

AB Geometrie & Topologie

Prof. Bernhard Leeb, Ph.D.

Dr. Christian Lange

More on cohomology

READING COURSE WiSEM 2026/2027

as of October 9, 2026

This reading course continues the algebraic topology cycle of the past two semesters. Its aim is to deepen our understanding of cohomology by working through explicit computations, classical applications, and the connections between cohomology and other topics in topology and algebra. Planned topics include

- **Computations:** cohomology rings of non-orientable surfaces, real and complex projective spaces, tori and lens spaces.
- **Applications:** Borsuk–Ulam theorem, ham sandwich theorem, real division algebras, Alexander duality, non-embedding results.
- **Comparison of different cohomology theories:** sheaves, singular, Čech and de Rham cohomology, de Rham theorem.

Further possible reading directions are the connections of cohomology with homotopy theory (Eilenberg–MacLane spaces, the representability theorem and the classification of line bundles) and with group theory (group cohomology, with the Poincaré homology sphere and the binary icosahedral group as a guiding example).

Some references:

Hatcher, *Algebraic topology*, Cambridge University Press, 2002.

Greenberg, Harper, *Algebraic topology: a first course*, 1981.

Warner, *Foundations of differentiable manifolds and Lie groups*, Springer, 1983.

Bott, Tu, *Differential forms in algebraic topology*, Springer, 1982.

Bredon, *Topology and geometry*, Springer, 1993.

Madsen, Tornehave, *From calculus to cohomology: de Rham cohomology and characteristic classes*, Cambridge University Press, 1997.

Brown, *Cohomology of groups*, Springer, 1982.

Prerequisites: Algebraic topology I+II, familiarity with de Rham cohomology is helpful.

Format: Before each meeting, all participants read the agreed material. In the meeting we discuss the reading, work through examples and exercises, and clarify open questions. Each week one participant leads the discussion.

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

Time+room: Monday 4:15-6:00 pm in B 134.

First meetings: October 12 (organizational questions, cohomology of orientable surfaces, first reading assignment), October 19 (first discussion session)