Geneva 2020 Plans

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Folder: 20-QGC

6-7 weeks at double intensity, mid April to late May. Likely 6 weeks April 20 - May 29. Possibly prepend another week.

4x45m per week, plus 2x45m tutorials maybe by TA.

Tentative Title. Knots and Quantum Groups: Theory and Computations without Representations

Tentative Abstract. Our class will run in two parallel streams: "Theory" and "Practice".

In the "Theory" stream we will start with knot theory and mention a few of the main problems that arise within it. This will lead us to learn about and covet Hopf algebras with certain properties, more or less what is known as "quantum groups". Quantum groups are often studied via their representations, but we will do better! We will find that quantum groups have "solvable approximations" that can be understood in terms of the almost-category of "Gaussian Differential Operators", leading to better relations with topology and enabling more effective computations.

The "Practice" stream will happen in a computer lab and in it everything theory will immediately become practice. Along the way we will learn how to implement sophisticated mathematics in Mathematica.

Tentative Prerequisites. Absolutely no fear of linear algebra: quotients, duality, tensor products, symmetric algebras, etc. No fear of Lie algebras. Having heard of universal enveloping algebras and the PBW theorem. Having seen Gaussian integration.

Tentative Weekly Plan. (This plan is just a feasibility test and is not to be taken seriously. By the time of the class things will surely change).

Wk	Theory	Practice
1	Course introduction, knots, Reidemeister moves, tangles, algebraic knot theory .	The Jones polynomial: the quick implementation and the fast implementation.
2	Knots, algebras, Hopf algebras, antipodes, rotational virtual knots.	Introduction to Mathematica.
3	The Drinfel'd double construction in the finite dimensional case and for sl2.	Computations in classical U(sl2); more Mathematica techniques.
4	The circuit algebra of quadratics, the almost-category GDO, and a calculus for the Alexander polynomial.	Implementation.
5	Solvable approximations. Docile perturbations. The elementary tensors.	Implementation.
6	The full sl2 portfolio. Questions and prospects.	Implementation.

Recycling:

Abstract. Our class will be about just one algebra U whose definition can be written on the back side of a conference name-tag (see http://drorbn.net/20-QGC/NameTag.png), and will run in several parallel streams:

1. Why is it, more or less, "quantum sl(2)"?