Temporal control of electronic ionisation in double well quantum systems with a strong high intensity high frequency laser field

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In this work, the motion of electrons in a double-well quantum dot is controlled using an oscillating electric field. Time-independent Kramers-Hennerberger calculations have been done to estimate oscillating electric field intensity and frequency parameters, at which the localization happens. At a particular intensity and frequency of electric field, both of the electrons get stabilized on top of the double well barrier. The energy is minimized at a particular value of the classical quiver distance, $\alpha_0=E_0/\omega^2=4.7525$ scaled Hartree units, here E_0 is the electric field strength and ω is frequency. Time-dependent and time-independent calculations have been done for that α_0 value of the artificial atom. Higher order frequency dependent time-independent terms have been calculated to estimate the electric field frequency to probe the system. Oscillating electric field parameters for the barrier localization of a double-well GaAs quantum dot occurs at the frequency ω = 43894.9 cm^{-1} in the deep ultra-violet range and on electric field strength of $E_0 = 2.00153\times10^5$ V/m. Shannon information entropies of FCI density in position space , momentum space and total entropic sum $S_T = S_\rho + S_\gamma$ have been calculated for different α_0, here $\rho(r)$ is the position space electron density and $\gamma(p)$ is conjugate momentum density. This calculation shows that S_T goes to a minimum and increases as α_0 value increases and the minimum in S_T = 10.278 a.u. is achieved from where the minimum in energy is achieved and it starts increasing as energy increases. This minimum in total entropy sum is a representation of a minimum uncertainty state. The time-dependent Hamiltonian has been solved with $\sin^2$ pulse and it becomes a cw electric field when t = t_{cw} oscillating electric field pulse for the time-evolution of configuration state functions (CSF) coefficients. In presence of the AC field the two quantum dots will behave as if they are a single unit and both electrons will be localized in an oscillating electric field with a long life time, as long as the CW profile of the pulse is on. Switching off the AC field leads to a single electron ionisation at the temporal edge of the pulse. Temporal control of the ionisation is hence achieved by changing the pulse width. This expected to be general and applicable to diatomic molecules as well.