A quantum concept of attosecond pulses: the attoquant.

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Abstract. The basic constituents of attosecond light pulses are the high-order harmonics generated by intense laser fields during the interaction with various material targets, like e.g. rare atom gas jets. In the simplest picture the different harmonics are emitted during the recombination of highly excited electrons of different but "synchronized" atoms. Thus, one may assume a regular phase relation between the harmonics, and their classical Fourier synthesis results in attosecond pulse trains. In the present talk we shall discuss the emergence of attosecond pulses from the point of view of quantum optics. The reason for this is that the mentioned recombination is in fact a spontaneous emission process, and it is far not trivial how can one understand the locking of the different harmonic components. According to our theoretical study, the process of collective emission yields entangled quantum states for the sequences of harmonics, which we call "attoquants". These are symmetric entangled coherent states of the emitted many-mode optical radiation, for which even a random distribution of the phases results in a locking of the temporal Fourier components. We shall present some characteristics of such entangled states, and offer a possible quantum optical interpretation of the generation of attosecond pulses.

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