

## **Influence of electromagnetic radiation of cellular radio telephones on biological objects and efficiency**

Following is an excerpt from the report made by the Laboratory for Electro-physics of Water Ecosystems of the St. Petersburg Polytechnic University on the subject: "**THE EFFECT OF THE ELECTROMAGNETIC RADIATION EMITTED BY CELLULAR RADIOTELEPHONES ON BIOLOGICAL OBJECTS. THE EVALUATION OF THE EFFICIENCY OF THE AIRES NEUTRALIZERS OF ELECTROMAGNETIC ABNORMALITIES**," St. Petersburg, 2003.

### **The Magnetic and Electric Fields of Cellular Telephone Sets Used in the Experiments**

Standard models of *Nokia* telephone sets (TSs) were used in the experiments, with the Aires Neutralizer of Electromagnetic Abnormalities attached to the body of a TS. Figure 16 illustrates the outward appearance of the cellular phone *Nokia 3110* with the neutralizer attached to it.

The measurements were performed in the Laboratory for Electromagnetism of Water Ecosystems of the St. Petersburg Polytechnic University with the use of the electric field measurer NEVA-N (measurement ranges: 0-0.25 and 0-1 [kV/m]) developed and manufactured by the Central Research Institute named after Kriylov.



Figure 16. Cellular phone Nokia 3110 with the Aires Neutralizer

## Evaluation of the Radiation Level of the TS in Different Operating Modes

This evaluation was carried out before the main experiments with animals were performed. Figure 17 shows a plot of  $E_z$  variations along the length of the TS in each of the three modes—"wait," "call," and "talking"—for two radiators. As can be seen from the plots, the "Neutralizer of Electromagnetic Abnormalities" (or just a "neutralizer") significantly reduces the level of radiation, especially in the area where the antenna and the speaker are located, which is critical to the user (Table 7).

Table 7

Results of Measurement of Electric Field Near Cellular Phone, V/m

length, m	0	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	
wait	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	
<b>with Neutralizer</b>																		
call	0.15	0.12	0.1	0.08	0.08	0.1	0.1	0.1	0.12	0.12	0.15	0.15	0.2	0.2	0.15	0.15	0.05	
talking	0.15	0.15	0.15	0.15	0.2	0.2	0.15	0.15	0.15	0.1	0.1	0.1	0.15	0.2	0.2	0.15	0.05	
<b>without Neutralizer</b>																		
call	0.5	0.4	0.2	0.2	0.2	0.2	0.15	0.15	0.15	0.15	0.15	0.15	0.3	0.4	0.4	0.2	0.15	
talking	0.6	0.4	0.2	0.2	0.2	0.2	0.2	0.3	0.3	0.3	0.3	0.3	0.5	0.5	0.5	0.5	0.15	

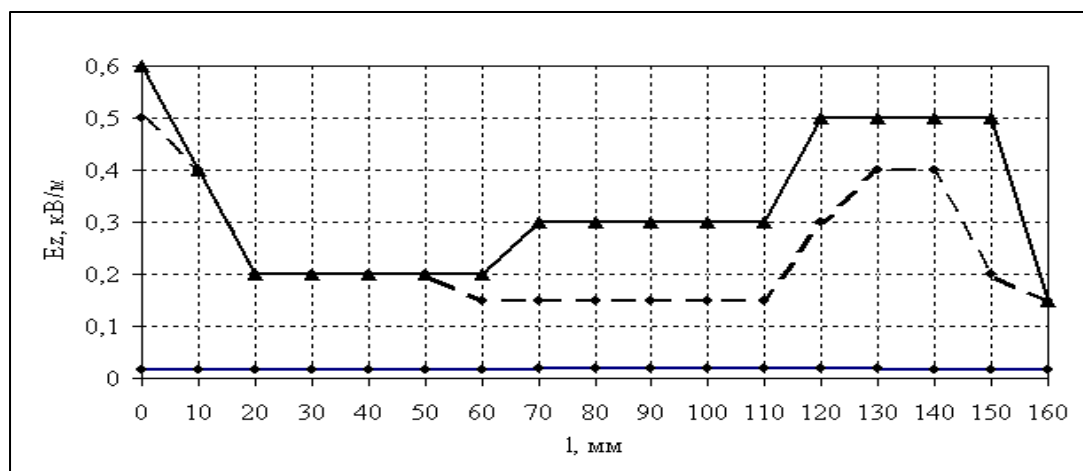
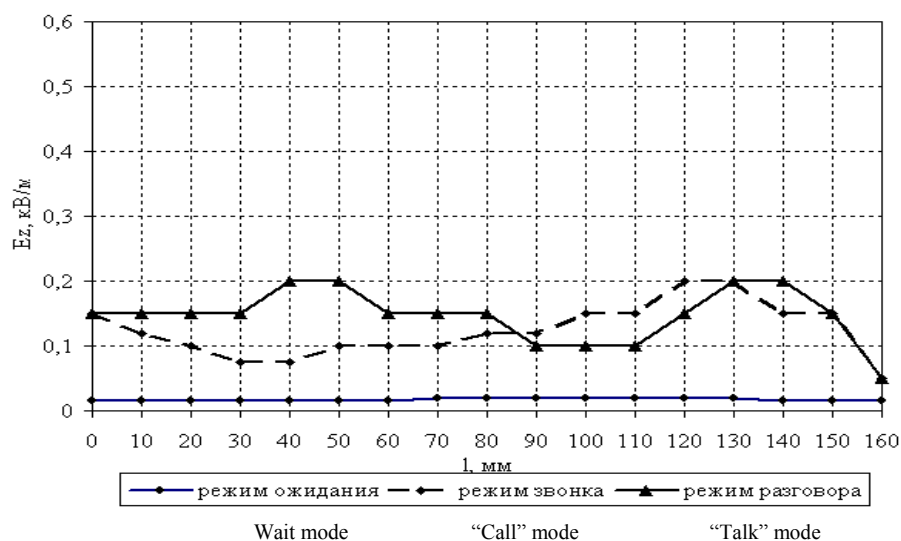


