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FAKULTÄT FÜR MATHEMATIK
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Einladung zur öffentlichen Defensio von

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Thema der Dissertation:

Causality theory for $C^{1,1}$ metrics

Abstract: This thesis studies the causality theory with low differentiability metrics, in particular, with metrics of $C^{1,1}$ regularity class. One of the key tools for studying local causality and therefore, singularity theory is the exponential map. In smooth pseudo-Riemannian geometry, the fact that the exponential map is a local diffeomorphism is of central importance for many fundamental constructions such as normal coordinates, normal neighborhoods, injectivity radius and comparison methods. There has for some time been considerable interest in determining the lowest degree of differentiability where one could expect the standard results of causality theory to remain valid. A reasonable candidate is given by the $C^{1,1}$ regularity class as it represents the threshold of the unique solvability of the geodesic equation.
Hence our aim is to show that the exponential map of a $C^{1,1}$ pseudo-Riemannian metric retains its maximal possible regularity, namely, that is a local bi-Lipschitz homeomorphism. This will allow us to prove the existence of totally normal neighborhoods and establish the key results of local causality theory.
The next goal is to further develop causality theory for $C^{1,1}$ metrics. We also study the global structure of spacetimes, reviewing the causality conditions that can be imposed on a spacetime and the main properties of Cauchy developments and Cauchy horizons.
The last part is devoted to the study of singularity theorems. Having the key elements of causality theory for $C^{1,1}$ metrics developed, we prove the Hawking singularity theorem in this regularity.

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