Comment on "Consistent Interpretation of Quantum Mechanics Using Quantum Trajectories"

Griffiths renews in a recent Letter [1] under the notion of *quantum trajectories* his thought-provoking concept of *consistent histories*, which he has elaborated most clearly in [2]. This concept was taken up and developed further into a logical framework by Omnès [3] and widely attracts attention in the interpretation debate on quantum theory [4]. Even so, we have severe doubts if this very concept is a physically significant advance.

The desire to avoid the state collapse as a fundamental concept independent of the state change by unitary time evolution is as old as quantum mechanics. Taking its formalism for granted, Wigner [5] saw already the unsolvability of this *measurement problem.* For a recent monograph on the topic see [6].

Against this background, the claims connected with Griffiths' approach [1,2] are indeed far reaching:

(i) Every experiment can be correctly described.

(ii) From the outset only closed systems are considered. There is no need to refer to any measurement procedure from outside. Apparatuses may be taken as part of the closed (compound) system, revealing preexisting values of the measured observable.

(iii) There is no state collapse; the quantum dynamics is entirely given by unitary time evolution.

(iv) It makes sense to speak about probabilities of quantum trajectories in analogy with probabilities of classical (phase-space) trajectories. The only difference lies in the formal description and the logical status of the events defining a trajectory.

(v) There is no formal difference between quantum descriptions of microscopic and macroscopic systems.

(vi) There is no interpretative difference between quantum descriptions of future and past events.

The notion of a quantum trajectory is, in essence, the special case of a quantum history [2], in which the projectors in the Heisenberg picture describing events at successive times t_j are all one dimensional, $|\Phi_j^\alpha(t_j)\rangle\langle\Phi_j^\alpha(t_j)|$.

To judge the physical relevance of quantum histories, attention must be paid to the consequences of the so-called *consistency condition* [2,3], which is implied by the *noninterference condition* [1] for trajectories. The latter condition, however, is empirically false if the absolute squares of the transition amplitudes (3) in [1] are regarded as the corresponding relative frequencies of measurement outcomes in an interference experiment. The noninterference condition serves merely as a mathematical criterion for the choice of a *complete family* of quantum trajectories, which in Griffiths' view is the proper framework for quantum descriptions. Although all possible $|\Phi\rangle\langle\Phi|$ may be thought of as embedded in quantum trajectories, we deny their physical relevance: There is an *unphysical arbitrariness* in the construction of the trajectories in that the choice of a consistent family is by no means unique even in physical situations as concrete as Griffiths' interferometer example [1]. Measurements cannot, even in principle, help to discriminate between different families. Moreover, the truth of (possibly probabilistic) quantum statements depends on the choice of a consistent family by a physicist, which calls logic itself into question. This approach is not a mere reformulation of the well-known quantum complementarity, for it contains nothing corresponding to the firm basis of measurement results. Questions about successive events which do not fit into a single family are disqualified as meaningless. Even macroscopic events become family dependent, as Eq. (8) and the text below in [1] clearly show.

We prefer to stick to the idea that measurements really *have* outcomes, and that the occurrence of events generates objective *facts* in the sense that no freedom of choice can dispense one from acknowledging them, be it a detector or a cat. Possible events in the future should not be treated like past facts. The orthodox view [5] including collapses is well adapted to the empirical basis and the predictive character of quantum statements. The state contains the whole information (or "knowledge") for every possible (probabilistic) prediction on the system. Measurements generate facts that change the knowledge irreversibly. To represent the updated knowledge, the state is to be changed then. Nature is not time symmetric. Why should theory be?

To conclude, we reject the high price to be paid for quantum trajectories. Much of the critique has been formulated already in [7].

We acknowledge helpful correspondence with R. B. Griffiths.

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Received 4 June 1993;
revised manuscript received 24 November 1993
PACS numbers: 03.65.Bz, 05.30.−d

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0031-9007/94/72(11)/1770(1)$06.00
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