Figure 17: Variations in the electric field intensity along the length of the cellular phone with (above) and without (below) the neutralizer

## The Structure of Quasiconstant Electric and Magnetic Fields in the Vicinity of the Telephone

It is evident that calculating the structure of these fields' changes in space is a very difficult task because of many other, secondary sources of electromagnetic radiation, while simulating this structure can give only an idealized picture. For these reasons, the electric field (EF) and the magnetic field (MF) occurring near the TS when it was in the call mode were measured at a real distance from the orientation axis of devices.

Tables 8, 9, 10, and 11, as well as Figures 18, 19, 20, and 21 describe the field structures observed. The distinguishing feature of the volumetric structures was that they clearly differed from one another as to whether the TS was with or without the neutralizer—the presence of the neutralizer gave rise to a two-humped distribution of the electric and the magnetic fields. Moreover, peak amplitude  $E_z$  was two times lower than that of the TS without the neutralizer, although the  $B_z$  amplitudes were much alike.

Table 8

The Electric Field That Occurred, during "Call" Mode, Around the Cellular Phone without the  
Neutralizer, kV/m

<i>cm</i>	<b>0</b>	<b>2</b>	<b>4</b>	<b>6</b>	<b>8</b>	<b>10</b>	<b>12</b>	<b>14</b>	<b>16</b>	<b>18</b>	<b>20</b>
<b>0</b>	0.075	0.075	0.050	0.050	0.050	0.050	0.050	0.100	0.025	0.030	0.030
<b>4</b>	0.017	0.015	0.030	0.030	0.040	0.040	0.040	0.030	0.020	0.015	0.030
<b>8</b>	0.040	0.050	0.040	0.050	0.050	0.030	0.015	0.030	0.030	0.030	0.030
<b>12</b>	0.050	0.075	0.075	0.100	0.200	0.300	0.200	0.100	0.050	0.030	0.020
<b>16</b>	0.075	0.050	0.050	0.075	0.200	0.250	0.200	0.100	0.050	0.050	0.030
<b>20</b>	0.050	0.050	0.030	0.050	0.075	0.100	0.100	0.050	0.030	0.050	0.050
<b>24</b>	0.050	0.030	0.030	0.050	0.050	0.075	0.075	0.100	0.050	0.050	0.050
<b>28</b>	0.050	0.030	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.030	0.050
<b>32</b>	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050

Table 9

The Electric Field That Occurred, during "Call" Mode, Around the Cellular Phone with the Neutralizer

<i>cm</i>	<b>0</b>	<b>2</b>	<b>4</b>	<b>6</b>	<b>8</b>	<b>10</b>	<b>12</b>	<b>14</b>	<b>16</b>	<b>18</b>	<b>20</b>
<b>0</b>	0.015	0.020	0.030	0.030	0.030	0.020	0.030	0.020	0.015	0.015	0.015
<b>4</b>	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015
<b>8</b>	0.030	0.030	0.030	0.030	0.030	0.020	0.015	0.015	0.015	0.015	0.015
<b>12</b>	0.030	0.040	0.075	0.050	0.100	0.120	0.100	0.050	0.030	0.015	0.015
<b>16</b>	0.030	0.050	0.050	0.050	0.075	0.075	0.075	0.050	0.030	0.015	0.015
<b>20</b>	0.030	0.030	0.030	0.030	0.040	0.050	0.050	0.030	0.020	0.015	0.015
<b>24</b>	0.030	0.030	0.040	0.100	0.100	0.050	0.050	0.030	0.015	0.015	0.015
<b>28</b>	0.030	0.030	0.040	0.050	0.050	0.050	0.030	0.030	0.020	0.015	0.015
<b>32</b>	0.015	0.015	0.015	0.015	0.030	0.030	0.030	0.015	0.015	0.015	0.015

