On the physical explanation of the experiments with double-slit and with the Mach-Zehnder interferometer.

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Young’s double-slit interference is one of the most fundamental effects in quantum physics. Different theoretical models well describe this phenomenon, but its physical explanation is unclear till now. Feynman wrote: “We choose to examine a phenomenon which is impossible, *absolutely* impossible, to explain in any classical way, and which has in it the heart of quantum mechanics. In reality, it contains the *only* mystery. We cannot make the mystery go away by “explaining” how it works” [1].

The situation looks like as when the photon (electron, neutron, atom) passes through one slit, it "knows" about the existence of the other slit. A similar situation exists in the Mach-Zehnder interferometer. When the photon reaches the second beam splitter (and “interferes with itself”), it "knows" about the existence of two ways in the interferometer. This corresponds to the idea of the existence of some "nonlocal knowledge" about the state of the macroquantum system. This point of view is known as the conspiracy theory [2]. It looks like a supernatural, impossible physical explanation. But, probably, this explanation is the only true one. And today we have certain physical base for such conclusion.

It is about the fact of nonequivalence of the forward and reversed processes in quantum physics. We have a plenty of indirect and a number of direct experimental proofs of huge inequality of differential cross-sections of the forward and reversed processes in quantum physics [3]. In fact, this is the main physical base of nonlinear optics. This nonequivalence directly demands the presence in a quantum system the memory about its initial state. Without this, it is impossible to distinguish a forward process from a reversed one. And this memory, obviously, should be nonlocal.

Thus, in one area of quantum physics we discuss "nonlocal knowledge" about the state of a quantum macrosystem. And in another area we are dealing with "nonlocal memory" of a quantum system about its initial state. These things look very similar to each other. Obviously, this is the same thing.

How can we study such memory of quantum system? Obviously, the most direct way here is to study the differential cross-sections of forward, reversed, partially reversed transitions. This is not a very difficult task [3]. Unfortunately, there is still no directional experiment of this type. Our scientific community ignores this task.

So, we believe that until the differential cross-sections of forward and reversed processes are studied, the problem of the physical explanation of the experiments with slits and interferometers will remain in the same dead end as in Feynman's time.

1. R. P. Feynman, R. B. Leighton, and M. Sands, *The Feynman Lectures on Physics* (Addison-Wesley. 1965).
2. G. Greenstein and A.G. Zajonc, *The Quantum Challenge*, Jones and Bartlett Publ., Boston, 2006, p. 38
3. V.A. Kuz’menko, “On the experimental proofs of strong time reversal noninvariance in nonlinear optics”, 2017. https://www.researchgate.net/publication/314032899