



# **Prof. Dr. Markus Pflaum**

## **Noncommutative Geometry and Index Theory (4)**

### **TIME:**

29 Jun 2010, 17:15 - 18:45

### **LOCATION:**

HU

Institut für Mathematik

Rudower Chaussee 25, 1.115

12489 Berlin

Noncommutative Geometry and Index-Theory

Content:

Noncommutative Geometry is a relatively young mathematical discipline. Its main idea is to study noncommutative algebras as "function algebras" of some abstract "noncommutative spaces". Among other, Noncommutative Geometry emanated from the mathematical structures governing quantum physics, where the observable space is encoded by a noncommutative algebra. Methods from Noncommutative Geometry have lead to new and striking results for Operator Theory, Global Analysis and Mathematical Physics, in particular for quantization theory and the index theory of geometrically defined operators on manifolds.

The lecture is intended for graduate students in Mathematics or Physics.

The foundations for further work in the field of Noncommutative Geometry or Index Theory will be provided in the course. Particular attention will be laid on deformation

quantization, since it provides a mathematically rigorous method for the construction of noncommutative algebras describing quantum mechanical systems.

Moreover, methods from deformation quantization give rise to a particularly elegant proof of index theorems. In the course, the concept of elliptic pseudodifferential operators and their indices will be explained. It will be shown how algebras of pseudodifferential operators can be interpreted as a deformation of an

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appropriate commutative function algebra. After that, we will explain the fundamental ideas of Connes' Noncommutative Geometry and apply it to the study of deformed algebras.

In a final lecture, these concepts will be brought together and used for a proof of the index theorem by Atiyah-Singer and its generalizations.

Prerequisites:

The course is mainly intended for students of Mathematics or Theoretical Physics.

Prerequisites for participation are a solid knowledge of the basic courses in Analysis and Linear Algebra. Some acquaintance with manifold theory and/or quantum mechanics is helpful.

Textbooks:

B. Fedosov, Deformation Quantization and Index Theory

M. Khalkhali, Basic Noncommutative Geometry

further course material will be presented during the lectures

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