

Target group: PhD students and postdocs in mathematics & mathematical physics

Course Title: Topics in Representation Theory

Extend: 3 hours per week / 15 weeks / 5 ECTS

Aims To introduce selected topics in modern representation theory, with emphasis on Lie algebras, highest weight representations, affine Kac–Moody algebras, and vertex algebras.

Synopsis The course will begin with the representation theory of semisimple Lie algebras, including root systems, highest weight representations, Verma modules, and basic aspects of category $\mathcal{O}$. We will then discuss affine Kac–Moody algebras and introduce vertex algebras, their basic examples, operator product expansions, and representations. Depending on time, further topics such as conformal blocks or KZ equations will be discussed. Frenkel–Ben-Zvi’s book develops precisely this passage from vertex algebras associated to Lie algebras to OPEs, modules, and conformal blocks.

Evaluation method:

The evaluation will be based on an one-hour presentation by each student in class (using the hours allocated for the course) on one of the topics covered in the course. The lecturer and an internal censor will be present during the talk to evaluate the presentation and ask the student questions. The evaluation will be pass/fail.

Teaching method: In person lectures

Responsible lecture(s) Mingyuan Hu

Literature

J. E. Humphreys, Introduction to Lie Algebras and Representation Theory.

J. E. Humphreys, Representations of Semisimple Lie Algebras in the BGG Category $\mathcal{O}$.

E. Frenkel and D. Ben-Zvi, Vertex Algebras and Algebraic Curves, 2nd ed., AMS.