EBERHARD KARLS
UNIVERSITÄT
TÜBINGEN

Mathematisch-
Naturwissenschaftliche
Fakultät
Fachbereich Mathematik
AB Geometrische Analysis und
Mathematische Relativitätstheorie

Summer Semester 2025

Mathematical Relativity

Lecturer: Prof. Dr. Carla Cederbaum, cederbaum@math.uni-tuebingen.de
Teaching Assistant: Ariadna León Quirós, quiros@math.uni-tuebingen.de
Start: Wednesday, April 16
Time: Wednesdays and Fridays, 10:15am-12:00am, N16
Platform: please join ILIAS group Mathematical Relativity 2025, all information will be shared there

Description

After a short introduction to Special Relativity and its underlying Minkowskian Geometry, we will study general Lorentzian manifolds and the Einstein equations of General Relativity. One part of the lecture course will focus on static solutions of the Einstein equation, describing spacetimes that are in a state of equilibrium. These solutions are geometrically rather simple and therefore suitable for a first approach to geometric, analytic, and physical questions about spacetimes and isolated systems. In particular, we will spend a reasonable amount of time on studying the Schwarzschild spacetime and many of its mathematical and physical properties. Time permitting, we will prove the Bunting–Masood-ul-Alam static black hole uniqueness theorem. In the Wintersemester, a seminar on causality and singularity theorems is planned as a follow up course building on this lecture as a prerequisite.

If desired, the lecture will take place in a hybrid format via zoom and will be recorded, enabling asynchronous and/or remote participation. Details will be discussed in the first week of classes.

Requirements

Geometry in Physics or Differential Geometry

Useful, but not required: Linear PDEs

Literature

R. M. Wald, *General Relativity*, The University of Chicago Press (1984)

H. Fischer und H. Kaul, *Mathematik für Physiker, Band 3*, Springer Spektrum, 3. Auflage (2013)

B. O'Neill, *Semi-Riemannian Geometry With Applications to Relativity*, Academic Press, Math. 103

S. W. Hawking und G. F. R. Ellis, *The large scale structure of space-time*, Cambridge Monographs on Mathematical Physics (1973)

Exam

To be admitted to the exam, you will need to get 50% of all points on the exercise sheets (including the project theses, see below). The exam will be oral, you will be able to choose from a list of dates in July–October.

Project theses

In the week of June 23-27, the participants will be asked to write little project theses about classical results in GR instead of solving exercises. The project theses will count like two exercise sheets. There will not be lectures in that week, instead there will be Q&A sessions for the projects.