SCIENCES & BIOENGINEERING SCIENCES

The Research Group

Algebra, Incidence Geometry (ALGB)

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

Theo RAEDSCHELDERS

to obtain the degree of Doctor of Sciences

Title of the PhD thesis:

Manin's universal Hopf algebras and highest weight categories

Promotor:

Prof. Dr. Michel Van den Bergh

The defense will take place on

Friday May 12 2017 at 16h00

in Auditorium D.2.01 at the Campus Humanities, Sciences and Engineering of the Vrije Universiteit Brussel, Pleinlaan 2 - 1050 Elsene, and will be followed by a reception.

Members of the jury:

Prof. Dr. Eric Jespers (chairman)
Prof. Dr. Kenny De Commer (secretary)
Prof. Dr. Stefaan Caenepeel
Prof. Yuri Manin (Max Planck Inst., Bonn)
Prof. Catharina Stroppel (Univ. of Bonn)
Prof. Joost Vercruysse (ULB)

Curriculum vitae

In 2008, Theo Raedschelders obtained a Bachelor's in economics & engineering from the EHSAL, and continued to take up studies in mathematics at the VUB. There he obtained in 2013 a Master in Mathematics. Funded by an aspirant fellowship from the Fund for Scientific Research Flanders (FWO), he then took up his PhD studies under the supervision of Prof. Michel Van den Bergh.
The resulting research was published in several peer-reviewed journals and has been presented internationally at conferences and workshops.

Abstract of the PhD research

Quantum mechanics is a staple of 20th century science, and has led to the realisation that physical quantities are governed by noncommutative algebra. In daily life we are constantly confronted with the noncommutativity of certain operations: it is not a good idea to first heat spaghetti and only then add the water!

Werner Heisenberg was responsible for replacing classical mechanics, in which observable quantities commute pairwise, with matrix mechanics, where crucial observables like position and momentum no longer commute with each other. In developing mathematical tools to study quantum mechanics, it is therefore natural to also try and extend the classical geometry of points, lines, planes etc. (which plays an important role in classical physics) to the noncommutative world. This gives rise to the mathematical field of noncommutative geometry.

Later on, the mathematician Hermann Weyl realised that the operators corresponding to position and momentum satisfied relations that occurred in another area of mathematics called representation theory, which studies the "symmetries" of spaces arising in mathematics by representing them using matrices, so one can use tools coming from more mature fields, like linear algebra.

In this thesis we analyse the symmetries of several spaces appearing in (noncommutative) geometry. More precisely, following a suggestion of Yuri Manin, the usual symmetry group of a space is replaced by a "noncommutative" version, which is much larger, and using representation theory we show that many of the nice properties one expects of symmetry groups are still true for the noncommutative versions, which are called Manin's Hopf algebras.