

[Hellwig, K.-E.](#)

Conditional expectations and duals of instruments. (English) Zbl 0537.60033

Interpretations and foundations of quantum theory, Proc. Conf., Marburg 1979, 113-124 (1981).

[For the entire collection see [Zbl 0455.00026](#).]

Classical probability theory and quantum mechanics are both special cases of a generalized probability theory developed by Davies and Lewis. In this general framework quantal measurements in the Hilbert space formulation are described by instruments which are certain operation-valued measures on suitable Borel spaces. Operations are positive linear maps on the trace class operators (describing the states of the system) in a given Hilbert space while observables are described by positive operator-valued measures. Conditional expectations are then defined by some requirements analogous to those known in classical probability theory.

In this paper the author formulates quantum stochastic processes based on the concept of conditional expectations, for a special situation, i.e. all observables are projection-valued measures and have a purely discrete bounded spectrum. One of the results is that in this special case a Markov process exists only if the observables all commute reducing this stochastic process to a classical one. There is however a more recent paper by the author and *W. Stulpe*, A formulation of quantum stochastic processes and some of its properties. *Found. Phys.* 13, 673-699 (1983)] which discusses more general cases and gives some explicit examples of quantum stochastic processes.

Reviewer: [H.Cycon](#)

MSC:

- [60G20](#) Generalized stochastic processes
- [46L51](#) Noncommutative measure and integration
- [46L53](#) Noncommutative probability and statistics
- [46L54](#) Free probability and free operator algebras
- [81P20](#) Stochastic mechanics (including stochastic electrodynamics)
- [60J99](#) Markov processes

Cited in **2** Documents

Keywords:

[Conditional expectations](#); [quantum stochastic processes](#)