Controlling Quantum Wave Packet of Electronic Motion on Field-Dressed Coulomb Potential of H_2^+ by Carrier-Envelope Phase-Dependent Strong Field Laser Pulses

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Abstract

Solving numerically a non-Born-Oppenheimer time-dependent Schrödinger equation to study the dissociative-ionization of H_2 subjected to strong field six-cycle laser pulses ($I = 4 \times 10^{14}$ W/cm^2, $\lambda = 800$ nm) leads to newly ultrafast images of electron dynamics in H_2^+. The electron distribution in H_2^+ oscillates symmetrically with laser cycle with $\vartheta + \pi$ periodicity and gets trapped between two protons for about 8 fs by a Coulomb potential well. Nonetheless, this electron symmetrical distribution breaks up for the H_2^+ internuclear separation larger than 9 a.u. in the field-free region at a time duration of 24 fs as a result of the distortion of Coulomb potential where the ejected electron preferentially localizes in one of the double-well potential separated by the inner Coulomb potential barrier. Moreover, controlling laser carrier-envelope phase ϑ enables one to generate the highest total asymmetry A_e^{tot} of 0.75 and -0.75 at 10^* and 190^*, respectively, associated with the electron preferential directionality being ionized to the left or the right paths along the H_2^+ molecular axis. Thus the laser-controlled electron slightly reorganizes its position accordingly to track the shift in the position of the protons despite much heavier the proton's mass.

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