

## AB Geometrie & Topologie

Prof. Bernhard Leeb, Ph.D.

# Knots

SEMINAR SOSEM 2026

as of February 3, 2026

Knots are very intuitive mathematical objects and basic questions about them are readily grasped, the first ones being: What is knottedness and how to detect it? How to distinguish knots from each other? In this way, they provide a wide playground to apply basic methods from algebraic topology.

Knots are also important mathematical objects, for instance, because they yield a rich family of interesting examples of 3-manifolds, namely knot complements. These are noncompact 3-manifolds with one end having a torus cross section and they can be closed up in various ways by Dehn filling, that is, by inserting a solid torus.

The seminar will focus on topological aspects even though we will also touch on some combinatorial techniques, elementary differential-geometric aspects (Fary-Milnor theorem) and explore connections to Thurston's Geometrization Program which changed the landscape of 3D-topology. Among the possible topics of the seminar are:

- colourings of knots and applications
- fundamental groups of knot complements (Wirtinger presentation)
- symmetries of knots, chirality
- Seifert surfaces
- Alexander polynomial
- torsion invariants
- total curvature of knots after 18 year young Milnor (a brief excursion into elementary differential geometry)
- geometric structures on knot complements

**Main references:** Burde, Zieschang, *Knots*, de Gruyter, 2nd ed, 2003.

Livingston, *Knot theory*, AMS, 1996.

Rolfsen, *Knots and Links*, Publish or Perish, 1976.

**Prerequisites:** Algebraic topology I (fundamental group, covering spaces, very beginnings of homology).

**For:** Students of mathematics or physics (master, TMP)

**Time+room:** Tuesday 4:15-6:00 pm in room B 252

**First talk:** April 14

**Registration:** Please write me e-mail if you want to participate. **The earlier, the better**, because this facilitates the organisation and the distribution of the talks and makes it possible that the seminar starts in the first week of the semester.