AB Geometrie & Topologie
Dr. Christian Lange
Panagiotis Papadopoulos

Riemannian Geometry

SoSem 2025

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Riemannian geometry emerged in the 19th century from the study of surfaces in $\mathbb{R}^3$ and is more generally concerned with the geometry of higher-dimensional curved spaces, so-called Riemannian manifolds. Beside its interactions with other mathematical branches like topology or geometric analysis, Riemannian geometry enabled the formulation of Einstein's general theory of relativity.

In the lecture we will give an introduction to Riemannian geometry including

- metric space structure of a Riemannian manifold, shortest paths, the theorem of Hopf–Rinow
- connections and different notions of curvature
- geodesics, exponential map and Jacobi fields
- relations between curvature and global shape (e.g. the theorem of Bonnet–Myers and the theorem of Cartan–Hadamard)

For master students of mathematics and physics and advanced bachelor students.

Prerequisites: basic theory of smooth manifolds (e.g. tangent bundle, differential forms, flows and distributions).

Time: Tue 14:15 - 16:00 in B 006 & Thu 8:30 - 10:00 in A 127

References:

M. Do Carmo, *Riemannian Geometry*, Birkhäuser, 1992
J. M. Lee, *Introduction to Riemannian manifolds*, Springer, 2018
W. Ballmann, *Lectures on Differential Geometry*
B. O'Neill, *Semi-Riemannian Geometry*, Academic Press, 1983

To participate please register in Moodle (enrolment key "Riemann").