SCIENCES & BIOENGINEERING SCIENCES

The Research Group
Mathematics and Data Science

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

Senne Trappeniers

to obtain the degree of Doctor of Sciences

Title of the PhD thesis:

Skew braces and their connection to the Yang—Baxter equation, Hopf—Galois structures and post-Lie rings

Supervisor:
Prof. dr. Leandro Vendramin (VUB)
Co-supervisor:
Dr. Arne Van Antwerpen (UGent)

The defence will take place on

Monday, September 29, 2025 at 5 p.m.

VUB Etterbeek campus, Pleinlaan 2, Elsene, auditorium D.2.01 (promotion room)

The defence can be followed through a live stream. Please send an e-mail to senne.trappeniers@vub.be to obtain the link.

Members of the jury

Prof. dr. Mark Sioen (VUB, chair)
Prof. dr. Kenny De Commer (VUB)
Prof. dr. Dominique Maes (VUB)
Prof. dr. Karel Dekimpe (KU Leuven)
Prof. dr. Anna Zamojska-Dzienio (Politechnika Warszawska, PL)

Curriculum vitae

Senne Trappeniers obtained his Master's degree in Mathematics at the VUB in 2021. After graduation, he obtained a FWO fellowship 'aspirant fundamental research' and started his doctoral studies at the research group Mathematics and Data Science at the VUB.

The doctoral research resulted in four publications in peer-reviewed journals and two preprints. Additionally, Senne was involved in teaching exercise classes for several courses.

Abstract of the PhD research

The Yang—Baxter equation originated in quantum and statistical mechanics. Drinfeld later proposed to focus attention to the set-theoretic solutions. Braces, introduced in the work of Rump, and skew braces, introduced by Guarnieri and Vendramin, provide the right algebraic framework to study these solutions and are the main focus of this thesis.

We first study two classes of skew braces. The first is the class of two-sided skew braces. We show that they can be described as extensions of weakly trivial skew braces by two-sided braces, which leads to novel structural results. The second class comprises bi-skew braces, which are closely related to brace blocks. We provide a technical characterization of brace blocks as well as more feasible constructions.

Next, we treat the connection between skew braces and non-degenerate set-theoretic solutions of the Yang—Baxter equation. After exploring how certain properties of solutions relate to those of their associated skew braces, we classify finite indecomposable involutive non-degenerate solutions whose permutation group is abelian or whose size is p^2, with p a prime.

Subsequently, we discuss the existing connection between skew braces and Hopf—Galois structures on finite Galois field extensions and propose a refined version. This enables an explicit classification of all such extensions where the Hopf—Galois correspondence is surjective, a behavior closely resembling that of the classical Galois correspondence.

At last, we develop a Lazard correspondence between L-nilpotent post-Lie rings and L-nilpotent skew braces. We use this to obtain in a more explicit form Zenouz's classification of skew braces of order p^3, $p > 3$ a prime, through a classification of L-nilpotent Lie rings of the same order.

Collectively, these results deepen the structural understanding of skew braces and emphasize their pivotal role, both in algebra and in relation with the Yang—Baxter equation.