Euler's equations are

$$
\begin{aligned}
M_a &= A\dot{\omega}_a - (B - C)\omega_b\omega_c \\
M_b &= B\dot{\omega}_b - (C - A)\omega_c\omega_a \\
M_c &= C\dot{\omega}_c - (A - B)\omega_a\omega_b
\end{aligned} \tag{3}
$$

Equations (1) are valid only for a rigid body which is dynamically symmetrical about an axis z. Axes x and y are any pair of orthogonal axes perpendicular to z. Axis z is fixed in the body, but axes x and y are not. The z component of the angular velocity of the system of axes x,y,z is arbitrary.

It is convenient to select the axes x and y such that the z component of angular velocity of the system of axes x,y,z is zero or negligible. By setting $\Omega_z = 0$ in Eqs. (1) one obtains for this special case

$$
\begin{aligned}
M_x &= A\dot{\Omega}_x + C\omega_z\Omega_y \\
M_y &= A\dot{\Omega}_y - C\omega_z\Omega_x \\
M_z &= C\dot{\omega}_z
\end{aligned} \tag{4}
$$

Kuznetsov drops the terms resulting from Ω_z at his Eq. (5). This is possible because the axes x and y were so chosen that Ω_z remains small. The analysis could therefore have commenced with the foregoing equations (4), rather than with Eqs. (1).

The author considers some special cases of the motion of the point of support of a pendulous vertical gyroscope. Two cases are discovered where the equations of precession (2) yield results at variance with the results obtained by Eqs. (1). The two cases are as follows:

1) The point of support performs harmonic oscillations along a great circle with frequency $\omega_2/2\pi$.

2) The point of support moves along a horizontal circle of radius ρ with speed v such that $v/\rho = \omega_2$.

In Kuznetsov's Eq. (17), ω_2 is given, which in the nomenclature used here becomes $\omega_2 = (C/A)\omega_z$.

In both cases, the point of support is subjected to forced oscillations, at a frequency f given by

$$
f = \omega_2/2\pi = \frac{1}{2\pi}\left\{\frac{C}{A}\right\}\omega_z \tag{5}
$$

The pendulous mass will respond to the forced oscillations by applying sinusoidal torques to the gyroscope at frequency f.

The frequency f is, however, the nutation frequency of the gyroscope. This may be seen readily by equating M_x and M_y in Eqs. (4) to zero, and solving for Ω_x and Ω_y.

Normally, nutation may be neglected, since it is rapidly damped by viscous forces in the suspension. The rotational motion of the gyroscope may be obtained by solving the equations of precession. However, if the gyroscope is subjected to sinusoidal torquing at or near the nutation frequency, a nutation of expanding amplitude will result. It is not surprising that the equations of precession then fail to provide an adequate description of the rotational motion of the gyroscope.

Digest of Translated Russian Literature

The following abstracts have been selected by the Editor from translated Russian journals supplied by the indicated societies and organizations, whose cooperation is gratefully acknowledged. Information concerning subscriptions to the publications may be obtained from these societies and organizations. Note: Volumes and numbers given are those of the English translations, not of the original Russian.

SOVIET PHYSICS—JETP (Zhurnal Eksperimental'noi i Teoreticheskoi Fiziki). Published by American Institute of Physics, New York

Volume 13, Number 2, August 1961

Three-Body Problem with Short-Range Forces, G. S. Danilov, pp. 349–355.

Skornyakov and Ter-Martirosyan have derived equations for the determination of the wave function of a system of three identical particles in the limiting case of zero-range forces. These equations allow one to express the scattering amplitude for the scattering of a neutron on a deuteron with the total spin $S = \frac{3}{2}$ for the system in terms of the parameters of the two-particle problem. Analogous calculations for the case $S = \frac{1}{2}$, however, have not been successful.

