

PhD THESIS REVIEW

PhD candidate:

Aleksandra Krawiec (Institute of Theoretical and Applied Informatics, Polish Academy of Sciences)

Title of PhD thesis:

Discrimination of quantum measurements

Review:

The thesis systematically addresses questions related to quantum decision problems for quantum measurements understood as quantum-classical channels. It is based on 5 original research papers published in recognized journals (Quantum, Scientific Reports 2x, Physical Review A, Quantum Information Processing). Apart of these publications A. Krawiec coauthored during her studies another 5 publications on different subjects in quantum information theory. I really appreciate the thesis is not a collection of these papers, but has the form of very accessible and coherent text on the subject introducing all required concepts and methods and providing good overview of existing results. I do not have any relevant comment to the text itself. The formulation of definitions and statements meet the highest standards, the proofs are well structured, organized and argued.

Apart of Introduction and Conclusion the thesis contains 5 chapters. First of them (Chapter 2) introduces the necessary mathematical framework and demonstrates her overview the field. In Chapter 3 she investigates symmetric single-shot discrimination problems that are extended to multiple-shots settings in Chapter 4. Chapter 5 contains original results on unambiguous discrimination of measurements. The asymmetric hypotheses testing problems are analyzed in Chapter 6. The particular results are best summarized in Chapter 7 and I am not going to repeat all of them here.

The particular attention is paid to the question when the adaptive schemes (compared to parallel) are required and beneficial. This is important to understand and theorems related to this (for all considered variations of the decision problems) are of general interests of the community and have also potential practical impact on experimental implementations. Second line connecting all chapters is the detailed analysis of von Neumann observables and so called SIC POVM observables. Both of them are “canonical” families of observables and this thesis completes the knowledge on discrimination problems for these families. The achieved results represent important contributions to the area of discrimination of measurements.

In my opinion there is no doubt that Aleksandra Krawiec clearly demonstrated her expertise in the subject of discrimination, achieved original results and I am happy to suggest the acceptance of her thesis and recommend the best possible mark. I have no doubts the presented dissertation meets the statutory requirements for doctoral theses in the field of engineering and technology in the discipline information and communication technology.

Minor comments and questions:

- 1) When you consider SIC POVM you are restricted to permutations. Is there a chance there will be some qualitative difference in the theorems (especially when discussing perfect discrimination) if you consider general unitary, or antiunitary relation between the considered SIC POVMs.
- 2) Just a minor remark – in longer texts it is better (in my opinion) to repeat the formulation of theorems, if they are proved in appendices.
- 3) Proposition 6 in 4.5 – for the proof I would recommend to show explicitly how the discrimination works. Further, isn't it possible to formulate proposition in a way that one of the permutations is identity?

09/06/2023


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