Highlight LIED: Laser-induced electron diffraction as a probe of charge resonance enhanced ionization

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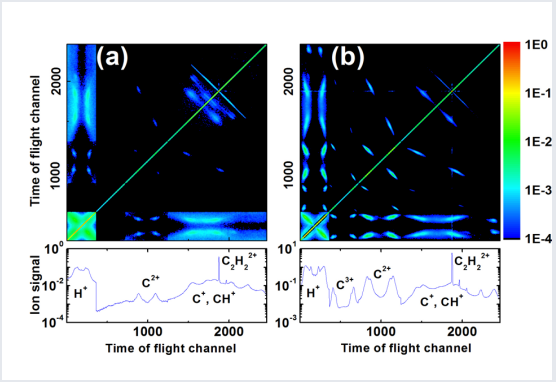
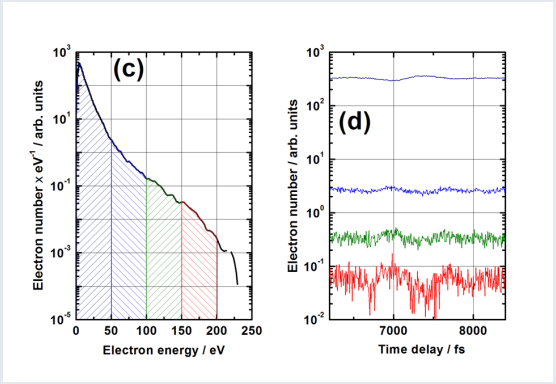
In laser-induced electron diffraction (LIED), low-energy direct and rescattered electron waves may interfere while the high-energy spectrum comes only from rescattering. We take benefit from this property to isolate the electrons from charge resonance enhanced ionization (CREI). In the 1990s, CREI was identified to lead to a noticeable increase of the molecular charge state prior to Coulomb explosion with a moderate increase of the laser intensity [Figures (a) & (b): Ion spectra & covariance maps at 10^{14} & 3×10^{14} Wcm^{-2}]. The associated electron emission remains difficult to deal with because CREI is part of an overall multielectron ionization, where the initial step of single ionization of neutral species dominates the electron spectrum [Figure (c): Electron energy < 50 eV].





Using the high-energy rescattered electrons from LIED [Figure (c): Electron energy > 100 eV], we show that it is possible to address the electron signal from CREI without any contribution from other electron signals. The electrons from CREI are preferentially emitted when the molecular axis is parallel to the laser electric field. Acetylene was chosen for demonstration purpose because single ionization, which is not related to CREI, is more pronounced when the C_2H_2 molecular axis is perpendicular to the laser electric field. Following impulsive alignment, the revivals of the electron signals from CREI [Figure (d): Lower curves] vary in opposition with the revival of single ionization [Figure (d): Upper curve] giving thus the spatial signature of the CREI electronic dynamics.

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