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Quantum contextuality in the Copenhagen approach. (English) [Zbl 1462.81018]

Summary: The origin and basis of the notion of quantum contextuality is identified in the Copenhagen approach to quantum mechanics, where context is automatically invoked by its requirement that the experimental arrangement involved in any measurements or set of measurements be taken into account while, in general, the outcome of a measurement may depend on other measurements immediately preceding or jointly performed on the same system. For Bohr, the specification of the experimental situation of any measurement is essential to its significance in light of complementarity and the omnipresence of the quantum of action in physics; for Heisenberg, the incompatibility of pairs of sharp measurements belonging to different situations coheres with both the completeness of the quantum state as an objective physical description and the principle of indeterminacy. Here, context in the Copenhagen approach is taken to be the equivalence class of experimental arrangements corresponding to a set of compatible measurements of quantum observables in standard quantum mechanics; the associated form of contextuality in quantum mechanics arises via the non-commutativity in general of sharp observables, proven by von Neumann, that can appear, providing different contexts. This notion is related to theoretical situations explored later by Bell, by Kochen and Specker, and by others in relation to the classification of hidden-variables theories and elsewhere in physics.

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References: