EBERHARD KARLS
UNIVERSITÄT
TÜBINGEN

Mathematisch-
Naturwissenschaftliche
Fakultät
Fachbereich Mathematik

Hamiltonian Systems

This course aims to provide students with an introduction to the theory of Hamiltonian systems as used in classical mechanics while emphasizing its role as a connecting framework between differential geometry, symplectic geometry, dynamical systems, and theoretical physics. Symplectic geometry plays a crucial role as the mathematical foundation of Hamiltonian dynamics, and understanding symplectic geometry offers essential insights into the geometry of Hamiltonian systems, facilitating the analysis of their behavior.

The main topics of the lecture include:

- Symplectic manifolds and the canonical 1-form of the cotangent bundle
- Darboux-Moser Theorem
- Lagrangian and Hamiltonian systems
- Integrable systems and Arnold-Liouville Theorem
- Momentum maps
- Symplectic reduction
- Symplectic manifolds and toric actions

References:

1. V.I. Arnol' d, *Mathematical methods of classical mechanics*, Graduate Texts in Mathematics (60), second edition, Springer-Verlag, New York (1989).
2. A. Cannas da Silva, *Lectures on symplectic geometry*, Lecture Notes in Mathematics (1764), Springer-Verlag, Berlin, (2001).

More references will be provided as the course progresses.

Lecturer: Dr. Stefan Suhr, stefan.suhr@ruhr-uni-bochum.de

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Lectures (online) Monday 12:15-14:00, Wednesday 10:15-12:00 **Start: 8. April 2024** (The link for the lectures will be shared on the ILIAS page of the course)

Exercise classes (in Tübingen): Thursday 10:15-12:00 or Friday 12:15-14:00 (will be decided in the first week of classes)

Language: English

Exam: Oral exam

SWS / ECTS: 4+2 / 9

Prerequisites: Basic knowledge in Differential Geometry, such as e.g. *Geometry in Physics*.