Quantum control by laser-induced conical intersections

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A few years ago we have started a systematic study of the nonadiabatic effect induced by laser waves in diatomic molecules. It has been shown that light-induced conical intersections (LICIs) can be formed in a molecular system either by standing or by running laser waves[1,2]. The energetic and internuclear positions of these CIs depend on the laser frequencies while the strength of their nonadiabatic couplings can be modified by the field intensities. The impact of these LICIs on different dynamical properties of the diatomics has been discussed in several papers[1-7].

Wave packet calculations have been performed for Na_2 dimer which demonstrate that LICIs exert strong effects on the quantum dynamics even for weak laser fields. The impact of LICIs on another process of interest has also been studied, namely on the spatial alignment of diatomics in fields of moderate intensity (~10^8-10^{10} W/cm^2). An important message is that LICIs can substantially influence molecular alignment. Calculating the population on the first excited electronic state of aligned molecules, there is a large difference between the results obtained in the presence of the LICI and those obtained by employing the "standard rigid rotor" one dimensional model. Since the electronic population is a relevant measurable quantity, we hope that our work concerning the molecular alignment will stimulate experimental investigations in the near future.

The photodissociation dynamics of the D_2^+ molecule in an intense laser field has also been studied. The results obtained undoubtedly demonstrate the strong impact of the coupling of the rotation to the vibrational and electronic motions and hence of the LICI on the dissociation dynamics of the D_2^+ molecule.

References

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