



## SFB-Seminar "Index Theory and Anomalies in QFT" (Teilprojekt C7)

### ZEIT:

10.11.2015, 15:00 Uhr - 18:00 Uhr

### ORT:

### PROGRAMM:

15:00 - 15:30 Kaffeepause

15:30 - 16:30 **Prof. Dr. Christian Baer (U. Potsdam)**

#### **An index theorem for compact Lorentzian manifolds with boundary**

Starting with the classical Gauss-Bonnet theorem we give a short historical introduction to index theory. Then we show that the Dirac operator on a compact globally hyperbolic Lorentzian space-time with space like Cauchy boundary is a Fredholm operator if appropriate boundary conditions are imposed. We prove that the index of this operator is given formally by the same expression as in the index formula of Atiyah-Patodi-Singer for Riemannian manifolds with boundary.

This is the first index theorem for Lorentzian manifolds and, from an analytic perspective, the methods to obtain it are quite different from the classical Riemannian case.

16:30 - 17:00 Kaffeepause

17:00 - 18:00 **Prof. Dr. Alexander Strohmaier (Loughborough University)**

#### **The gravitational chiral anomaly and index theory for hyperbolic operators**

Anomalies play an important role in our understanding of Quantum Field Theory. They can be understood in the context of QFT in

### Kontakt:

Humboldt-Universität zu Berlin . Institut für Mathematik  
SFB 647 . Unter den Linden 6 . 10099 Berlin  
Tel. +49 30 2093 1804 . Fax. +49 30 2093 2727  
sfb647@math.hu-berlin.de

[www.raumzeitmaterie.de](http://www.raumzeitmaterie.de)

external fields in terms of charge generation by interaction with an external field. I will explain in rigorous terms the mathematics behind this process and relate it to index theory. I will then show how this relates to the index of the Dirac operator with Atiyah-Patodi-Singer boundary conditions as explained in the talk of C. Bär. This allows for a rigorous derivation of the gravitational chiral anomaly and an eta correction term. I will briefly discuss some physical consequences.

**Kontakt:**

Humboldt-Universität zu Berlin . Institut für Mathematik  
SFB 647 . Unter den Linden 6 . 10099 Berlin  
Tel. +49 30 2093 1804 . Fax. +49 30 2093 2727  
sfb647@math.hu-berlin.de

[www.raumzeitmaterie.de](http://www.raumzeitmaterie.de)