Comment on entangled two-photon absorption in molecules.

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A possible physical explanation is proposed for the large difference in the results of experimental studies of entangled two-photon absorption (ETPA) in molecules.

Two-photon absorption in molecules usually occurs at a very high intensity of radiation. In a number of experiments, it was found that a similar two-photon absorption of entangled photons can effectively occur at a much lower radiation intensity (up to six orders of magnitude) [1–5]. This is very attractive for a number of practical applications. However, in a number of other similar experiments, only a slight superiority of the entangled two-photon absorption was observed, or it was not observed at all [6-8]. The reason for these differences is unclear. The purpose of this comment is to suggest a possible physical explanation for these differences.

Forward and reversed into the initial state processes are not equivalent in quantum physics [9]. The latter have a very large differential cross section. The absorption of entangled photons by molecules is such a reversed (or partially reversed) process. Its differential cross section depends on the initial state of the macro-quantum system. It depends on the method of formation of entangled photons, on the distances, on the size and design of the experimental setup. Theorists call this contextuality [10, 11]. This contextuality is not taken into account or controlled in the discussed experiments. This is a possible physical reason for the difference in the results of seemingly similar experiments.

It is also important here the properties of the memory of macro quantum systems about their initial state. We are probably dealing with non-local memory. However, the nonlocality of memory of macro quantum systems is much easier to study on simpler objects. An example of such a simple object is the interference of photons (photon) on a beam splitter [12, 13]. Unfortunately, these simple experiments have not yet been carried out.

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