Scientific session of the Division of General Physics and Astronomy of the Academy of Sciences of the USSR (21 December 1988)

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A scientific session of the Division of General Physics and Astronomy of the USSR Academy of Sciences was held on 21 December 1988 at the S. I. Vavilov Institute of Physics Problems of the Academy of Sciences of the USSR. The papers listed below were presented at this session.

Scientific session dedicated to the hundredth anniversary of the experiments of H. Hertz

1. V. V. Migulin. Hundredth anniversary of the work of H. Hertz on the experimental proof of the existence of electromagnetic waves.

2. G. I. Makarov, V. V. Novikov, and A. B. Orlov. On the propagation of kilometer and longer radiowaves.

3. V. I. Baĭbakov, V. N. Datsko, and Yu. V. Kostovich. Experimental discovery of Zenneck's surface electromagnetic waves.

A brief summary of the papers is given below.

V. V. Migulin. Hundredth anniversary of the work of H. Hertz on the experimental proof of the existence of the electromagnetic waves. The year 1988 marks the hundredth anniversary of the publication of the remarkable papers by Heinrich Hertz in which he on the basis of brilliant experiments proved the validity of the theory of electromagnetism created by Maxwell and demonstrated the possibility of exciting electromagnetic waves of the same physical nature as light waves by electrical oscillations at radio frequencies.

Having initiated at the suggestion of Helmholtz a search of experimental confirmation of the existence of displacement currents introduced by Maxwell Hertz began his research by developing devices capable of generating high frequency electrical oscillations and exciting electromagnetic waves. The vibrator constructed by him excited by a spark discharge, which later acquired the name of a Hertz vibrator, enabled him for the first time to obtain in laboratory conditions electromagnetic waves in the meter and decimeter ranges. In his experiments H. Hertz demonstrated the physical identity of electromagnetic waves obtained by him and light waves by establishing their transverse nature, polarization, possibility of refraction and by determining their speed of propagation equal to the velocity of light.

This incontrovertibly proved the validity of Maxwell's theory and laid the foundation for practical means of exciting electromagnetic waves at radio frequencies which several years later were utilized for transmitting information, i.e., for radio communication.

On the basis of Maxwell's theory H. Hertz developed a method of making calculations concerning the process of radiation of electromagnetic waves by means of a special vector introduced by him into the theory which is now known as the Hertz vector and which is used until the present time in designing antennas and making calculations concerning the propagation of radio waves.

H. Hertz was born in 1857, and his brilliant work which has been acclaimed worldwide was carried out when he was only 31 years old.

It should also be pointed out that Hertz in 1887 was the first to discover the phenomenon of the photoeffect, but H. Hertz having noted this phenomenon of the photoeffect, but H. Hertz having noted this phenomenon could not undertake its detailed study having devoted all his energies to the investigation of the electromagnetic waves.

He died early–in 1894 at the age of 37 and in his untimely death world science lost one of its most brilliant representatives. Hertz's name is now associated with the unit of frequency.

G. I. Makarov, V. V. Novikov, and A. B. Orlov. On the propagation of kilometer and longer radiowaves. The paper presents a brief discussion of the problem of predicting the propagation of radiowaves in the range of ultralong waves (ULW). A large number of papers has been devoted to the experimental and theoretical investigations of the laws of propagation of radiowaves in the ULW-range. References to them can be found in the review articles of Refs. 1–3 and the papers of Refs. 4, 5.

In order to improve the reliability and accuracy of the operation of radiotechnical systems in the frequency range under consideration it is necessary to have a global forecast of electromagnetic waves taking into account both the regular variations of the properties of the ionosphere (daily, seasonal, latitudinal ones corresponding to cases of different solar activity), and also the large-scale ionospheric disturbances of the VIV(SID) and PPSH(PCA) type.[1] Forecasting of electromagnetic fields can be carried out on the basis of a numerical solution of the direct problem of the field in a waveguide channel of given properties.

By now there has been developed a theory of the propagation of low-frequency radiowaves in a spherical waveguide channel with an anisotropic ionosphere whose properties vary both according to altitude and in the direction of propagation (in the longitudinal direction), and also according to the properties of the earth which is inhomogeneous both in depth and in the longitudinal direction. For the analysis and the numerical calculations of the electromagnetic field at distances from the source greater than 500-1000 km a representation of the solution is used in the form of a number of

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