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FAKULTÄT FÜR MATHEMATIK
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Einladung zur öffentlichen Defensio von

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Thema der Dissertation:

Analytic and geometric aspects of spacetimes of low regularity

Abstract: The general theory of relativity describes the effect of gravitation in terms of the geometry of spacetimes. The curvature of Lorentzian manifolds is related to the energy and momentum of matter (or vacuum) by the Einstein equations, a system of nonlinear partial differential equations. In the 1950s the initial value formulation and local existence of solutions to the Einstein equations were established. As of yet the global structure of spacetimes is much less understood. Motivated by this I investigate the evolution as well as the regularity of spacetimes. I show that certain energy estimates can be controlled by one-sided bounds on the geometry only. Estimates of the Bel-Robinson energy, for example, play a crucial role in the derivation of breakdown criteria for solutions of the vacuum Einstein equations. As an important astrophysical model spacetimes with perfect fluid sources are considered. An existence theory for spherically symmetric solutions to the Einstein-Euler equations is presented, and I identify for the first time a class of untrapped initial data that leads to the dynamical formation of trapped surfaces. To allow for shock waves, solutions are regarded to be of bounded variation. The distributional framework is essential here and in other areas of general relativity, and it is crucial to understand if and how the regularity of metrics influences the geometry of spacetimes. I account for this by deriving some general results on continuous Riemannian metrics. This thesis thus illustrates that spacetimes of low regularity exhibit a wide range of interesting phenomena during their evolution.

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Zeit: Montag, 13. Januar 2014, 10:00 Uhr

Ort: Fakultät für Mathematik, Vislab 01.313, Oskar-Morgenstern-Platz 1