Explanatory Principle no.1 in Quantum Physics: The entropy-lessness of physical subsystems with apparent retrocausality

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Abstract

The EPR-phenomenon, usually described with the use of the rather mystical process of quantum entanglement, is consistenly explained here as a consequence of the ambivalence of the time direction in entropy-less physical subsystems of our world.

Keywords: EPR-phenomenon – causality – counter-intuitivity – Quantum physics – time-directions – retrocausality – entropy-less subsystems

Introduction

The query of the mystical weirdness of Quantum physics reached a high popularity with the appearence of the book "Dance of the Photons" with the main theme being the EPR-phenomenon, written by A. Zeilinger (2010) on a popular, yet still serious, level. There, on the last page of the book (p.287), the author presents the idea that the solution could be assumption "... that the individual measurements ... act back into the past." The author, however, rejects this option. Nonetheless, A. Zeilinger does not deny that the principal logical and philosophical problems remain in spite of the ingenious methods of research applied by him (and his collaborators) as well as of the rich respective results.

1. Starting with the basic principle

Despite their space and time extension, in such subsystems of the physical world of our Universe where the notion of entropy (pertaining the statistical physics) is irrelevant, the direction of time is ambivalent.

2. The two mutually opposite time directions mean the two different descriptions

Seen in the 'classical' time[1] direction, where the entropy in closed physical systems is increasing (or at least not decreasing), the causality exists and some phenomena seem to be counter-intuitive, as is, e.g., the famous EPR-phenomenon.

[1] The time is a way to order the events in our causal Universe (Voráček 2003).

When, however, the same phenomena are described in the time with the opposite direction (which is permitted both in Quantum physics and entropy-less physical subsystems), their counter-intuitive character changes to be quite logical, nevertheless with the causality chain apparently reversed: *retrocausality*. As we, being the living observers, are the physical systems existentially tightly bound to the entropy therein, the counter-intuitivity of some phenomena – as that of the EPR-phenomenon – clearly becomes the consequence.

In our view the observationally ascertained counter-intuitivity arises in the border area between the considered quantum entropy-less subsystem and its envelope system identified as our entropic causal cosmic world with its laws of the conventional physics (including Relativity and relativistic cosmology).

In the view of a hypothetical 'comoving observer', where for the wave-train being the form of an elementary light quantum, its emission and its reception are two colocal and simultaneous events, any adjacent problem connected to the causality is to be – quite logically – dropped by principle (Voráček 1989). Anyway, some new problems arise: Is it possible to speak about the existence of a reference frame bound to the wave-train when its duration is zero? The query could seem to be just semantic if it could not be objected that, owing to Special relativity theory, in the considered reference frame the proper length of the train necessarily would be infinite in order to be finite for a physically real observer in the Universe. The solution to the dilemma, which we discovered is based on the fact that it is not logically possible to perform a measurement of the proper length of the wave-train during a time interval with zero duration. This is the possible way to escape the abjection presented above.

An entropy-less process is not necessarily limited in space and time to the world of microphysics; on the contrary, it pertains often to the world of macrophysics and even to cosmology.

The above presented view is perfectly compatible with the right conception of the CPT theorem. The same theorem is used as a starting point in the recent paper of Yu *et al.* (2022; see also the references therein), where the idea of indefiniteness of direction of the input-output is proposed as an appealing option to the explanation of the phenomenon in consideration, and which was experimentally tested as well. In the article of Strömberg *et al.* (2022; with the rich review of pertinent references) the solution to the problem is outlined where the both possible time directions are considered to be in a coherent superposition and the notion of *time-flip* is introduced. We believe anyway that our idea of the entropy-less processes is the optimal approach to the solution of the considered conundrum.

Motto a posteriori: The qubit is dead, long live the qubit!

References

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