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Report on the PhD Thesis of Mateusz Wasilewski On q -deformed von Neumann algebras

The thesis of Mateusz Wasilewski deals with properties of von Neumann algebras, mostly in a type III non-tracial setting. The main types of considered von Neumann algebras are the q -Araki-Woods algebras and special Hecke-von Neumann algebras. The addressed properties are approximation properties (Haagerup property and CMAP) and properties of maximal abelian subalgebras (MASAs), like singularity or non-conjugacy of those. This is a very active and interesting field with quite some new developments in recent years - in particular concerning extensions of results from the type II to the type III setting. The latter is technically very demanding and a couple of deep tools and techniques have to be combined.

It seems that Wasilewski has mastered very successfully the theory of the considered q -Araki-Woods and Hecke-von Neumann algebras, as well as sophisticated techniques like ultraproducts, intertwining techniques, or operator space techniques. This becomes quite clear from Chapters 2 - 4 of the thesis which describe in a very nice and readable way the needed preliminaries, the considered approximation properties as well as the considered algebras. This is not just a collection of definitions and theorems, but it gives also the ideas and often also details of the main proofs in this context.

The main results of the thesis are Theorems A, B, C, D, whose proofs are given in Chapter 5, building on the considerations in the previous chapters. Those results have already appeared in various articles of Wasilewski, with different groups of coauthors. Theorem A is from the single-author paper [Was17], which appeared in the *Proceeding of AMS*, Theorem B is from [ABW18], which appeared in *Journal of Functional Analysis*, and Theorems C and D are from [CSW17], which is a recent preprint on the arXiv. All those results are important contributions to an active field and their proofs are quite non-trivial. For example, the proof of Theorem B relies on establishing a transference result of radial multipliers on the q -Araki-Woods algebras by using the ultraproduct embedding. For this one has to understand images of Wick words under special homomorphisms, as well as estimating the norms of operator-valued linear combinations of Wick words. All this relies on various different results and techniques (like Khintchine inequalities or properties of the Haagerup tensor product) and combines and enriches those in non-trivial ways. I find this amazing and am very impressed by the mastery of all this.

As a conclusion: this is a first-class PhD thesis with important new results on interesting questions in an active area of mathematics.

I recommend to accept this work as a PhD thesis. Actually, according to the depth and importance of the results as well as the apparent mastery of quite involved mathematics, this thesis ranks clearly among the top 20% of PhD theses I have reviewed and thus I would rate the thesis of Mateusz Wasilewski as *outstanding*.

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