MP 7: Nichtkommutative Geometrie

Zeit: Donnerstag 14:00–16:00 Raum: KGI-HS 1023

MP 7.1 Do 14:00 KGI-HS 1023

Morita-Äquivalenz, Hopf-Algebren und Deformationsquantisierung — •Stefan Jansen, Stefan Waldmann und Nikolai Neumaier — Fakultät für Mathematik und Physik, Physikalisches Institut, Freiburg

In diesem Vortrag werde ich einige wesentlich Ergebnisse meiner Doktorarbeit vorstellen. In dieser habe ich mich mit der Morita-Äquivalenz von *-Algebren, d.h. Algebren mit einen antilinearen Antiautomorphismus auseinandergesetzt, die mit einer durch eine Hopf-*-Algebra induzierte Symmetrie ausgestattet sind. Ich werde die wesentlichen Konzepte und ergebnisse vorstellen, sowie die Bedeutung für die moderne Physik herauszuarbeiten.

MP 7.2 Do 14:20 KGI-HS 1023

Neutrino Masses in Noncommutative Geometry — •Christoph Alexander Stephan — Universität Potsdam, Institut für Mathematik, Am Neuen Palais 10, 14469 Potsdam

During the last two decades Alain Connes developed noncommutative Geometry, which allows to unify two of the basic theories of modern physics: General Relativity and the Standard Model of Particle Physics.

In its original version the noncommutative Standard Model allowed only Dirac-Neutrinos. Recently Alain Connes and John Barrett showed that this is due to the fact that the internal space of noncommutative Geometry is Euclidian in an algebraic sense. If one changes its signature from Euclidian to Minkowskian signature, Majorana mass terms are in principle allowed and the SeeSaw mechanism appears naturally.

In this talk I will give an overview of the different possibilities to introduce neutrino masses in the noncommutative Standard Model à la Connes. Since Majorana masses for right-handed Neutrinos result in an incompatibility with the Connes' axiom of orientability for noncommutative spaces, I will present a model which offers a bypass to the SeeSaw mechanism by enlarging the Standard Model particle content while respecting the whole set of axioms.

MP 7.3 Do 14:40 KGI-HS 1023

Recent Results on the Topology of Non-commutative Geometry on the Lattice — Wolfgang Frisch[1], Harald Grosse[2], •Harald Markum[1], and Florian Teischinger[1] — [1]Atominstitut, Vienna University of Technology, Austria — [2]Department for Theoretical Physics, University of Vienna, Austria

Theories with noncommutative space-time coordinates represent alternative candidates of grand unified theories. We discuss U(1) gauge theory in 2 dimensions on a lattice with N sites [1]. The mapping to a U(N) one-plaquette model in the sense of Eguchi and Kawai can be used for computer simulations. We are interested in the formulation and evaluation of topological objects [2]. We performed quantum Monte Carlo simulations and calculated the topological charge for different matrix sizes and several values of the coupling constant. We constructed classical gauge field configurations with large topological charge and used them to initialize quantum simulations. It turned out that the value of the topological charge is decreasing during a Monte Carlo history. Our results show that the topological charge is in general supressed. The situation is similar to lattice QCD where quantum gauge field configurations are topologically trivial and one needs to apply some cooling procedure on the gauge fields to unhide the integer number of the instantons. Our recent analyses will be presented [3].

[1] W. Bietenholz et al., Fortsch. Phys. 53 (2005) 418
[2] H. Aoki, J. Nishimura, Y. Susaki, hep-th/0602078
[3] W. Frisch, H. Grosse, H. Markum, PoS(LAT2007)317

MP 7.4 Do 15:00 KGI-HS 1023

On positivity and normalization for a quantum field theory on non–commutative spacetime — •Christoph Dehne — ITP, Universität Leipzig, Vor dem Hospitaltore 1, D - 04103 Leipzig

It is well–known that for non–commutative theories with time/space non–commutativity different perturbation schemes (for vacuum expectation values of quantum fields) are no longer equivalent. Therefore, we would like to find out which ones respect the criteria necessary for a probability interpretation, namely positivity and normalization. To this end, we derive - under special assumptions - spectral representations and sum rules that correspond to the different perturbation schemes. Then, in each case, we make a perturbative analysis of the spectral density for a theory with ϕ_*^3–interaction. It turns out that the conditions are fulfilled by those Feynman rules that are considered as unitary. However, as for those Feynman rules that are "usually known to violate unitarity", we argue that they can be understood as positivity and normalization preserving distributions, too.

MP 7.5 Do 15:20 KGI-HS 1023

Dirac Field on Moyal-Minkowski Spacetime — •Markus Borris and Rainer Verch — Inst. f. Theoretische Physik, Universität Leipzig, 04009 Leipzig

We present the Dirac field on Moyal-Minkowski spacetime as a model of quantum field theory on a Lorentzian non-commutative background spacetime. This provides an example for a quantum field theory on Lorentzian spectral geometries proposed by M. Paschke and R. Verch, and others. The scattering of the Dirac field coupled to a noncommutative potential term is investigated and it is shown that the scattering transformation is unitarily implementable in the vacuum Hilbert-space representation of the Dirac field. The way in which the scattering transformations induce observables of the Dirac field on Moyal-Minkowski spacetime, and their possible interpretation, will also be discussed.

MP 7.6 Do 15:40 KGI-HS 1023

Zustände auf nichtkommutativen Raumzeiten — •Daniel Kaschek, Nikolai Neumaier und Stefan Waldmann — Physikalisches Institut, Freiburg

Im Bestreben, eine Quantentheorie der Gravitation zu entwickeln, sind neben vielen weiteren Kandidaten auch nichtkommutative Quantenfeldtheorien in den Blickpunkt gerückt. Die Nichtkommutativität bezieht sich dabei auf die Raumzeit selbst. Was jedoch genau unter einer nichtkommutativen Raumzeit zu verstehen ist, gilt es erst noch zu klären.

Ein mathematisches Modell zur Beschreibung einer Raumzeit mit nichtkommutativer Struktur basiert auf Techniken der Deformationsquantisierung. Mit Hilfe der Rieffel-Konstruktion wird die Funktionenalgebra der Observablen auf der Raumzeit zu einer nichtkommutativen C*-Algebra deformiert. Zustände und Erwartungswerte sind somit formal erklärt.

Der konkrete Zugang zu den Zuständen eröffnet sich jedoch erst, nachdem man den aus der formalen Deformationsquantisierung bekannten Übergang zwischen Weyl- und Wickprodukt auf den konvergenten Rahmen überträgt und die benötigten Positivitätseigenschaften so direkt sichtbar werden.