Symplectic Geometry, Non-Abelian Localization and Path Integrals

Level of course
PhD Course

Semester/quarter
1st + 2nd quarter (Autumn 2011)

Hours per week
4 hours

Name of lecturers
Jørgen Andersen and Brendan McLellan

Objectives of the course
Our main objective will be to understand the following two papers as applications of the method of non-abelian localization in quantum field theory:

1) E. Witten, *Two dimensional gauge theories revisted*, Commun. Math. Phys. **9** (1992), no. 4, 303-678,

2) C. Beasley and E. Witten, *Non-abelian localization for Chern-Simons theory*, J. Differential Geom. **70** (2005), 183-323.

Prerequisites
Basic theory of manifolds

Course contents
Introductory symplectic geometry, (exact) stationary phase approximation, Duistermaat-Heckman theorem, equivariant localization theorem, path integrals, gauge theories, moduli spaces of connections, non-abelian localization for 2D Yang-Mills theory, non-abelian localization for 3D Chern-Simons theory, three-dimensional geometry and topology.

Learning outcomes and competences
Relevant to the course subject matter the student should at the end of the course be able to:

(a) reproduce key results and give rigorous and detailed proofs of them,

(b) compare key results,

(c) apply the basic techniques, results and concepts of the course to concrete examples and exercises,

(d) to study a prescribed topic on his own and give an oral presentation of selected parts of the topic for his fellow students with pertinent written notes.

Literature

C. Beasley and E. Witten, *Non-abelian localization for Chern-Simons theory*, J. Differential Geom. **70** (2005), 183-323.

N. Berlinge, E. Getzler and M. Vergne, *Heat kernels and Dirac operators*, Grundlehren, vol. 298, Springer-Verlag, 1992.

C. P. Boyer and K. Galicki, *Sasakian geometry*, Oxford University Press, 2008.

D. Freed, *Classical Chern-Simons theory. I*, Adv. Math. **113** (1995), no. 2, 237-303.

E. Witten, *Two dimensional gauge theories revisted*, Commun. Math. Phys. **9** (1992), no. 4, 303-678.

E. Witten, *Quantum field theory and the Jones polynomial*, Commun. Math. Phys. **121** (1989), no. 3, 351-399

Assessment methods

Passed / not passed will be based on the students participation in the course

Credits

10 ECTS

Language of instruction

English