Mathematical Methods of Quantum Mechanics

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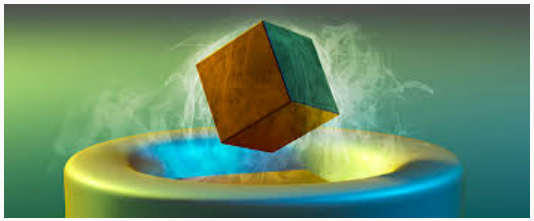
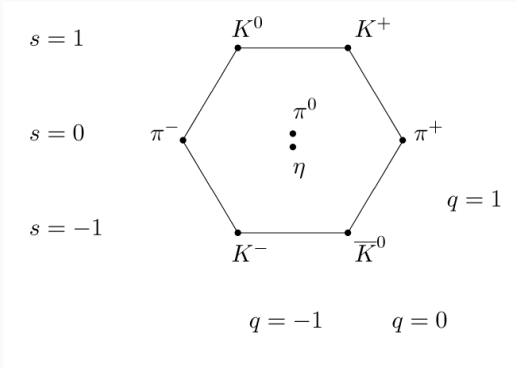
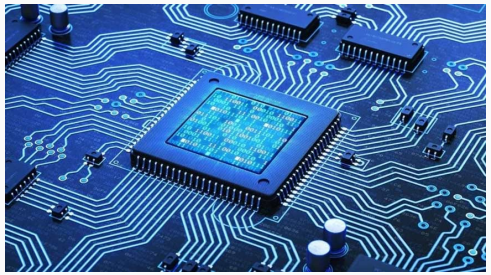
Presentation of PhD Courses in Mathematics 2024/2025

Mathematical Methods of Quantum Mechanics







Quantum mechanics: central theory in physics, describing elementary particles, superconductors, quantum computers, ...

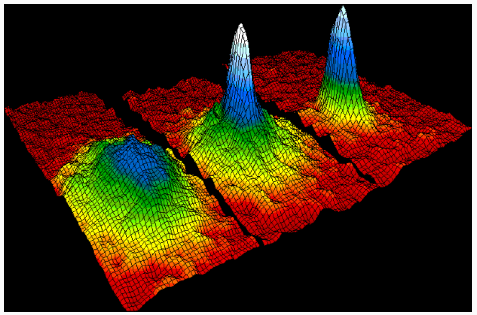
Challenging mathematical problems in functional analysis, partial differential equations and operator theory. Very active current research topic.

Mathematical Methods of Quantum Mechanics

Course Description: Introduction to the rigorous mathematical framework of quantum mechanics

- Operator theory, self-adjointness
- Time-dependent Schrödinger equation, Schrödinger operators
- Symmetries and conservations laws
- Existence of stationary states

The course will conclude with an introduction to current problems in many-body systems (nonlinear Schrödinger equation, stability of matter, phase transitions, universality)



Prerequisites: Basic notions of analysis.
Course Period: Last week of February until the last week of May (30 hours).
Exam: Oral examination.

The course is directed to Master's students and PhD students.

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References

Main references

- Gerald Teschl: Mathematical Methods in Quantum Mechanics, With Applications to Schrödinger Operators
  https://www.mat.univie.ac.at/~gerald/ftp/book-schroe/index.html
- Jan Philip Solovej: Many Body Quantum Mechanics, Lecture Notes
  https://web.math.ku.dk/~solovej/MANYBODY/mbnotes-ptn-5-3-14.pdf

Other references

- Hamiltonian mechanics: Chapter 3 in Bergfinnur Duurhus, Jan Philip Solovej, Mathematical Physics, lecture notes
  https://noter.math.ku.dk/mathphys2014.pdf
- Overview: Stephen J. Gustafson, Israel Michael Sigal, Mathematical Concepts of Quantum Mechanics.
  https://www.math.utoronto.ca/~sigal/semlectnotes/1.pdf
- Constructive approach to functional analysis: Elliott H. Lieb, Michael Loss, Analysis.