

# MINI-COURSES

## Quantum Topology and Hyperbolic Geometry Conference Quy Nhon University, June 2 - Jun 5 , 2019

### Schedule

All lectures will be in Lecture Hall B, Quy Nhon University.

|        |             |             |               |              |
|--------|-------------|-------------|---------------|--------------|
|        | 13:00-13:45 | 14:00-14:45 | 15:00 - 15:45 | 16:30-17:30  |
| Sunday | Thăng Lê    | Thăng Lê    | Khôi Vũ       | Paul Wedrich |

|           |           |            |               |             |             |
|-----------|-----------|------------|---------------|-------------|-------------|
|           | 8:00-9:00 | 9:30-10:30 | 11:00 - 11:45 | 13:00-14:00 | 14:30-15:30 |
| Monday    | Wedrich   | Wedrich    | discussion    | Sikora      | Porti       |
| Tuesday   | Wedrich   | Sikora     | discussion    | Porti       | Porti       |
| Wednesday | Sikora    | Sikora     | discussion    | Porti       | Porti       |

### Introductory talks

- **Le, Thang** (Georgia Institute of Technology, USA)

#### Introduction to knot theory

Knots, Reidemeister moves. Composite and satellite knots. Jones polynomials. Skein module, skein algebra. We will do a lot of examples.

- **Vu, Khoi** (Institute of Mathematics, Ha Noi)

#### Character variety, Alexander polynomials

Knot groups, Wirtinger presentations. Examples of character varieties and Alexander polynomials.

### Mini-courses

- **Sikora, Adam** (University at Buffalo, USA)

#### Character varieties in low-dimensional topology

For a matrix group  $G$ , the  $G$ -character variety  $X_G(Y)$  of a topological space  $Y$  the set all representations of  $\pi_1(Y)$  into  $G$  up to conjugation. We will discuss its algebraic properties as well as some of its important applications to low-dimensional topology through the Culler-Shalen theory, the A-polynomial invariant of knots and skein modules.

- **Porti, Joan** (Universitat Autònoma de Barcelona, Spain)

#### Hyperbolic knot theory **Lecture Notes**

I plan to start with the basics of hyperbolic geometry and I will go to the main results of the theory, in particular Thurston's hyperbolization. I will not prove this theorem, but construct several examples. I also plan to cover important results as Margulis lemma, Mostow rigidity and hyperbolic Dehn surgery. As a consequence of Mostow rigidity, metric invariants are also topological invariants. A particular attention will be devoted to the volume. I will also talk about invariants like Chern-Simons and Reidemeister torsion.

- **Wedrich, Paul** (The Australian National University, Australia)

#### Skein theory quantum $gl_n$ **Lecture Notes**

The famous Temperley-Lieb algebra or, in other words, the Kauffman bracket skein relations give a diagrammatic way to describe the representation theory of quantum  $sl_2$  and to compute the Jones polynomial and its colored versions. In this mini-course, I will

give an introduction to the less well-known skein theory for quantum  $gl_n$ . In the first lecture, I will define the diagrammatic calculus of  $gl_n$  webs and show how it can be used to compute (colored)  $gl_n$  and HOMFLY knot polynomials. In the second lecture, I will explain how webs faithfully encode intertwiners for representations of quantum  $gl_n$ . In the third lecture, I will introduce  $gl_n$  skein modules and skein algebras and compare the  $gl_2$  case to the Kauffman bracket skein modules and skein algebras. Possible topics for the final lecture, depending on the interests of the audience, include quantum  $gl(m|n)$  skein theory and categorified skein theory.