Double-Slit Interference in the Ion Dynamics of Dissociative Photoionization

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The ion momentum distribution in the x-ray-induced dissociative photoionization of molecules is investigated, treating the ionization analytically under the Born-Oppenheimer approximation and simulating numerically the ion motion via the Schrödinger equation. The ion-photoelectron entanglement transfers information of the electronic interference to the ion dynamics. As a consequence, the ion momentum distributions of dissociative molecular photoionization present Young's double-slit interference when the photoelectron emission angle is fixed. We demonstrate that double-slit interference signatures persist in the ion longitudinal momentum shift even when the information of the correlated photoelectron is lost, which is the case for heteronuclear molecules when an additional photoelectron recoil momentum arises due to the different ion masses. For the case of sequential double ionization, we show that double-slit interference in the ion dynamics can be utilized for coherent control of the molecular dynamics.

References

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