Recent progress on attosecond science at RIKEN

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Abstracts: *We have been developing two types of intense attosecond beam lines for investigating attosecond wavepackt dynamics in atoms and molecules. One produces an attosecond pulse train for attosecond Fourier transform spectroscopy by attosecond-pump/ attosecond-probe scheme, while the other produces an intense isolated attosecond pulse for attosecond nonlinear optics.*

Firstly, a high-power attosecond pulse train (ATP) beamline has been upgraded by introducing 100 Hz 12 fs 50 mJ Ti:sapphire laser as a pump source and a velocity map imaging spectrometer. Using this beamline, we have implemented attosecond Fourier transform spectroscopy with attosecond pulse trains for observing ultrafast quantum wavepacket dynamics in diatomic molecules [1, 2]. We use attosecond-pump/ attosecond-probe scheme to measure the electronic and vibrational response of diatomic molecules in the intrinsic timescale of electrons. Our attosecond light source, a-few-pulse attosecond pulse train with a moderate spectral bandwidth, is a unique device for measuring ultrafast quantum dynamics in a molecule because it allows us to achieve sufficiently high intensity for performing attosecond-pump/ attosecond-probe measurements with moderate statistics and a sufficiently high spectral resolution for identifying the relevant states.

Secondly, an intense isolated attosecond beam line [3] has also been improved. The main pump source of the beam line is a CEP-stabilized high energy Ti:sapphire laser [4] operating at 10 Hz, with multi-TW peak power and 25-fs duration. Our two-color waveform synthesizer for generating an isolated attosecond pulse consists of a Ti:sapphire laser pulse (44 mJ, 28 fs, 0.8 μm) and an infrared OPA pulse (6 mJ, 33fs, 1.35 μm), which is pumped with a part of the Ti:sapphire pump pulse. The relative delay jitter of both constituent pulses is precisely suppressed to 360 as rms by an active feedback, and directly monitored with out-of-loop by a balanced optical cross-correlator. The two-color pulse energy reaches 50 mJ, which is sufficient for generating an isolated attosecond pulse with micro-joule class energy.

References

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