GR 3: Hauptvorträge: Mathematische Methoden

Zeit: Dienstag 11:15–12:45 Raum: HS 6

Hauptvortrag GR 3.1 Di 11:15 HS 6

Causal fermion systems: A quantum space-time emerging from an action principle — •Felix Finster — Mathematics Department, University of Regensburg, Germany

Causal fermion systems provide a general framework for the formulation of relativistic quantum theory. A particular feature is that space-time is a secondary object which emerges by minimizing an action. The aim of the talk is to give a simple introduction, with an emphasis on conceptual issues. We begin with Dirac spinors in Minkowski space and explain how to formulate the system as a causal fermion system. As an example in curved space-time, we then consider spinors on a globally hyperbolic space-time. An example on a space-time lattice illustrates that causal fermion systems also allow for the description of discrete space-times. These examples lead us to the general definition of causal fermion systems. The causal action principle is introduced. We outline how for a given minimizer, one has notions of causality, connection and curvature, which generalize the classical notions and give rise to a proposal for a "quantum geometry". In the last part of the talk, we outline how quantum field theory can be described in this framework and discuss the relation to other approaches.

Hauptvortrag GR 3.2 Di 12:00 HS 6

How to reconstruct a metric by its unparameterized geodesics — •Vladimir Matveev — Mathematical Institute , University of Jena

We discuss whether it is possible to reconstruct a metric by its unparameterized geodesics, and how to do it effectively. We explain why this problem may be interesting for general relativity. We show how to understand whether all curves from a sufficiently big family are unparameterized geodesics of a certain affine connection, and how to reconstruct algorithmically a generic 4-dimensional metric by its unparameterized geodesics. The algorithm works very effectively if the searched metric is Ricci-flat. We also prove that almost every metric does not allow non-trivial geodesic equivalence, and construct all pairs of 4-dimensional geodesically equivalent metrics of Lorenz signature. If the time allows, I will also explain how this theory helped to solve two mathematical problems explicitly formulated by Sophus Lie in 1882, and the semi-Riemannian two-dimensional version of the projective Lichnerowicz-Obata conjecture. The new results of the talk are based on the papers arXiv:1010.4699, arXiv:1002.3934, arXiv:0806.3169, arXiv:0802.2344, arXiv:0705.3592 joint with Bryant, Bolsinov, Kiosak, Manno, Pucacco, and on an unpublished work with Trautman.