Generalized Quantum Measurements – Cornerstones of Quantum Information Theory

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Exploiting the potential of quantum systems for technological purposes is a major driving motivation in quantum information science. For advancing the capabilities of quantum systems the development of efficient and possibly even optimal procedures for measuring quantum systems is an important prerequisite. Generalized quantum measurements [1], *i.e.* positive operator valued measures (POVMs), represent the most general notion of measurement processes compatible with the laws of quantum theory, which allow to address such optimization issues in a systematic way.

Starting from basic theoretical aspects of generalized quantum measurements, which particularly emphasize their significance for optimizing quantum measurements within the fundamental limits of quantum theory, in its second part this presentation focusses on current theoretical developments [2-6] aiming at unifying different types of recently discussed symmetric quantum measurement procedures, such as projective measurements involving mutually unbiased bases (MUBs), mutually unbiased measurements (MUMs), symmetric informationally complete measurements (SIC POVMs) or their generalizations, so-called GSIC POVMs. Possible applications of these generalized symmetric quantum measurements are discussed in the context of local bipartite entanglement detection [4], a measurement process of particular practical relevance for secure quantum key distribution.

References

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