

Advanced Chapters of the Quantum Theory– syllabus

- **Operator algebras and sets**
 - Basic notions
 - C^* algebras
 - GNS construction
 - W^* algebras
 - States on algebras
 - Properties of operator sets
 - Algebraic axiomatization of the quantum theory
- **Unstable quantum systems**
 - Quantum kinematics of decays
 - Are unstable states physically realizable?
 - Resonances as poles of the continued resolvent
 - Friedrichs model
- **Schrödinger operators**
 - Definition domain of the free Hamiltonian
 - Self-adjointness: perturbative and other methods
 - Minimax principle
 - Perturbation theory of eigenvalues
 - Discrete spectrum: number of bound states
 - Further properties of bound states
 - Resonances: complex scaling method
 - Essential spectrum: HVZ theorem
- **Scattering theory**
 - wave operators, asymptotic completeness
 - Existence criteria for wave operators
 - Potential scattering
 - A model of two-channel scattering
- **Quantum waveguides**
 - Curvature-induced bound states
 - Laterally coupled waveguides
 - Scattering in curved tubes
 - Weak coupling asymptotic behaviour
 - Curved Dirichlet layers

- **Quantum mechanics on graphs**

- The class of admissible hamiltonians

- Meaning of the boundary conditions: weak coupling

- A duality

- Periodic systems: lattice graphs

- Generalized graphs with components of different dimensions

- Leaky graphs

- **Wannier-Stark systems**

- Regular periodic potencial: a “ladder” of resonances

- Onedimensional point interactions

- Strongly singular WS systems: character of the spectrum

- A seemingly simple problem with δ interactions

- **Magnetic systems**

- Local magnetic fields: Aharonov-Casher theorem

- Binding due to anomalous magnetic moment

- Magnetic resonances in open quantum dots

- Edge states and purely quantum magnetic transport