Table 10

The Magnetic Field That Occurred, during "Call" Mode, Around the Cellular Phone without the Neutralizer,  $\mu\text{T}$

<b>cm</b>	<b>0</b>	<b>2</b>	<b>4</b>	<b>6</b>	<b>8</b>
<b>0</b>	35	43	55	48	38
<b>2</b>	48	80	138	120	39
<b>4</b>	44	76	135	105	44
<b>6</b>	38	55	80	51	38
<b>8</b>	37	43	42	35	33
<b>10</b>	37	33	33	32	34
<b>12</b>	38	42	45	37	36
<b>14</b>	37	48	97	54	43
<b>16</b>	38	45	138	105	44
<b>18</b>	40	42	53	55	44

Table 11

The Magnetic Field That Occurred, during "Call" Mode, Around the Cellular Phone with the Neutralizer,  $\mu\text{T}$

<b>cm</b>	<b>0</b>	<b>2</b>	<b>4</b>	<b>6</b>	<b>8</b>
<b>0</b>	44	52	79	64	44
<b>2</b>	51	77	143	116	54
<b>4</b>	44	99	141	107	59
<b>6</b>	47	62	79	64	44
<b>8</b>	41	46	50	46	43
<b>10</b>	40	40	42	42	40
<b>12</b>	39	36	32	32	35
<b>14</b>	39	29	13	15	29
<b>16</b>	38	29	0	9	29
<b>18</b>	40	43	40	37	40

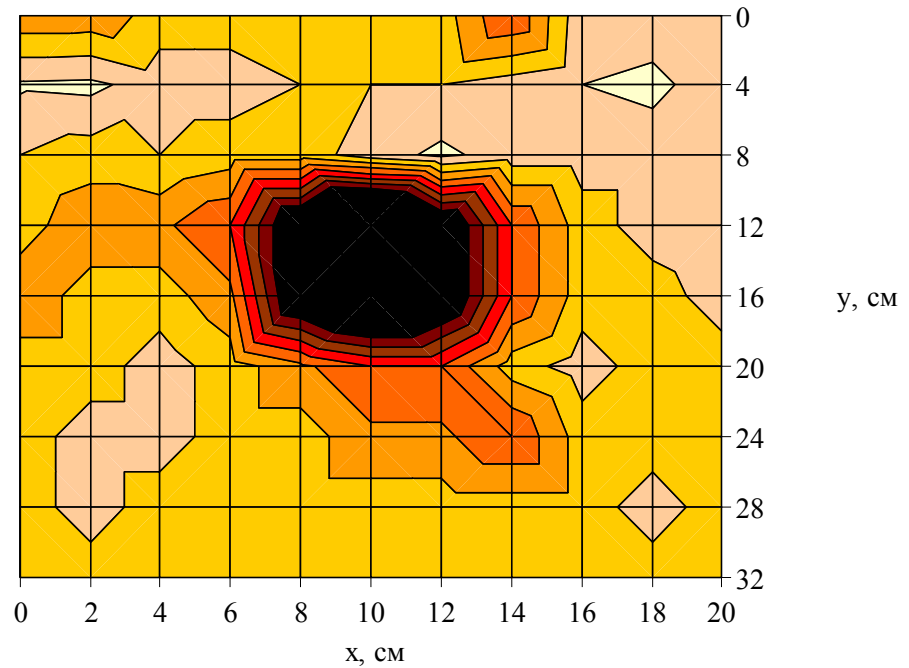
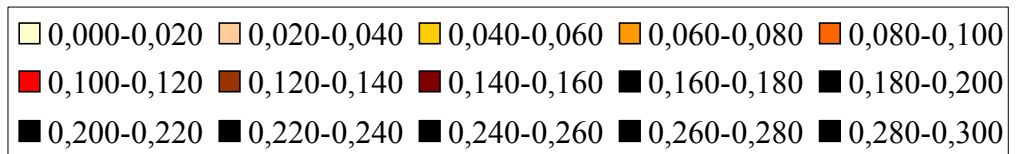
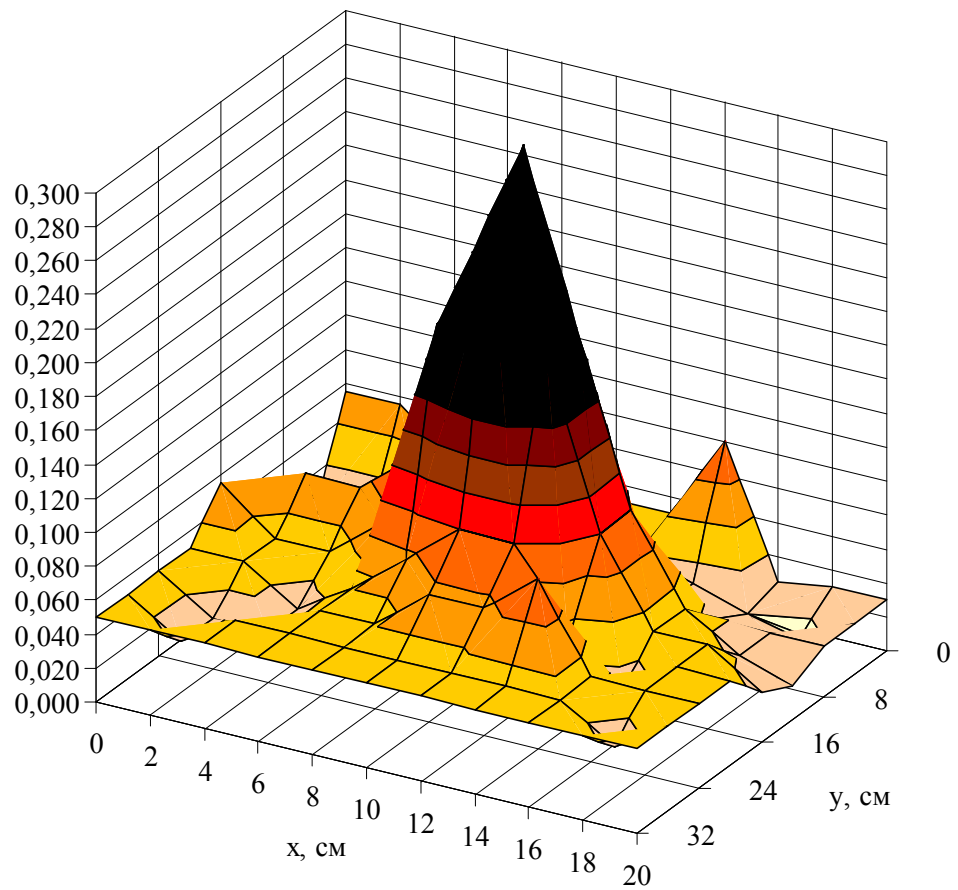


