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Accurate retrieval of atomic structures from high-order harmonic spectra

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Synopsis We extracted the photorecombination cross sections from the high-order harmonic spectra generated from rare gases by intense femtosecond pulses. By taking the ratio between the observed high-order harmonic spectra and recolliding electron wave packets, we successfully obtained the photorecombination cross sections.

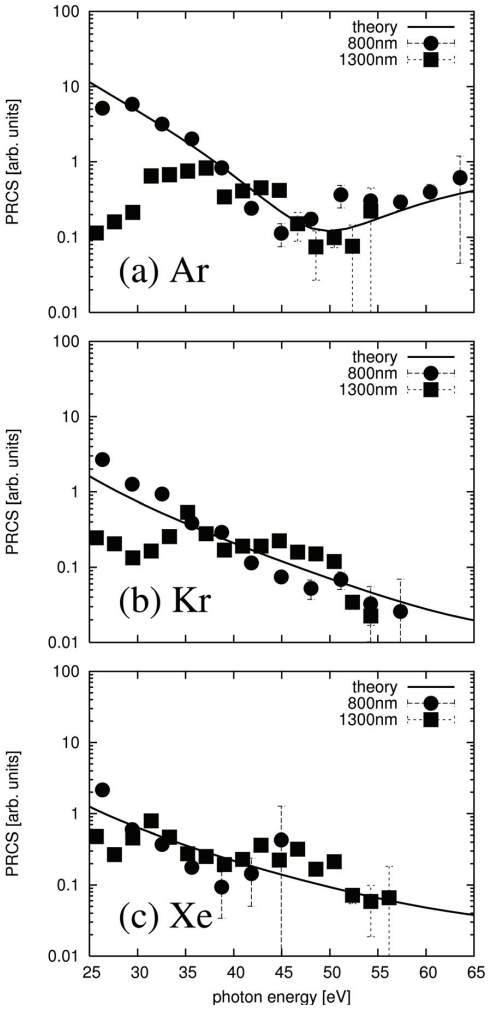

Fig. 1. Photorecombination cross sections of (a)Ar, (b)Kr and (c)Xe. Circles and squares represent the cross sections extracted from experimental spectra with 800 and 1300nm-wavelength pulses, respectively. Solid curves are theoretical cross sections with a single active electron model.

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We extracted the photorecombination cross sections from the high-order harmonic spectra generated from rare gases by intense femtosecond pulses [1]. The high-order harmonic spectra $S(\omega)$ can be expressed as

$$S(\omega) = \sigma(\omega)W(E), \qquad (1)$$

where $\sigma(\omega)$ is the photorecombination cross section, and $W(E)$ is the recolliding electron wavepacket [2]. We extract the photorecombination cross sections by taking the ratio between the observed high-order harmonic spectra and the calculated wavepackets. Since the energy distribution of the wavepacket does not depend on the target atoms, we calculate the wavepackets by solving the time-dependent Schrödinger equation for the scaled hydrogen atoms with the effective charges chosen such that their 1s binding energies are the same as the 3p, 4p and 5p ones of Ar, Kr and Xe, respectively. In Figure 1, we compare the extracted photorecombination cross sections with the theoretical ones using the single active electron model. One can see that the extracted photorecombination cross sections reasonably agree with the theoretical curves.

We will also present theoretical results for extracting the information of molecular targets.

References

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[2] T. Morishita et al., 2008 *Phys. Rev. Lett.* **100**, 013903.