# Prof. Dr. Markus Pflaum
# Noncommutative Geometry and Index Theory (3)

**TIME:**
21 Jun 2010, 8:00 - 9:30

**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 de□fined 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 pseudodiff□erential operators and their indices will be explained. It will be shown how algebras of pseudodi□fferential operators can be interpreted as a deformation of an

**Contact:**
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

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 fi□nal 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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