ulm university universität
uulm
Fakultät für Naturwissenschaften, Fachbereich Physik

Announcement

Nonlinear Physics

Description

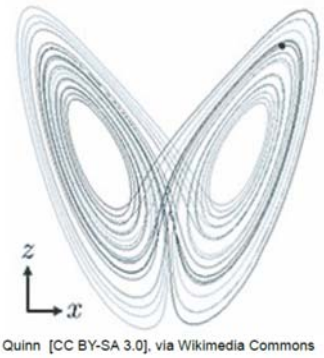
Everyone knows the harmonic oscillator, the paradigmatic model in all fields of physics. It is simple since its equation of motion is linear. However, the real world is ruled by nonlinearities. In fact, nonlinearities give rise to a fascinating wealth of phenomena ranging from bi- and multi-stabilities to chaotic behaviour. In the quantum domain, nonlinear effects like down-conversion are of crucial importance in quantum optics.

The lecture will be complemented by a graduate seminar. Students can attend lecture and seminar independently.

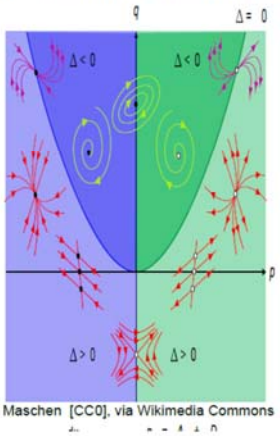
Content

In this graduate seminar we will cover the following topics:

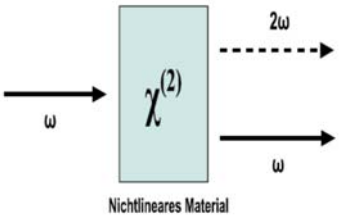
1. Recap classical mechanics: Lagrange, Hamilton, phase space orbit
   - Example 1: Driven dissipative harmonic oscillator
   - Example 2: Duffing oscillator (overview)
2. Bifurcations, stability analysis, Lyapunov exponents, route towards chaos
3. Duffing oscillator (details);
   rotating frame, elliptic functions, catastrophes
4. Josephson Junctions as a possible platforms:
   Josephson bifurcation amplifier (JBA)
5. Van der Pol Oscillator (synchronization)
6. Solitons: Fiber optics or Bose-Einstein condensates
7. Quantum: Parametric oscillator, RWA, quasi-energy, dynamical Casimir effect
8. Nonlinear optics: Down conversion
9. Driven quantum oscillators: Master equation, semiclassics
10. Josephson-cavity devices or nanomechanics or optomechanics



Quinn [CC BY-SA 3.0], via Wikimedia Commons



Maschen [CC0], via Wikimedia Commons



Nichtlineares Material

Prerequisites

Formal prerequisites: none

Recommended prerequisites: Bachelor courses on Theoretical Mechanics and Quantum Mechanics

Additional Information

2 hours weekly

Begin: 21.04.2017 at 12.15 in N24/252

With oral examination: 3 ECTS credits
Without examination: 2 ECTS credits

Lecturer

Prof. Ankerhold and Dr. Kubala, Institute of Complex Quantum Systems