DISCUSSION

Response to the Comment on “Paradox of Photons Disconnected Trajectories Being Located by Means of ‘Weak Measurements’ in the Nested Mach–Zehnder Interferometer” (JETP Letters 105, 152 (2017))

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Received February 27, 2017

DOI: 10.1134/S0021364017070116

The author of the comment on my work [1] states that the proposed modification of the scheme of the experiment reported in [2] is improper and that the experiment faithfully demonstrates a discontinuous trace of photons. It is difficult to agree with this statement because of the absence of clear and well-founded (see below).

In [1], I discussed the recent experiment [2] with a nested Mach–Zehnder interferometer. The authors treated the experiment so that the past of photons is not described by continuous trajectories *because photons are detected inside the inner Mach–Zehnder interferometer and are not detected outside it*.

The idea of a small modification of the scheme of the experiment [2] has been proposed just to detect photons at the input of the inner Mach–Zehnder interferometer. Instead of the vibration of the mirror, the direction of polarization of light is modulated in this scheme. Further, in one of the arms of the inner Mach–Zehnder interferometer, this modulation is converted into a shift of the light beam of orthogonal polarization, which is then transformed to the original polarization.

The realization of the idea is as follows. A birefringent plate, a phase compensator, and two polarizers that oriented at the angle of 45° and in parallel to the initial polarization are placed in one of the arms of the inner Mach–Zehnder interferometer. The same polarizers are placed in the other two arms of the nested Mach–Zehnder interferometer.

The author of the comment states that such a modification is improper because it *“violates the faithfulness of the experiment because it causes different transformations of the polarization record at E into a signal at the detector, depending on the path the beam takes.”* The author of the comment also claims that *“the signal at the detector does not present a faithful indication of the trace inside the interferometer” in the absence of con-*

ditions that “the shift of the direction in the region of the local coupling is translated to the shift of the output beam in the same way for all possible paths of the beam toward the detector.” It is not explained what is the “faithfulness” of the experiment and indication and how it is logically related to the cited conditions. *The necessity of these conditions was not justified either in [2] or in subsequent works of these authors [3–10].*

The authors’ treatment of the two-state vector formalism is attractively simple but is not justified and, thereby, can provide false conclusions and is limited. This concerns the *interpretation* of the results of the experiment as *the manifestation of the “discontinuous trace”* of photons by the authors of [2]. *The same treatment does not explain the absence of any signals when the beam of light in the lower arm of the outer Mach–Zehnder interferometer is blocked.* At the same time, this absence is clearly explained by the traditional theories of light and quantum mechanics. *Therefore, it is unnecessary to introduce a new concept of discontinuity of possible paths of photons.*

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Translated by R. Tyapayev