Quantum Dynamical Study of Ionization and Stabilization in a Circularly Polarized Intense Laser Field

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We perform a theoretical and computational study of the quantum dynamics of the electron in the hydrogen atom subjected to a circularly polarized intense laser field. As the laser intensity is increased from a low value, the initial electron wave packet shows an increasingly strong tendency to spread and become delocalized. In this regime, the ionization rate is found to increase rapidly with the laser intensity. As the laser intensity is further increased beyond a certain critical value, the wave packet begins to show a tendency to localize around the core region. When this happens, the ionization rate stops increasing with respect to the laser intensity and stabilization of ionization results.

Physical interpretation of the stabilization of ionization can be provided by the Floquet theory. Husimi plots of the Floquet states indicate that the wave packet localization and the subsequent stabilization are accompanied by 'sharp' avoided crossings between a scarred state localized along unstable periodic orbits embedded in a large chaotic sea and a delocalized state. On the other hand, the wave packet delocalization and a subsequent increase of the ionization rate with respect to the laser intensity are characterized by 'broad' avoided crossings between delocalized Floquet states.