



## LECTURE COURSE IN THE QUANTUM UNIVERSE RESEARCH SCHOOL

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Winter Term 2023/2024

# Lie Algebras

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### Course Description:

The importance of Lie algebras derives from their relation to Lie groups. A Lie group is a group and a manifold, such that the group operations are smooth maps. They often arise as symmetry groups in physics and mathematics. The group  $SO(n)$  of rotations in  $\mathbb{R}^n$  is such an example. Lie algebras, the topic of this course, in turn are "linearisations" of Lie groups, or "infinitesimal symmetry transformations". They consist of a vector space together with a bilinear operation, the Lie bracket. Surprisingly, many of the properties of Lie groups can be derived from these linearisations. We will study:

- definition and basic properties of Lie algebras,
- nilpotent and solvable Lie algebras,
- universal enveloping algebra and PBW-basis,
- semisimple Lie algebras: root systems, Dynkin diagrams, classification,
- highest weight representations.

This course is mainly aimed at Masters students in Mathematics and Mathematical Physics.

### Prerequisites:

Basic notions from algebra (groups, fields, linear algebra).

<b>Date and Place:</b>	Tue, 12:15–13:45, Hörsaal H3, Geomatikum Fri, 14:15–15:45, Hörsaal H3, Geomatikum
<b>Problem Classes:</b>	Fri, 16:15–17:45, Hörsaal H3, Geomatikum
<b>Starting on:</b>	17 October 2023

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