TOMSK POLYTECHNIC UNIVERSITY
DEPARTMENT OF GENERAL PHYSICS

"QUANTUM MECHANICS / PROFESSIONAL ENGLISH STUDY"

COLLOQUIUM 1

Developed by
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2016

Wave-particle duality.
1. The quantum light theory.
2. The wave properties of electrons. Phase velocity. Group velocity and wave packets.

Schroedinger Equation.
1. Hamilton-Jacobi equation.
2. Wave-equation for electrons. ψ -function.
3. Lenear operators.

Schroedinger Equation solutions.
1. Stationary states. General solution. Statistical manner of wavefunction.
2. Discret and contiuous energy spectrum of operators.
3. Square potential well.
4. Free particle.
5. Borm method.
6. Dirac's delta-function.
7. Normalisation of eigenfunctions of continuous-spectrum operators.
8. Solution of Poisson equation for charged particle.

Schroedinger equation solution.
1. Method of classical boundary approximation.
2. Barer tunneling.
3. The ejection of electrons from the metal. Cold emission
4. Alpha-decay. The concept of quasilevels (quasi- discrete spectrum).

Statistical properties of quantities.
1. Mean values in quantum physics. Quantum Poisson brackets.
2. Indetermination relations.
3. Ehrenfest's theorems.

Harmonic oscillator.
1. Eigenvalues and eigenfunctions.
2. Matrix representation. Coordinate and momentum matrix elements.
3. Annigilation-creation operators repesentation for harmonic oscillator.

Representation theory.
1. Vector –state representation. Different operator representations.
2. Transformation of representations. Harmonic oscillator solution in momentum representation.
3. Heisenberg and Schroedinger representations.
4. Matrix representation.

Additional questions

1. Eslimation of wavepacket life-time for electron.
2. Fundamental cosequenses for physical quantities with noncomute operators.
3. Conservation laws in quantum theory.
4. Classical approach for quantum systems.
5. Complete set of physical quantities of a system.
6. Complementary principle.
7. Probability density in quantu theory.
8. Momentum distribution function in quantum theory.
9. Degenerate quantum state.
10. Complete set of eigenfunctions. Theorem formulation.
11. Defenition of coordinate representation for wavefunctions and operators.
12. Normalisation of eigenfuncions of continuous spectrum operator.
13. Parity of harmonic oscillator eigenfunctions.
14. Zeroth-energy of harmonic oscillator.
15. Heisenberg indeterminasy relations for adjointed coordinate andmomentum. Fourth indeterminasy condition. Fundamental meaning of indeterminacy relations.
16. Defenition of stationary states.
17. Eigenfunctions parity for particle in square well potential.
18. Number of particles operator.
19. Matrix representation of coordinate in the basis of harmonic oscillator.
20. Momentum operator and coordinate operator in momentum representation..
21. Classical approximation breackdown.
22. The difference in Heisenberg and Schroedinger representation for operators and wavefunctions.
23. Matrix representation: solution of Schroedinger equation.
24. Orthonormalization equality for eigenfunctions of discrete spectrum operator.