QUANTUM MECHANICS FOR MATHEMATICIANS

PROF. DR. A. S. CATTANEO

HS 2014

Programm

(1) Hilbert spaces: Basic definitions. Bounded operators. Compact operators. The spectral theorem for self-adjoint compact operators. Trace-class and Hilbert–Schmidt operators. Closed operators. Symmetric and self-adjoint operators. Resolvent and spectrum. The spectrum of self-adjoint operators. The spectral theorem for (bounded and unbounded) self-adjoint operators. Stone's theorem. [2, 3, 4]

(2) Basic principles of quantum mechanics: Observables, states, and dynamics. Heisenberg's uncertainty relations. Heisenberg's commutation relations. Coordinate and momentum representations. Free quantum particle. Harmonic oscillator. Stone–von Neumann theorem. Deformation quantization. [1][Chapter 2]

(3) Schrödinger equation: The virial theorem. Angular momentum and $SO(3)$. Two-body problem. Hydrogen atom; hidden $SO(4)$ symmetry. [1][Chapter 3: Sections 1.3, 3, 4.1, 4.2, 5]

(4) Spin and identical particles: Spin operators and representation theory of $SU(2)$. Pauli Hamiltonian. Systems of identical particles. [1][Chapter 4: Sections 1, 2, 3.1]

(5) Feynman path integral: The fundamental solution of the Schrödinger equation. Path integral. [1][Chapter 5: Sections 1.1, 1.2, 1.3]

References

[1] L. A. Takhtajan, *Quantum Mechanics for Mathematicians*, American Mathematical Society, 2008.

[2] N. P. Landsman, *Hilbert Spaces and Quantum Mechanics*, old version, http://www.math.kun.nl/~landsman/HSQM.pdf

[3] N. P. Landsman, *Hilbert Spaces and Quantum Mechanics*, http://www.math.kun.nl/~landsman/HSQM2006.pdf

[4] M. Reed, B. Simons, *Methods of Modern Mathematical Physics I: Functional Analysis.*, Academic Press, 1980.