Fig. 18. The Electric field that occurred, during "Call" mode, around the cellular phone without the Neutralizer

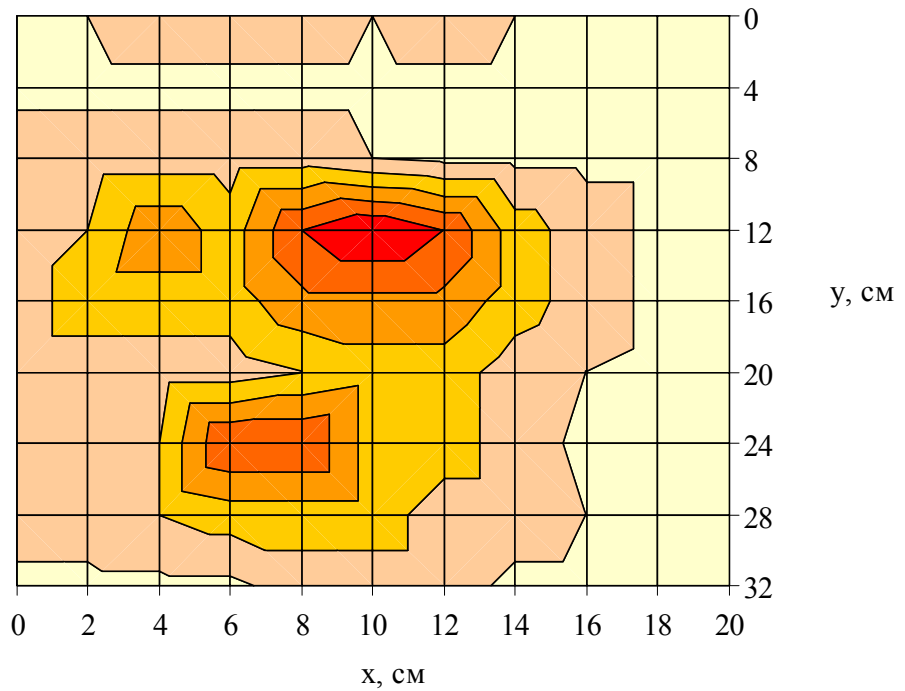
