SCIENCES & BIOENGINEERING SCIENCES

The Research Group
Algebra & Analysis

has the honor to invite you to the public defence of the PhD thesis of

Johan Konings

to obtain the degree of Doctor of Sciences

Title of the PhD thesis:

Partial Algebraic Quantum Groups

Promotor:
Prof. dr. Kenny De Commer

The defence will take place on

Wednesday, September 27, 2023 at 14h in Promotion Room D2.01

The presentation can also be followed through a live stream. Send an email to Kenny.De.Commer@vub.be to get the link.

Members of the jury

Prof. dr. Frederik Tielens (VUB, chair)
Prof. dr. Jan De Beule (VUB, secretary)
Prof. dr. em. Stefaan Caenepeel (VUB)
Prof. dr. Ana Agore (Institute of Mathematics of the Romanian Academy, Romania)
Prof. dr. Sonia Natale (Universidad Nacional de Córdoba, Argentina)
Prof. dr. Joost Vercruysse (Université Libre de Bruxelles)

Curriculum vitae

Johan Konings obtained his Master's degree in Mathematics at the Universiteit Antwerpen in 2017. In 2017, he started as assistant and PhD-student at the department of Mathematics and Data Science at the Vrije Universiteit Brussel. Johan is (co-)author of 2 articles which were published in international journals. Moreover, Johan was involved in teaching various courses in Mathematics at the faculty of Sciences and Bio-Engineering sciences, and at the faculty of Engineering.

Abstract of the PhD research

To every finite group, one can associate two distinct algebras. The first one is the set of complex-valued functions on the group. The group operation then induces a comultiplication, so that this algebra becomes a Hopf algebra. This Hopf algebra will always be commutative. Dually, one can consider the group algebra, whose multiplication reflects the group structure. This Hopf algebra will always be cocommutative.

However, there exist Hopf algebras which are not necessarily commutative or cocommutative, but which share many other properties of the above examples. Such Hopf algebras are called quantum groups.

In the first part of the thesis, we discuss a generalisation of algebraic quantum groups, which were introduced by Van Daele. An important remark is that our objects, the partial algebraic quantum groups, are no longer Hopf algebras. This is because we also want to be able to work with infinite groupoids in our framework, instead of just finite groups. We regularly take inspiration from the theory of weak multiplier Hopf algebras, as introduced by Van Daele and Wang. The partial algebraic quantum groups we introduce are indeed examples of weak multiplier Hopf algebras. We also construct in this setting the notion of a Drinfeld double of a partial algebraic quantum group of compact type.

In the second part of the thesis we study two special types of coactions of Hopf algebras. These are the homogeneous and Galois coactions. If a Hopf algebra corresponds to a group, a coaction of this Hopf algebra corresponds to an action of the group. The two special types correspond to ergodic, resp. free actions. We show that the two types of coactions are in one-to-one correspondence to each other, modulo Morita equivalence. We also focus on coactions which are simultaneously Galois and 'almost' homogeneous.

This PhD thesis is based on two articles by De Commer and Konings from 2020 and 2023.