For the total spin $S = \frac{1}{2}$ the wave function of the system does not vanish when the distances between all particles become zero, as in the case when $S = \frac{3}{2}$. It will be shown in the present paper that the forementioned equations have a non-unique solution in this case. We shall also see that the wave functions for different energies are proportional to one another in the region where the three particles are sufficiently close to each other. We must therefore choose that solution of the equations of Skornyakov and Ter-Martirosyan which guarantees that the wave functions for different energies are proportional to each other in the forementioned region. This requirement allows us to choose a unique solution for an arbitrary energy if the wave function for a single value of the energy is known. For this wave function one can, for example, take the wave function of tritium. The determination of this wave function requires the knowledge of the binding energy of tritium. To solve the three-body problem with short range forces, we thus require one more parameter in addition to the parameters of the two-body problem, as, for example, the binding energy of tritium.

The idea that the non-uniqueness of the solution of the equations of Skornyakov and Ter-Martirosyan can be removed by introducing an experimental parameter is due to Gribov.

In the present paper we explain why the equation of Skornyakov and Ter-Martirosyan for three identical spinless particles has no unique solution. We also determine the behavior of the wave function in the region where the distances between all particles are close to zero. The rigorous proof of the non-uniqueness of the solution of the equation of Skornyakov and Ter-Martirosyan is given. We prove that the wave functions for different energies are proportional to one another in the region where the distances between all particles are close to zero. We derive for the wave function of three identical spinless particles an equation with a unique solution. In this form the equation of Skornyakov and Ter-Martirosyan can be solved numerically. We consider the same problem, but take in account the spin and the isotopic spin of the particles.

Physical Meaning of Negative Probabilities, J.-P. Vigier and Ya. P. Terletskii, pp. 356–359.

It is shown that the calculation of the statistical averages of a series of physical quantities can be carried out with the help of the distribution function instead of the probability density. The distribution function is the mathematical expectation of the particle density and is proportional to the probability density for a single particle only if all particles are absolutely identical. For a set of particles and antiparticles (with respect to some single property) the distribution function can also assume negative values. In this case it is no longer proportional to the probability, but it can be used to compute the averages of a number of physical quantities. It is shown that in the field theory of elementary particles the average values of some quantities characterizing the entire field (energy, momentum, charge, etc.) can be computed with the help of the corresponding distribution function.

Attenuation of Magnetohydrodynamic and Magnetoacoustic Waves in a Plasma with Anisotropic Conductivity and Viscosity, R. V. Deutsch, pp. 367–368.

Attenuation of weak magnetohydrodynamic and magnetoacoustic waves in an anisotropic plasma located in an external magnetic field is considered for the case where the wave frequency is smaller than the particle collision frequency and the wavelength is larger than the mean free path.

Doppler Width of Emission and Absorption Lines, M. I. Podgoretskii and A. V. Stepanov, pp. 393–396.

We give a classical and quantum mechanical treatment of the influence of the Doppler effect on line shape. We consider the possibility of experimental observation of resonance absorption of γ rays in liquids.

Electromagnetic Properties of a Relativistic Plasma, II, V. P. Silin, pp. 430–435.

We consider the reflection and absorption of electromagnetic radiation incident perpendicular to a plane surface bounding an electron plasma with relativistic particle-momentum distribution. The surface impedance of the plasma is calculated both for relativistic and for nonrelativistic temperatures. Specular and diffuse reflection of the electrons from the surface of the plasma is considered.

Vortex Lines in an Imperfect Bose Gas, L. P. Pitaevskii, pp. 451–454.

It is shown that the vortex lines possessing a thickness which is inversely proportional to the square root of the gas density and of the intensity of the interaction may exist in Bose gases with weak repulsion between the atoms. The energy of a vortex line is computed. It is also shown that in the presence of a vortex line a branch appears in the energy spectrum of the gas which corresponds to oscillations of the vortex.

Variation of the Adiabatic Invariant of a Particle in a Magnetic Field. II, A. M. Dykhne and A. V. Chaplik, pp. 465–467.

The change in the adiabatic invariant during passage of a charged particle through a magnetic inhomogeneity is calculated by a previously developed method. The results differ significantly from those obtained with the help of a Hamiltonian model.

Volume 13, Number 3, September 1961

Atomic First Ionization Potentials Determined by the Method of Surface Ionization, N. I. Ionov and M. A. Mittsev, pp. 518–519.