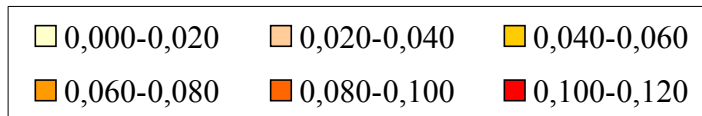
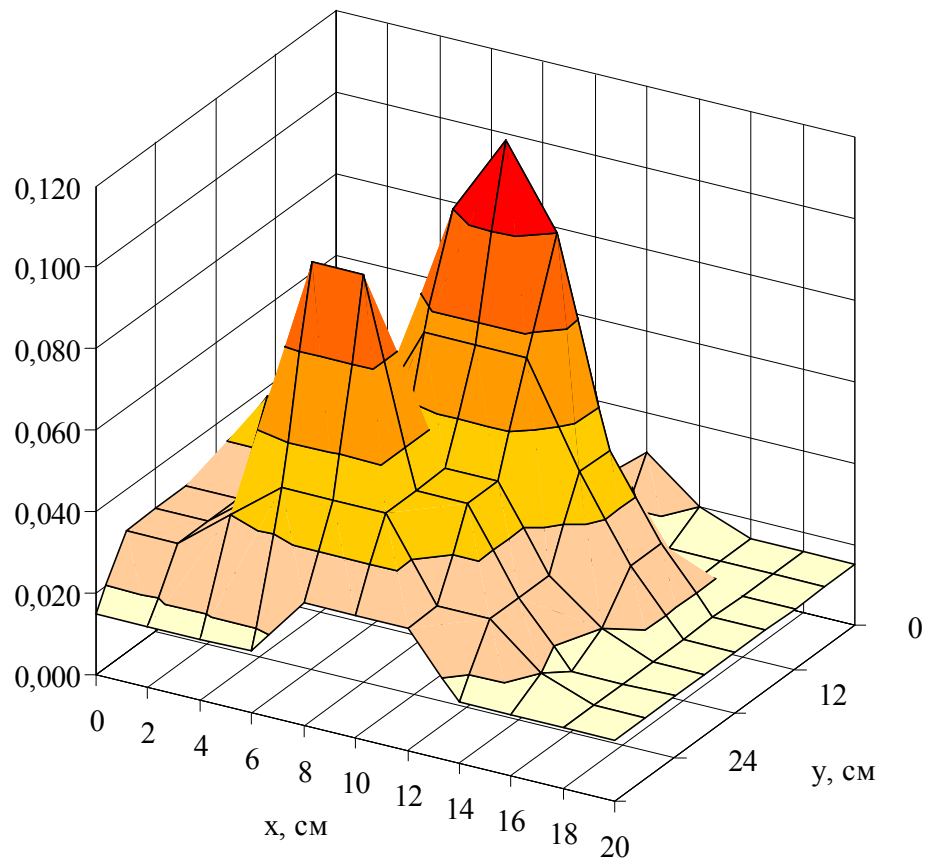
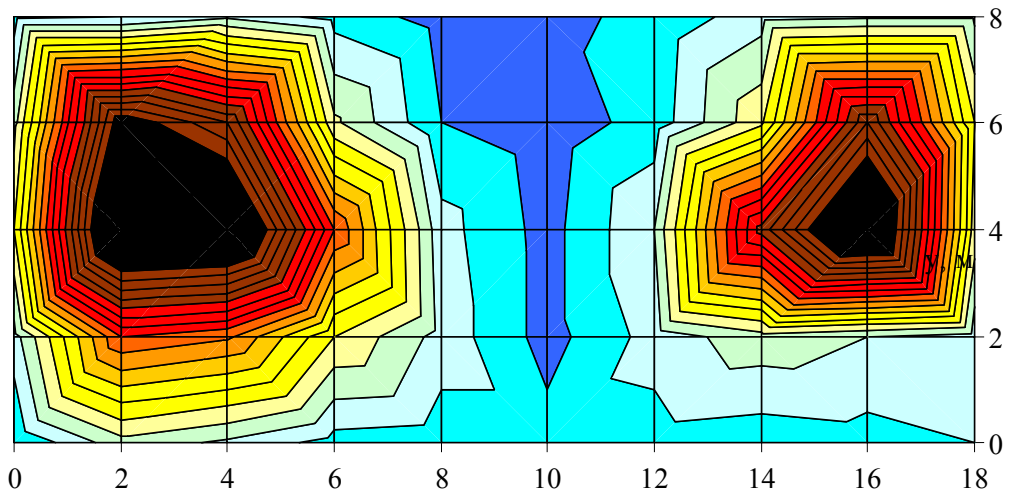
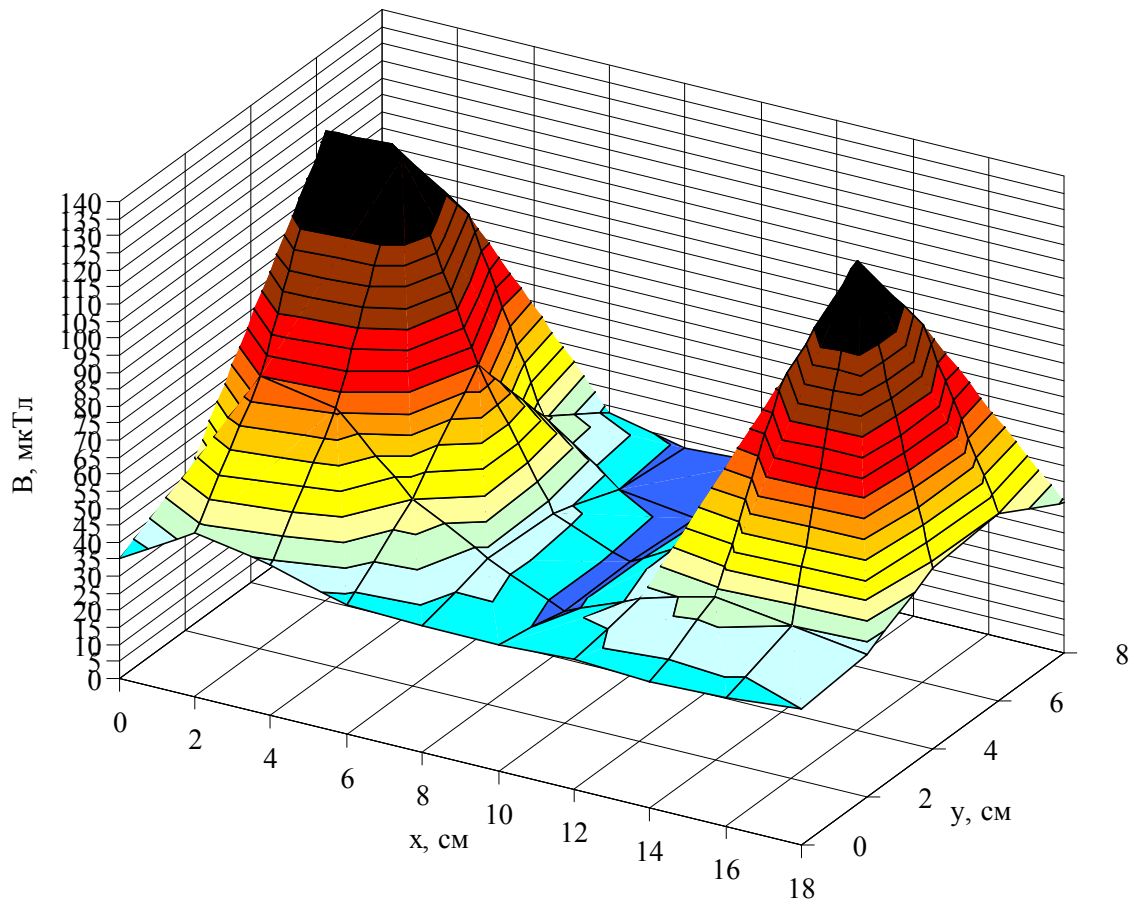


