Double Ionization of Alkaline Earth Atoms via Non-Sequential Mechanism Using Near-Single Cycle Laser Pulses in a Linearly Polarized Field

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In our study, we introduce an analytical model devised to examine the multifaceted non-sequential double ionization (NSDI) dynamics triggered by electron-electron correlation in alkaline earth atoms under the influence of an 800 nm laser pulse. This model is distinctively characterized by meticulously incorporating all the salient interactions between the electrons and the laser field. It offers a novel perspective that is imperative for grasping the electron behaviors involved. This region garners interest due to the necessity of laser radiation in facilitating the complex interactions that eventually lead to a doubly charged ion formation [1]. One of the salient features of our model is its capacity for time-resolved analysis, providing invaluable insights into the complex dynamics of NSDI from inception to culmination. With this time-resolved capability, we can trace the evolution of electronic states, shedding light on how electron-electron correlations mold the course of NSDI.

An exhaustive and systematic analysis was conducted, encompassing an array of simulations and parameter explorations. The findings underscore that NSDI is principally orchestrated by combining single ionization and subsequent recollision events. This revelation is critical to demystifying the microscale mechanisms. Furthermore, our study illuminates the attosecond dynamics of electron correlation during NSDI. The attosecond timescale is particularly important as it aligns with the natural timescale of electron movement in atoms and molecules. Gaining insights into these dynamics could pave the way for manipulating electron motion, which holds promising applications in attosecond spectroscopy [2], controlling chemical reactions [3], and could provide impetus to advancements in quantum computing technologies [4].

References

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