MODERN PROBLEMS OF QUANTUM PHYSICS

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Content

The discipline themes and lesson types

Lecture 1. Subject topics, conceptions, most bright results, prospects. The V.L. Ginsburg "list"– most important and interesting problems of physics at the beginning of XXI century.

Lecture 2. New sources of energy, modern conceptions. P.L. Kapitza "Energy and physics": physical bases of energetics, the prospects.

Lecture 3. Nuclear physics, chain reaction in uranium, modern problematics, perspectives of the safe reactor. Reactors on the fast neutrons, reactors-multipliers, transmutation of the elements.

Lecture 4. Muonic catalysis. Discovery of the resonance creation of mesomolecules in Dubna (JINR). Main results, prospects, contribution of Russian scientists.

Lecture 5. Coulomb problem of three bodies, weakly coupled states of mesomolecules of heavy hydrogen isotopes. Adiabatic expansion, hyperradial expansions, variational computations.

Lecture 6. Slow collisions in the three body system. Resonance shapes, threshold peculiarities, ramsauer effect. Resonance creation of mesomolecules of deuterium and deuterium-tritium mesomolecules.

Lecture 7. Relativistic effects in the Coulomb three body problem. Breit equations, quasipotential equations. Relativistic corrections to the energy levels of mesomolecules. Effects of polarization of vacuum in the resonance creation of mesomolecules and scattering of mesoatoms in excited states.

Lecture 8. Few-nucleon physics. Nuclear reactions of synthesis in the mesomolecules. The problem of charge asymmetry in the deuterium mesomolecule.

Lecture 9. Nuclear astrophysics, the problem of extrapolation of astrophysical factors to the low energies domain, accounting of electronic screening.

Lecture 10. Exotic atoms, the antiproton helium, antihydrogen, positronium, protonium, kaon and pion atoms.

Lecture 11. Exotic nuclei, nucleus "halo". The problem of decrypting of two-nuclon "halo" nucleus. Anomalic big sections of disintegration of "halo" nuclei.

Lecture 12. Ultracold atoms, quantum collisions in "limited geometry", resonances stimulated by confinement. Bose-Einstein condensate.

Lecture 13. Atomic laser, atomic interferometer, atomic clocks. The quantum computer problem.

Lecture 14. The colloquium: defence of the essays.