Fig. 19. The Electric field that occurred, during "Call" mode, around the cellular phone without the Neutralizer



0-5	5-10	10-15	15-20	20-25	25-30	30-35
35-40	40-45	45-50	50-55	55-60	60-65	65-70
70-75	75-80	80-85	85-90	90-95	95-100	100-105
105-110	110-115	115-120	120-125	125-130	130-135	135-140

Fig. 20. The Magnetic field that occurred, during "Call" mode, around the cellular phone without the Neutralizer

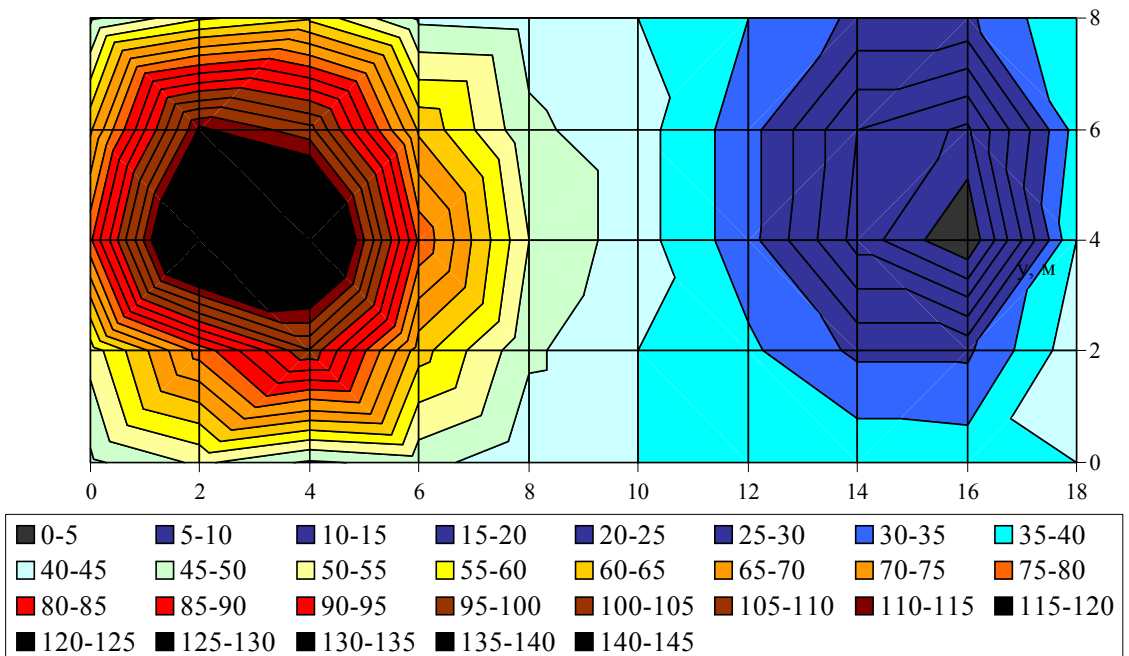
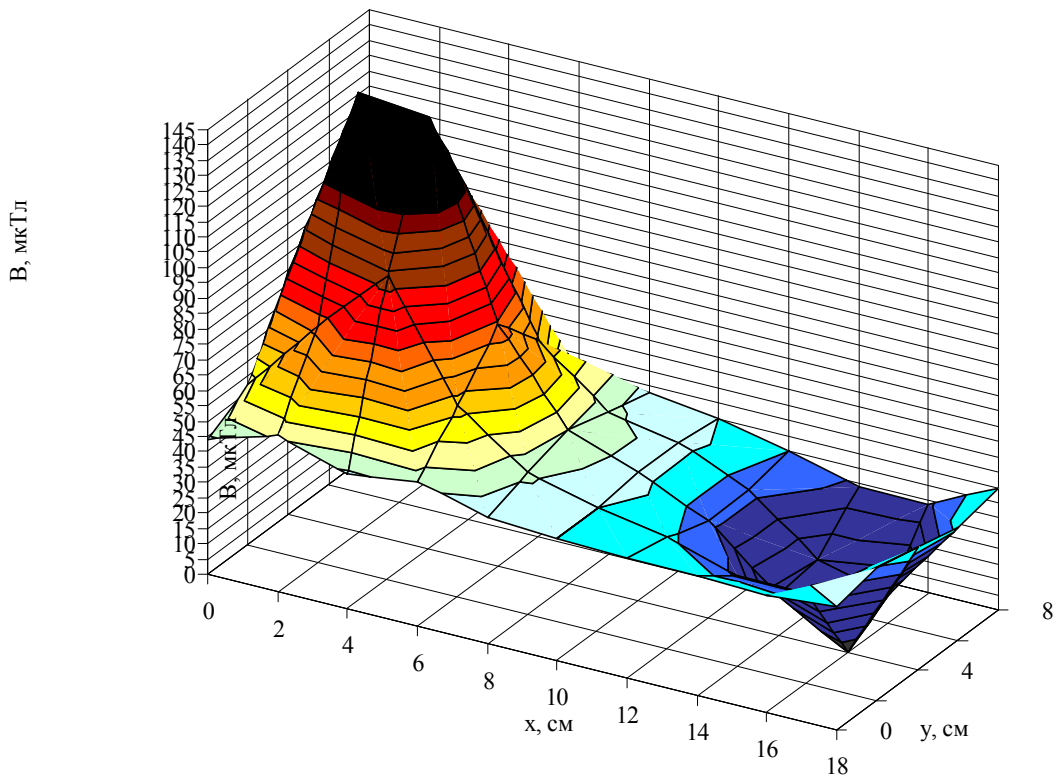


Fig. 21. The Magnetic field that occurred, during "Call" mode, around the cellular phone with the Neutralizer