Atoms of the rare-earth metals Er, Tb, and Ce, together with the molecule $ThCl_4$, have been studied using the method of surface ionization on polycrystalline tungsten. It is shown that the temperature dependence of the ion current agrees with the theory of surface ionization on complex surfaces. The ionization potentials of the atoms Er, Tb, Ce, and Th have been found by comparing the temperature dependence of their respective ion currents with the same quantity for positive In ions.

Method to Verify Experimentally That the Speed of Light Is Independent of the Velocity of the Source, A. G. Baranov, pp. 603–605.

A laboratory experiment is suggested which can be employed to verify directly whether the speed of light is independent of the velocity of the source. The effect is of the first order in v/c.

A direct experimental confirmation of the law that the speed of light does not depend on the velocity of the source would be a significant matter of principle.

The work published by A. M. Bonch-Bruevich in 1956 is based on astronomical observations, namely, comparison of the speed of light from different regions of the solar disk. We do not consider this work entirely convincing.

On the one hand, the author begins with some a priori assumptions concerning the speed of light after reflection from a mirror; on the other hand, owing to the low accuracy inherent in the method, the observed results have a large scatter, several times larger than the effect expected from classical theory. To obtain the final result the author had to treat statistically a very large number (1727) of observations, in which very large deviations were excluded outright.

In view of what has been said this work should not be regarded as a direct experimental verification of the independence of the speed of light of the source velocity.

Here we propose a scheme by which to verify directly in the laboratory the postulate of the constancy of the speed of light. In this method the difference between the effects predicted by the postulate and by classical theory is of the order v/c (not v^2/c^2), so that the postulate can be verified with an accuracy far greater than by any other method.

The basic idea of the method is to use an interferometer with a moving mirror. Calculation shows that the speed of the mirror in this experiment can be of the order of one meter per second and even less.

Theory of the Interaction of a Charged Particle with a Plasma in a Magnetic Field, I. A. Akhiezer, pp. 667–672.

The interaction of a nonrelativistic charged particle with an electron plasma in a magnetic field is studied by quantum field theoretic methods. The dielectric constant, frequencies, and damping coefficients for the longitudinal oscillations of the plasma in the magnetic field are calculated to first order in e^2. A general formula is obtained for the energy loss of a particle moving through a plasma. The case in which the particle moves with a velocity much greater than the mean thermal velocity of the electrons in the plasma is investigated in detail.

Stability Conditions on the Electron Distribution Function for a Plasma, A. I. Akhiezer, G. Ya. Lyubarskii, and R. V. Polovin, pp. 673–676.

General conditions for the stability of the electron distribution function for a plasma with respect to high frequency plasma oscillations are deduced neglecting collisions. Free plasma and plasma immersed in a constant, uniform electric or magnetic field are considered.

Volume 13, Number 4, October 1961

Kinetic Theory of Shock Waves, G. Ya. Lyubarskii, pp. 740–745.

The structure of a low intensity shock wave in a monatomic gas is obtained at large distances from the wave front. The calculation is based on a kinetic equation with a simplified collision integral containing a constant collision time. It is shown that in this case various physical quantities approach their limiting values at infinity with a slower rate than in the hydrodynamic theory. Therefore, if the kinetic equation is replaced by a finite system of ordinary differential equations it is impossible in principle to obtain the correct asymptotic solutions of the kinetic equation.

Structure of the Transition Layer between a Plasma and a Magnetic Field, V. P. Shabanskii, pp. 746–750.

The structure of the region in which a plasma beam is reflected by a magnetic field has been investigated using the self-consistent microscopic equations of motion for the particles; the structure of the transition layer between a fixed plasma and a magnetic field has also been investigated. In the first case corrections are introduced to take account of the polarization which is produced at high velocities of the incident beam.

Quantum Theory of the Spectrum of Excitations of an Electron Gas in a Magnetic Field, P. S. Zyryanov, pp. 751–755.

