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Generation of isolated attosecond pulses with double optical gating and electronic dynamics in molecules studied via attosecond pump-probe experiment

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Single isolated attosecond pulses are useful tools for studying electron dynamics. Previously, such as pulses can be generated by few cycle 5 fs driving lasers. It is still a technical challenge to reproduce daily such pulses. In order to allow longer driving laser pulses, two optical gating methods of polarization gating and two-color gating are combined. This approach is dubbed double optical gating. Due to less depletion of the ground state population by the leading edge of the field, this technique can produce isolated 250 as pulses using up to $\sim$25 fs driving laser pulses. Also, the supercontinuous spectra (28-620 eV) can in principle support a 16 as pulse duration, obtained from 8 fs driving lasers. Because of the relaxation on the driving laser requirements, more laboratories can enter the isolated attosecond pulse science field. Pump-probe experiments with such isolated attosecond pulses and IR pulses can provide quantitative information on electronic dynamics. In recent work, the photoelectron spectra of sulfur hexafluoride (SF_6) clearly indicates the precise shape of the IR driving pulse (1.5 eV), verifying that isolated $\sim$400 as pulses (93 eV) are achieved and these pulses produce an instantaneous inner valence ionization in the molecule. The pump-probe spectra of cation fragments resulting from double and triple ionization show 6-7 fs rise times (SF_4^{2+}, SF_3^{2+}, SF_2^{2+} and S^{2+}) or decay times (SF^+ and S^+) times governed by the overlap of the IR and XUV pulses. A suppression or enhancement of certain fragmentation channels is tentatively interpreted as resulting from the IR laser exciting the initial cations to higher states that exhibit different decay channels. This type of pump-probe experiment with isolated attosecond pulses is powerful for the study of electronic dynamics as well as resulting nuclear fragmentation measurements.