PhD Program in Mathematics - 2021/2022

Introduction to quantum groups

Instructor.

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Basic information.

The aim of this course is to provide an elementary introduction to the theory of quantum groups.

The course will be a blend of mostly representation theory (quantum groups and Hopf algebras), a bit of basic complex algebraic geometry (blowups), some category theory (braided monoidal categories), and some deformation theory (Hochschild cohomology). The course is intended for a general mathematical audience: I will do everything from scratch, assuming only the basic notions in algebra and geometry.

The first part of the course will provide a parallel between the classical theory of the Lie algebra $\mathfrak{sl}(2)$ and that of its quantum counterpart $U_q\mathfrak{sl}(2)$, with a special focus on the role of the universal R-matrix and the Yang-Baxter equation.

The topics discussed in the second part of the course will depend upon the main interests of the audience. Potential topics are: monodromy of the Knizhnick-Zamoldchikov equations and Kohno-Drinfeld theorem; Yangians and quantum loop algebras; Etingof-Kazhdan quantization of Lie bialgebras; categorification and Khovanov-Lauda-Rouquier algebras; Reshetikhin-Turaev invariants; quantum groups at root of unity.

The exam will consist in a seminar on a closely related topic (see below).

The course will be held in hybrid format.
Dates: January – March 2022 (approx. 24 hours)

CFU: 4

Essential Bibliography.

        V. Chari, A. Pressley, *A guide to quantum groups.*
        P. Etingof, O. Schiffmann, *Lectures on quantum groups.*
        P. Etingof, I. Frenkel, A. Kirillov Jr., *Lectures on representation theory and Knizhnik-Zamolodchikov equations*