The quantum dispersion equation is found for the longitudinal oscillations of an electron gas in a magnetic field, for the case of an arbitrary energy distribution of the particles. A criterion (with respect to the magnetic field) for the applicability of the hydrodynamical approximation is established. It is shown that as we go from very high magnetic field strengths to low fields the frequency of the longitudinal oscillations changes discontinuously. The longitudinal permittivity of a plasma is calculated.

Stability of a Plasma Pinch with Anisotropic Particle Velocity Distribution and Arbitrary Current Distribution, V. F. Aleksin and V. I. Yashin, pp. 787–788.

The necessary conditions for stability of a plasma with an anisotropic distribution of particle velocities located in a helical magnetic field are derived on the basis of kinetic theory without taking close collisions into account.

Equation of State of Partially Ionized Hydrogen, L. P. Kudrin, pp. 798–801.

We propose a method for approximate evaluation of the thermodynamic functions of a partially ionized gas, taking into account deviations from ideality. We obtain an equation of state and an ionization formula which is appreciably different from the Saha formula.

Polarization of Recombination Radiation, B. A. Lysov, L. P. Belova, and L. I. Korovina, pp. 816–819.

The polarization of radiation following the capture of a relativistic electron into the K shell is considered. Partial elliptical polarization is shown to occur in this case. The expression for the intensity of the unpolarized part of the radiation is given. The electron-spin contribution is discussed. The calculations are performed to the lowest order in αZ.

Momentum Distribution of Particles in a Dilute Fermi Gas, V. A. Belyakov, pp. 850–851.

The first two terms of the expansion in powers of the gas parameter of the momentum distribution of particles in a nonideal Fermi gas are obtained by means of a perturbation method.

Magnetohydrodynamics for Nonisothermal Plasma without Collisions, Yu. L. Klimontovich and V. P. Silin, pp. 852–859.

The magnetohydrodynamic equations are considered for a plasma without collisions. Dissipation due to the absorption of magnetohydrodynamic and magneto-acoustic waves by electrons is taken into account. The resultant equations are applied in the analysis of the smearing out of a packet in the plasma. It is shown that under the conditions assumed, when the spatial dimensions considerably exceed the Debye and Larmor ranges, stationary shock waves with a width much smaller than the mean free path cannot exist.

SOVIET PHYSICS—SOLID STATE (Fizika Tverdogo Tela). Published by American Institute of Physics, New York

Volume 3, Number 8, February 1962

Effect of Halogen Additions on the Thermal Conductivity of Lead Telluride, E. D. Devyatkova and I. A. Smirnov, pp. 1666–1674.

The thermal conductivity, electrical conductivity, Hall coefficient, and thermo-emf of 14 pairs of single-crystal and polycrystalline specimens of PbTe and one pair each of polycrystalline specimens of the solid solutions PbTe + 1% PbSe and PbTe + 1% SnTe, have been measured in the temperature range 80°–460°K. Specimens of n-type PbTe were obtained by alloying with the binary addition: PbI_2 (or $PbBr_2$ or $PbCl_2$) + Pb.

It is shown that additions of chlorine, bromine and iodine considerably reduce the thermal conductivity of the PbTe crystal lattice. With $n \sim 3\cdot10^{19}$–$2\cdot10^{20}$ cm^{-3} the additional thermal resistivity due to the additions is proportional to the concentration of the halogens introduced. It is found that the thermal conductivity of the lattice changes to the same extent, irrespective of the amount of halogen introduced (chlorine, bromine, or iodine). This effect of the halogen additions may be due to the large static dielectric permeability of PbTe. The scattering cross section for phonons has been calculated in the case of the halogens, selenium, and tin.

It is also shown that the electrical conductivity and thermoemf of PbTe are independent of the form of the alloying addition (chlorine, bromine, or iodine) and of the amount of excess lead introduced (from 0.3 to 3 wt %).

Conclusions: From the investigation of PbTe described, it is possible to draw the following conclusions:

1) Additions of chlorine, bromine, and iodine markedly reduce the thermal conductivity of the crystal lattice of PbTe. The additions begin to exert a marked effect on χ at a concentration of $1\cdot10^{19}$ cm^{-3}.

