



PŘEDNÁŠKOVÁ SÉRIE LECTURE SERIES

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Indefinite causal orders in quantum physics

In quantum physics, causal nonseparability characterises experiments (or better, quantum processes) that are incompatible with any definite causal structure among interacting parties. One talks about indefinite causal orders. A famous example of causally nonseparable processes is called the quantum switch (QS). It is extensively studied in the literature in virtue of its simple architecture and its various implementations in laboratories.

The present work discusses the possible interpretations of the QS's causal nonseparability under the assumption of a scientific realist approach towards quantum processes. In order to explore the potential impact of causal nonseparability on spacetime, we shift from the notion of (indefinite) causal structure to (indefinite) spatiotemporal ones. This shift was allowed under a set of reasonable assumptions regarding the properties of a physical spacetime manifold. While different readings were suggested for indefiniteness of spatiotemporal relations, we insist in particular on an understanding appealing to the concept of metaphysical indeterminacy. It is argued that such an approach could prove useful in a more general theoretical context such as quantum gravity, while being already partly supported in standard quantum mechanics.

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