EBERHARD KARLS
UNIVERSITÄT
TÜBINGEN

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

Sommersemester 2021

Mathematical Relativity

Lecturer: Prof. Dr. Carla Cederbaum
Start: Monday, April 19; first Q&A on Wednesday, April 21
Time: Asynchronous class with Q&A on Wednesdays, 8.30am-10.00am
Platform: please join ILIAS group Mathematical Relativity 2021, 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. Another part of the lecture course will be dedicated to investigating causality, cosmological models, and the Big Bang, specifically the Hawking singularity theorem.

Requirements

Geometry in Physics or Differential Geometry or Mathematische Physik: Klassische Mechanik

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.

Project theses

In the week of June 28–July 2, the participants will be asked to write little project theses about classical result in GR instead of solving exercises. The project theses will count like two exercise sheets.

Exercise classes

The timing and form (analog/digital/hybrid) of the synchronous exercise classes will be determined in the first or second week of classes.

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