2) Between $n \simeq 3\cdot10^{19}$ and $2\cdot10^{20}$ cm^{-3}, the additional thermal resistivity is proportional to the concentration of current carriers.

3) The thermal conductivity of the lattice varies by the same amount, irrespective of the mass of the halogen introduced (chlorine, bromine, or iodine). The similar effect of the different additions can be explained if it is assumed that PbTe has a large static dielectric permeability.

4) In contrast to halogen additions, selenium and tin have smaller scattering cross sections for phonons.

5) The varying effects of additions of halogens, tin, and selenium are evidently connected with their different positions relative to lead and tellurium in the Periodic Table.

6) The electrical conductivity, thermo-emf, and thermal conductivity do not depend on the kind of alloying addition (chlorine, bromine, or iodine), or on the amount of excess lead introduced, in the temperature range investigated.

Photoconductivity and Quantum Yield in Germanium under the Action of x Rays, M. G. Kamoldinov and É. M. Reikhrudel', pp. 1713–1717.

The influence of x rays on the electrical conductivity (concentration, mobility, and lifetime of carriers) of a uniform germanium specimen was investigated by taking simultaneous measurements of the conductivity and Hall effect as a function of absorbed radiation dosage. The energy of electron-hole pair production and quantum yield were determined in a wavelength range from 0.248 to 0.062 Å. The photoconductivity increases "superlinearly" with increasing x-ray dose rate.

Conclusions:

1) The variation in electrical properties of germanium under the action of x rays generated at voltages of 100–200 kv have been investigated; the variation in conductivity and other quantities depending on it was demonstrated experimentally. X-ray absorption leads to the appearance of additional bound states in the forbidden zone and causes an increase in carrier lifetime and the observed "superlinearity."

2) For a certain minimum dose, saturation of the photoconductivity of germanium sets in. The steady-state value of the photoconductivity depends on the x-ray quantum energy and on the dose rate. For the same given value of the quantum energy and equal absorbed doses, the photoconductivity is approximately proportional to the dose rate.

Study of Dopant Distribution in the Surface Layer of Photoelectric Solar Energy Converters Made from n-Type Silicon, A. K. Zaitseva and A. Ya. Gliberman, pp. 1724–1727.

A model of a silicon photoconverter in which the p-n junction is obtained by means of thermodiffusion of boron into n-type Si is described. It permits one to conduct a layer by layer study of the diffusion layer up to the depth of occurrence of the p-n junction.

From the data of the measurements made on this model, the character of the concentration distribution of the impurity which was diffused is studied over the entire layer, and the optimum depth for occurrence of the p-n junction in the photoconverter is determined. Data are presented on the change of open-circuit voltage, short-circuit current, maximum power, and resistance of the doped layer as a function of its gradual etching.

Photoconductivity of Neutron-Irradiated p-Type Silicon, V. S. Vavilov and A. F. Plotnikov, pp. 1783–1784.

We present new data regarding the dependence of the photoconductivity of silicon for silicon containing radiational defects. We complete the system of energy levels for defects in silicon, and present conclusions regarding the electrical nature of some of the newly discovered levels.

Volume 3, Number 9, March 1962

Electrical Properties of Cadmium Antimonide Single Crystals at Low Temperatures, I. K. Andronik, M. V. Kot, and O. V. Emel'yanenko, pp. 1853–1856.

In this work, results are presented on the study of the temperature dependence of two components of the conductivity tensor, of the Hall effect, and of the magnetoresistivity in the range 2.4° to 78°K. It is shown that with a defect concentration of the order of 10^{15} cm^{-3} an acceptor impurity band is formed in cadmium antimonide crystals. The discussion of the results is carried out on the basis of the concept of the existence of an impurity band.

In the present work the electrical properties of undoped CdSb crystals in the temperature range from 2.4° to 78°K are described.

Conclusions:

1) It has been established that in cadmium antimonide monocrystals with a defect concentration of $3\cdot10^{15}$ cm^{-3}, an acceptor