哈爾濱工業大學
HARBIN INSTITUTE OF TECHNOLOGY

MINI-WORKSHOP ON TOPOLOGICAL QUANTUM GROUPS AND QUANTUM SYMMETRIES

CONFERENCE BOOKLET

Harbin Institute of Technology

24–25 September, 2023

Mini-Workshop on Topological Quantum Groups and Quantum Symmetries

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About

This meeting aims to discuss the state of the art of various analytic approaches to quantum group and quantum symmetry theory, such as locally compact quantum groups, topological Hopf algebras, planar algebras, fusion categories and related topics.

Venue

Room 201, Ming De Building, Harbin Institute of Technology

Participants:

Oleg Aristov	Harbin Institute of Technology
Huichi Huang	Chongqing University
Linzhe Huang	Tsinghua University
Manish Kumar	Institute of Mathematics of the Polish Academy of Sciences
Adam Skalski	Institute of Mathematics of the Polish Academy of Sciences
Hua Wang	Institute of Mathematics of the Polish Academy of Sciences
Jianquan Wang	Harbin Institute of Technology
Simeng Wang	Harbin Institute of Technology
Xumin Wang	Seoul National University
Jinsong Wu	Yanqi Lake Beijing Institute of Mathematical Sciences and Applications

Timetable

Sunday, September 24

9:30-10:30	**Adam Skalski** Institute of Mathematics of the Polish Academy of Sciences	Separation properties for quantum positive-definite functions and associated von Neumann algebras
10:50-11:50	**Jinsong Wu** Yanqi Lake Beijing Institute of Mathematical Sciences and Applications	Quantum invariants for 3-manifolds with boundary
11:50-14:00	**lunch break**	
14:00-15:00	**Linzhe Huang** Tsinghua University	Quantum inequalities and unitary categorification
15:00-16:00	**Oleg Aristov** Harbin Institute of Technology	Quantum groups in complex-analytic setting
16:20-17:20	**Hua Wang** Institute of Mathematics of the Polish Academy of Sciences	A revisit of Woronowicz's Tannaka-Krein duality

Monday, September 25

9:00-10:00	**Huichi Huang** Chongqing University	Discrete quantum group fixing a sequence of finite sets
10:00-11:00	**Simeng Wang** Harbin Institute of Technology	Classical actions of quantum permutation groups
11:20-12:00	**Jianquan Wang** Harbin Institute of Technology	Finite de Finetti theorems for free easy quantum groups

Abstracts

Sunday, September 24

Separation properties for quantum positive-definite functions and associated von Neumann algebras

Adam Skalski (Institute of Mathematics of the Polish Academy of Sciences) 9:30-10:30

It is well known that amenability of a discrete (quantum) group is equivalent to the existence of a net of finitely supported (quantum) positive-definite functions converging pointwise to 1. We will show that using the (quantum) Godement mean one can weaken the latter condition to the existence of a net of finitely supported normalised (quantum) positive-definite functions which is 'pointwise strictly positive in the limit'. This further implies that von Neumann algebras of unimodular discrete quantum groups enjoy a strong form of non-w*-CPAP, which we call the matrix epsilon-separation property. Based on the joint work with Jacek Krajczok.

Quantum invariants for 3-manifolds with boundary

Jinsong Wu (Beijing Institute of Mathematical Sciences and Applications) 10:50-11:50

In this talk, we introduce the 3-alterfold with a separating surface. When the separating surface is decorated by a spherical fusion category, we obtain quantum invariants of 3-alterfold, which is consistent with many topological moves. These moves provide evaluation algorithms for various presentations of 3-alterfold, e.g. Heegaard splittings, triangulations, link surgeries. In particular, we obtain quantum invariants of 3-manifolds containing surfaces, generalizing those of 3-manifolds containing framed links. Moreover, in this framework, we topologize fundamental algebraic concepts. For instance, we implement the Drinfeld center by tube diagrams as a blow up of framed links. The topologized center leads to a quick proof of the equality between the Reshetikhin-Turaev invariants and the Turaev-Viro invariants for spherical fusion categories. In addition, we topologize half-braiding, S-matrix and the generalized Frobenius-Schur indicators, etc.

Quantum inequalities and unitary categorification

Linzhe Huang (Tsinghua University) 14:00-15:00

In this talk, we will introduce the applications of quantum inequalities on quantum symmetries in category theory, especially for the unitary categorification of fusion rings. We provide various analytic criteria for this problem based on the completely positivity of comultiplication and numerous examples of fusion rings are given to illustrate the efficiency. These criteria are also applied as analytic obstructions of principal graphs of subfactors.

Quantum groups in complex-analytic setting

Oleg Aristov (Harbin Institute of Technology) 15:00-16:00

We will start with complex-analytic versions of some classical quantum groups. One of the advantages of the complex-analytic approach is that the use of holomorphic functions leads to specialization of formal parameters to complex numbers. To include obtained examples in some general context I propose to consider topological Hopf algebras with a finiteness condition (holomorphically finitely generated or HFG for short). The emerging theory is closer to classical quantum group theory than to C*-algebraic one (no multipliers and no invariant weights). Nevertheless, this topic seems to open up a wide range of research opportunities. A classification theorem for commutative Hopf HFG algebras and some results in the cocommutative case will be presented. I also plan to discuss the holomorphic duality.

A revisit of Woronowicz's Tannaka-Krein duality

Hua Wang (Institute of Mathematics of the Polish Academy of Sciences) 16:20-17:20

Based on the previous work of Kac, Takesaki et al. and further studied later by Woronowicz and Sołtan, the work of Baaj & Skandalis raised and systematically developed the theory of multiplicative unitaries. This simple yet powerful framework plays a pivotal role for the Pontryagin duality of locally compact quantum groups. In this talk, I will present how one can recover the underlying multiplicative unitary directly from the representation theory of a compact quantum group, hence describing a parallel approach to Woronowicz's Tannaka-Krein reconstruction.

Monday, September 25

Discrete quantum group fixing a sequence of finite sets

Huichi Huang (Chongqing University) 9:00-10:00

Motivated by generalizing Szemerédi's theorem, we define the elements in a discrete quantum group fixing a sequence of finite subsets and prove that the set of these elements is a quantum subgroup. Using this we obtain a version of mean ergodic theorem for discrete quantum groups. Finally we give a conjecture concerning arithmetic progressions in discrete quantum groups.

Classical actions of quantum permutation groups

Simeng Wang (Harbin Institute of Technology) 10:00-11:00

We describe explicitly all actions of the quantum permutation groups on classical compact spaces. In particular, we show that the defining action is the only non-trivial ergodic one. We then extend these results to all easy quantum groups associated to non-crossing partitions. This is joint work with A. Freslon and F. Taipe.

Finite de Finetti theorems for free easy quantum groups

Jianquan Wang (Harbin Institute of Technology) 11:20-12:00

We prove various finite de Finetti theorems for noncommutative distribution which are invariant under the free easy quantum group actions. This complements the de Finetti theorem by Banica, Curran and Speicher; the latter only applies to infinite sequences. We also discuss some refined results for the infinite setting.