THE MODIFIED MAGNUS APPROXIMATION FOR IONIZATION IN ATTOSECOND PULSES

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In the limit of very short duration, a half-cycle pulse delivers an impulsive kick to an atomic electron. The simplest approximation applicable in this case is the first Magnus approximation (FMA) [1]. In FMA the transition amplitude from an initial to a final state reduces to the boost matrix element involving the momentum transfer delivered to the electron by the field.

With increase of momentum transfer, the atomic system is eventually fully ionised. However, in the case of a one-cycle pulse, the numerical results indicate that the ionisation after the first half cycle is largely reversed by the second half cycle, i.e. the population in the continuum recombines into the initial state [2]. The periodic occurrence of ionization and recombination in time can persist for several cycles of the field depending on the momentum transfer and the half-cycle duration [3] A pulse with constant envelope consisting of even number of half cycles gives zero transition probability in FMA. However, numerical results show less than 100 per cent recombination.To overcome this shortcoming, a modified FMA (MMA) has been proposed [2,3], where the propagation in the atomic field between the half cycles is included. The analytic expressions for the transition probabilities obtained with the MMA are in excellent agreement with the numerical results for all momentum transfers [2,3]. In this talk I discuss the extension of the above approach to include attosecond pulses with arbitrary envelopes and to describe many-electron atomic systems, where electron repulsion effects in the continuum must be taken into account. Finally the similarities and differences of applying the MMA to ionisation by charged particles will be discussed.

References

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