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Generic Probabilistic Theories - Reconstruction of quantum theory

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ABSTRACT

It is fair to say that we still lack intuitive clear and broadly accepted physical principles that are ground basis of quantum theory. This lack is the main reason for today's coexistence of various interpretations of quantum theory, some of which even use mutually exclusive concepts. One of the main objectives of this thesis was to identify those features of quantum theory, which singles it out from the broad class of the probabilistic theories. Such an attempt is called reconstruction of quantum theory. Based on the principle of limited information content the full hierarchy of theories that share this property with quantum and classical probability theory was derived. In order to single out quantum theory from the full class of the probabilistic theories additional assumptions were adopted: locality and reversibility. In addition, in this thesis, one of the basic quantum concepts, the complementarity principle was investigated through so called mutually unbiased bases. Furthermore, the non-classical features of quantum mechanics including quantum statistics, quantum correlations and quantum simulations were studied.