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Thesis report on the dissertation "Non-classical effects on generalized quantum channels" by Martin Plávala

The thesis covers a topic of current research in the intersection of the foundations of quantum mechanics with mathematical physics, the characterization of physical theories from the point of view of states and measurements as generalized probabilistic theories (GPTs). The author starts by a comprehensive review about the topic, including in-depth comments on some of the assumptions made and the general scope and applicability of the approach. The review is very well written, concise, mathematically precise and provides a detailed introduction into the topic of GPTs. This introduction is followed by a cumulative thesis made up of five of the authors own publications, all of which have already undergone peer review and have been either accepted or published in journals of the highest quality in the field. As two of the publications are single author, there is not a shred of doubt about the contribution from the doctoral student and thus clear proof that he displays the necessary independence and scientific professionalism in line with the highest of international PhD standards. The results are new and lie at forefront of theoretical research in general probabilistic theories. The results cover mathematical properties of measurements in these theories, with a strong focus on the notion of compatibility of measurements. To be precise, the author discusses a notion of compatibility of channels (that both channels can be realized through a partial trace of a channel mapping on a larger space) and recovers notions of measurement compatibility as a special case. The fact that non-compatible channels (and measurements) exist is one of the hallmark properties of quantum theory as classical theories (also in the sense of GPTs) contain only compatible effects (measurements). The author has proven that for all measurements to be compatible, the state space needs to be a simplex, derived conditions on the existence of maximally incompatible 2-outcome measurements and has worked on the connection of incompatibility to notions of steering and non-locality (correlations that are stronger than classical in the sense that they do not allow for a local realistic description). He furthermore proved that principles that apply to quantum theory (no-free information principle and no-information-without-disturbance), do not generalize to any GPT and derives conditions for when they do.

The results are timely, mathematically non-trivial, bring highly relevant contributions to the field and are of interest to the community. I can only conclude with suggesting the highest possible grade, ie. **A**, for the thesis at hand.

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