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Qeios

Peer Review

Review of: "Axiomatic Foundation of Quantum Measurements and Survival Effect"

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Qeios paper referee comment

Axiomatic foundation of quantum measurements and survival effect”

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This paper presents axiomatic foundation of quantum measurements and survival effect. The main issue would be the formulation of conditional densitiy matrix. The paper combines the scattering formalism with the density formalism, which takes into accout the boundary conditions of wave functions.

In judging the paper, it would be clear to separate the issue to mathematical aspect and physical aspect. From mathematical view point, the issue is if the material is logically developed and connections with natural phenomena may not be so important. From physical point view, on the other hand, logical developement is necessary but there is an additional point. That is if the materials studied are rellevant to physics or natural phenomena, including measurements. The present referee understands that measurement problem is delicate problem that is connected with both.

[0]. The standard scattering formlism has been formulated more than half a century ago, and has been used as a standard method. This formalim is fine in many cases but is subject of various drawbacks. These drawbacks may have not been serious before, but, recent developements of the quantum mechanics reveals that is not the case. EPR long range correlation is one example. These are connected with the content of present paper. The present referee judges the

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manuscript from this viewpoint.

Mathematical aspect:

The present referee has difficulties in understanding several statements in the manuscipt. The paper claims these but the proves were not given.

(M.1). Orthogonality and normalization of states play critical roles in the contexs of manuscript, Eqs. (A.8),(A14), (A15), and (A17).

Eq.(A.8): Eigenstate $|\Phi\lambda\rangle$ is not normalized and the scalar product is proportional to Dirac delta function, which is the first term in Eq.(A.14). For continious eigenvalues, this is proportional to $\delta(0) = \infty$ and normalization parameter $N\lambda = \langle\Psi\lambda|\Psi\lambda\rangle = \delta\lambda\lambda = \infty$. For discrete eigenvalues the normalization is one. In appendix A, This problem is mentioned and one of standard procedures of introducing finite volume as a cut off parameter is explained. It writes that this problem is solved by applying the periodic boundary condition. However, this is not a real solution, because scattering waves do not satisfy generaly the periodic boundary conditions, rigorous scattering probability is not found using periodic boundary conditions. So this methos is not a real solution in a rigorous scence.

(M.2.2) Function $Q(Z, Z')$ is used without a definition in Eq.(7) and (15). Definition and meaning must be provided.

Physical aspects:

(P.1) The expectation values given by density matrix such as $\int dE\rho E <$ $ct\psi E\ |A|\psi E >$ are usefull for studying the thermodynamic quantities of the system based on the standard method. The manuscript seems to assume further

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that this expectation value is physically observable. However, it is not clear if such expectation value of operator is directly measurable. In the quantum mechanics, all the processes occur following the quantum mechanics, and physical quantities are measured from the physical transition processes. It is meanningless, stricly speaking, to assume unrealsitic measuments. The present referee is not aware of any example of realizing this idea. If there is any example of measurement apparaturus of operator A, the present referee sugests author to indicate it in the manuscript. This problem is actually connected with computing the thermodynamic quantities rigorously from the first principle, in quantum mechanics.

(P.2) Orthogonality and normalizability of states, which are almost trivial in finite dimensional space, are not obvious in infinite dimensional sace. The standard methods play key roles in the present paper. These are subject of various drawbacks as mentioned above, which are serious in physics also. In the present form it is not clear if the statements are proved or assumed or conjectured These are not carefully addressed in the present form. It would be good to clarify EPR correlation for instance. Following recent references addrese orthogonality and related problems and might be useful. Overlap integral of continuum stationary states, Annals of Physics, 469,(2024),169750; Potential scatterings in the L2 space: (2) Rigorous scattering probability of wave packets ,Annals of Physics, 460,(2024) 169571

The present referee suggests revision of the paper.

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Declarations

Potential competing interests: No potential competing interests to declare.