

*Lecturer:* Batu Güneysu

*Title of the seminar:* The probabilistic proof of the Atiyah-Singer Index Theorem, SS 2019, University of Bonn (S2B3, Hauptseminar globale Analysis)

*Prerequisites:* functional analysis (spectral theorem), stochastic differential equations, a basic knowledge of differential geometry (manifolds, tangent spaces, ...)

*Content:* The Atiyah-Singer index theorem is one of the most important mathematical results of the past century. Roughly, it states that the index of a twisted Dirac operator on a compact even dimensional Riemannian spin manifold can be calculated from topological data. Thus, the Atiyah-Singer index theorem allows to calculate geometric data from topological data. The aim of this seminar is to give an introduction to this topic, by explaining all data that appear in the index theorem, and finally explaining its probabilistic proof, originally given by Bismut. The latter proof uses path integral methods.

Possible topics include:

- Spin groups
- Spin manifolds
- Characteric classes
- Fredholm operators on manifolds
- Introduction to stochastic analysis
- Introduction to stochastic analysis on manifolds
- Brownian motion on Riemannian manifolds
- The covariant Feynman-Kac formula
- Fredholm operators on manifolds
- The probabilistic proof of the Atiyah-Singer index theorem

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