EBERHARD KARLS
UNIVERSITÄT
TÜBINGEN

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

Wintersemester 2019/20

Vorlesung: Advanced methods in general relativity

Instructor: Dr. Edward T. Bryden
Start: Wednesday, October 16th 2019
Time and place: Wednesday, 16 c. t. to 18, in C-N16/M3

Description

In this course we will study some important geometric inequalities applying to initial data sets for Einstein's equation. We will focus our attention on axisymmetric metrics, by taking advantage of the additional symmetry to provide a simple proof of the positive mass theorem. If time and interest allow, we may also cover the more general positive mass theorem, and the Penrose inequality.

We will also study angular momentum, a phenomenon which is straightforward to define in axisymmetry, but is not well understood in full generality. In particular, we look at an elaboration of the positive mass theorem: the mass-angular momentum-inequality, and the charge-angular momentum- mass-inequality. We will also study the area-charge-angular momentum-inequality, an example of the analogy between the properties of blackholes and thermodynamical quantities.

Requirements

Geometry in Physics and Mathematical Relativity or some other course that includes differential geometry, especially containing some submanifold theory. Familiarity with partial differential equations is welcome, though not necessary.

Literature

Jost, Jürgen., *Riemannian geometry and geometric analysis*, Universitext, Springer-Verlag Berlin Heidelberg, 2011.

Chruściel, Piotr T., *Mass and angular-momentum inequalities for axi-symmetric initial data sets I. Positivity of mass*, Annals of Physics, **323** (2008), 2566-2590.

R. Schoen, and X. Zhou, *Convexity of reduced energy and mass angular momentum inequalities*, Ann. Henri Poincareé, **14** (2013), 1747-1773.

E.T. Bryden, and M.A. Khuri, *The area-angular momentum-charge inequality for black holes with positive cosmological constant*, Class. Quantum Grav., **34** (2017), 125017.