and S.A. Rice, "High-Precision Molecular Wave-Packet Interferometry with Hg-Ar Dimers", Phys. Rev. Lett. 91, 243003 (2003).

[4] H. Katsuki, H. Chiba, B. Girard, C. Meier, and K. Ohmori, "Visualizing Picometric Quantum Ripples of Ultrafast Wave-Packet Interference", Science 311, 1589 (2006).

[5] Y. Teranishi, Y. Ohtsuki, K. Hosaka, H. Chiba, H. Katsuki, and K. Ohmori, "Implementation of quantum gate operations in molecules with weak laser fields", J. Chem. Phys. 124, 114110 (2006).

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