

## Scientific seminar Invited papers

**\* September 30, 2015 at 15:00**

***Dr. Levitskaya E.A. Resonant scattering of ultrarelativistic electrons in the strong field of a pulsed laser wave.***

Scattering of an electron by an electron with ultrarelativistic energy in the strong field of a pulsed laser wave is studied theoretically. Resonant scattering kinematics at small polar is studied in detail. Analytical expressions for the amplitude and differential cross section for the wave elliptical polarization are obtained. It was shown that the resonant cross section of electron-electron scattering decreases sharply with increasing of electron ultrarelativistic energy for weak and moderately strong fields. The resonant cross section in the case of the circular polarization is four times greater than the corresponding cross section for the linear polarization. The resonant cross section of ultrarelativistic electrons scattering in the field of a strong pulsed laser wave at small incoming electron angles may exceed the corresponding cross section in an external field absence by 5-6 orders of the magnitude for the electron MeV-energy and petawatt optical lasers (PHELIX, Vulcan) and 8-9 orders of the magnitude for multipetawatt laser field within the femtosecond range (Vulcan10, ELI).

**\* October 7, 2015 at 15:00**

***Dr. Lebed A.A. Resonant scattering of ultrarelativistic electrons in the field of two strong pulsed laser waves.***

The case of electron ultrarelativistic energy and the small incoming angles was under consideration. It was shown that in this case the perturbation theory respect to external laser field is applicable under resonant conditions. The interference kinematical region was determined, where emission-absorption processes of photons of the each of the waves occur in correlated manner. Comparative analysis of the resonance cross section in the interference region and cross section in the Bunkin-Fedorov region (independent processes of emission-absorption) was performed. Resonant cross section of scattering of electron by an electron in the field of two strong pulsed waves, integrated over the scattering angle, can exceed the field-free cross section in 6-7 orders of the magnitude.

**\* October 13, 2015 at 15:00**

***Dr. Starodub S.S. Interaction of nonrelativistic electrons in the pulsed field of two perpendicular laser waves.***

The interaction of two nonrelativistic electrons in the pulsed field of two linearly polarized laser waves, propagating perpendicular to each other is investigated. The Coulomb repulsion compensation between the electrons is shown. The averaged effective force of electrons attraction exceeds the Coulomb force 1.5-2 times is obtained.

**\* October 21, 2015 at 15:00**

***I. Nickishkin I.I. Modeling of dynamics of charged particle beams and plasma process by PIC method.***

Reviewed of methods PIC for modeling of dynamics of charged particle beams and plasma processes. The method is illustrated by examples of the processes of expansion of the electron gas, fluctuations in electron-positron plasmas and electron emission.

**2. Musienko I.I. *The role of field emission and dark current in high-gradient breakdown.***

The paper discusses the types of emissions, the mechanism of field emission, electrical breakdown, the influence of external electromagnetic fields on the cold emission.

**\* October 28, 2015 at 15:00**

***Helemelya A.V. Energy losses of the ion in an electron gas in a strong magnetic field.***

The analytical expression of imaginary part of susceptibility of the electron gas in a strong magnetic field is obtained. Energy losses of the ion are numerical calculated. Results of numerical calculations are compared with experiments.

**\* November 4, 2015 15,000**

***Dr. Novak A.P. Matrix elements of inner-shell ionisation in superheavy quasimolecules.***

The matrix elements of transitions in two center potential have been calculated using non-perturbative technique. A parametrization of the radial matrix elements have been carried out for the purpose of analytical solution of the coupled channels equations. The research is carried out in collaboration with SPARC@FAIR.

**\* November 11, 2015 at 15:00**

***Dr. Lysenko O.B. Creation of electron-positron pair by a photon in the two pulsed light waves.***

The process of electron-positron pair production by a photon in the two pulsed light waves is investigated. Determined the expression for the differential probability of the process.

**\* November 18, 2015 at 15:00**

***1. Dr. Denisenko O.I. Resonance annihilation of ultrarelativistic electron pair in the light field.***

This report discusses the resonant two-photon annihilation of an electron-positron pair in the field of a circularly polarized moderately strong light wave. The process is described by the two pairs of the Feynman diagram having the lines in intermediate stages either electron or positron. Due to the influence of the external field the resonant process can be effectively split into few processes of the first order in the fine structure constant: a single photon annihilation of an electron-positron pair in the field of external wave and the positron (electron) scattering with the emission of spontaneous photon taking into account the nature of intermediate particle.

***2. Lebedynskiy S. A generalization of the approach of Fowler-Nordheim field emission to the relativistic case.***

In the Fowler-Nordheim approach by the method of linking the solutions of the Klein-Gordon equation found a relativistic solution for field emission current density. Was made a comparison with the current obtained by Fowler and Nordheim in the nonrelativistic limit.

**\* November 25, 2015 at 15:00**

***Diachenko M.M. Two-photon electron-positron pair production in a strong magnetic field.***

The resonant process of electron-positron pair production by two photons on arbitrary low Landau levels has been considered. The threshold and resonance conditions of this process have been found. The general amplitude of the process for arbitrary particles polarization has been calculated and the resonance cross section of the process has been obtained in the LLL-approximation. It has been shown that the Breit-Wigner rule can be used for this case. The comparison of the pair creation rates in the

cases two and one photons has been done. The critical synchrotron photon density has been calculated in which the resonant two-photon process is comparable with one-photon, which is considered basic in the process of generation of electron-positron plasma near pulsars.

**\* December 2, 2015 at 15:00**

***1. Dr. Nedoreshta V.N. Resonant two-photon emission of an electron in the field of a pulsed laser wave.***

We present a theoretical investigation of the resonant two-photon emission of an electron in the field of a pulsed laser wave. The resonance kinematics of the process is defined. The probability is obtained. It is demonstrated that the resonant two-photon emission probability may be several orders magnitude greater than the probability of the corresponding process out of the resonance.

***2. Dr. Kravchenko S.M. Calculation of the friction force, related with pair collisions, in the impulse approximation.***

In the impulse approximation of the classical theory of collisions between two particles interacting through a central potential, friction force acting on a charged particle moving in an electron gas is calculated. The dependence of the friction force on the particle charge is analyzed in the higher orders of the impulse approximation.

**\* December 9, 2015 at 15:00**

***Dr. Voroshilo O.I. Two-photon annihilation of electron-positron pair in the field of a plane pulsed electromagnetic wave.***

Study of two-photon annihilation of electron-positron pair in the field of a plane electromagnetic wave with an envelope is continued.

Conditions of resonance of the process were determined. The expression for the resonance cross section in the case of low-intensity wave. The analysis of these expressions shown that under the resonant condition the cross-section of the studied process is on the several orders higher than the non-resonant case.

**\* December 16, 2015 at 15:00**

***1. Prof. Roshupkin S.P. Electron scattering by a nucleus in a pulsed laser field: second born approximation.***

Electron scattering by a nucleus in a pulsed laser field in the second Born approximation on interaction of an electron with the nucleus field is studied. The amplitude and cross section of the given process is obtained. Essential difference of the given process in the laser field from corresponding process without laser field is shown.

**\* December 23, 2015 at 15:00**

***1. Dr. Kholodov R.I. Spin-polarization effects in QED processes in strong magnetic fields.***

The effects of the influence of polarization of initial photons at spins of final electrons (positrons) and vice versa the effects of the influence of spins of initial particles at polarization of final photons are studied in the processes of quantum electrodynamics of the first and second orders in the strong magnetic field. Analysis is carried out in the ultraquantum and ultrarelativistic approximations.