## **The Structure of the Variable Component of the MF of the Cellular Phone**

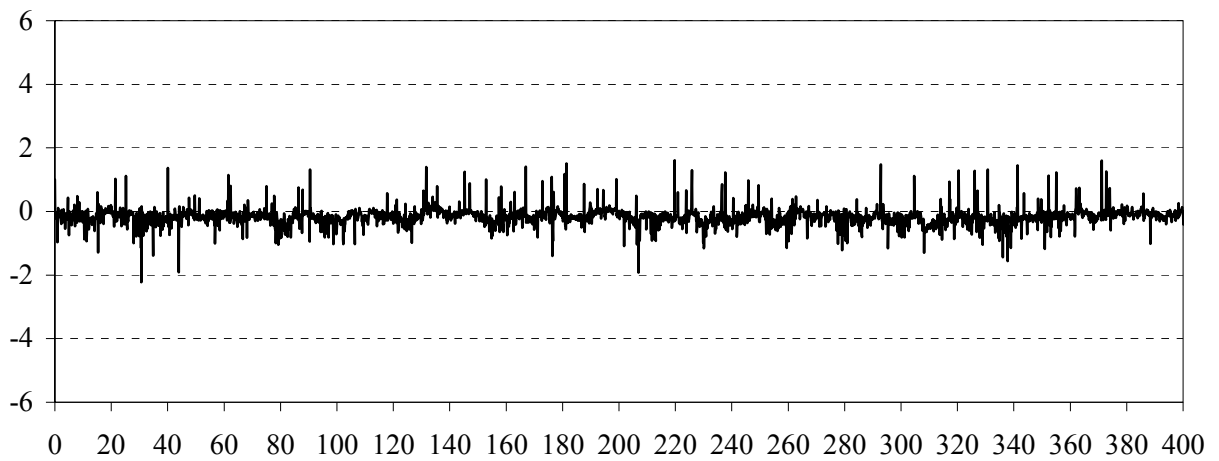
When studying the effect of the electromagnetic radiation (EMR) emitted by a cellular phone on the environment, we came up against the problem of compatibility of technical devices, biological objects and geophysical factors (in particular, the geomagnetic field). The analysis and interpretation of the magnetic field oscillations registered, in laboratory conditions, as a background characteristic taken in real amplitude-time scale revealed a very interesting feature, which is of importance now that we should be careful to details so as to be able to evaluate subtle interactions.

Figure 22 shows the magnetic field oscillations that were registered in the Laboratory and are characterizing the disturbance caused by the operation of the **TS**. The **TS** was placed near a magnetometric sensor, and the time when the cellular phone was operating in "wait" mode or in "call" mode was noted. The telephone sets were either with the neutralizer or without it, and each registration continued for 400 seconds.

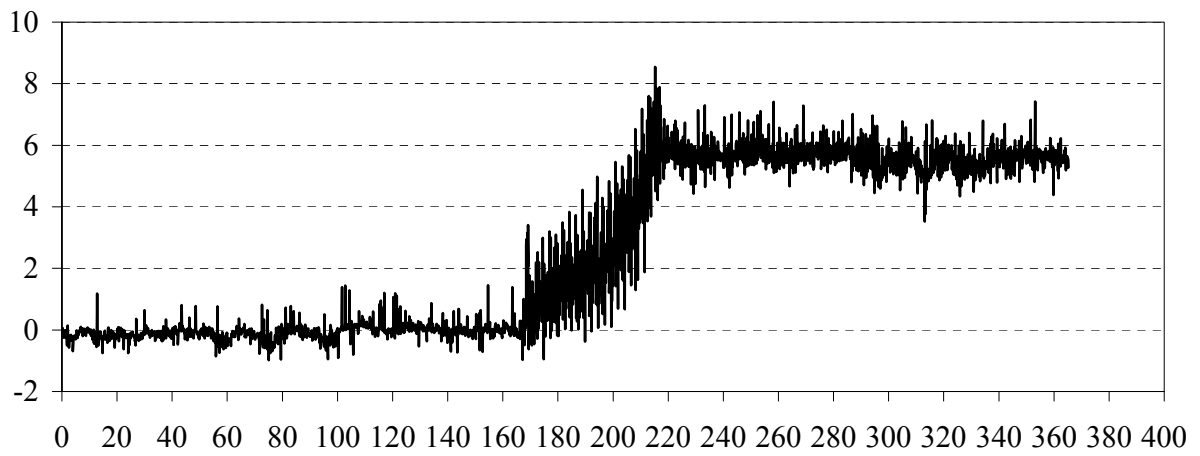
When the **TS** without the neutralizer was in "call" mode, its **EMR** induced a growing signal which, in the end, displaced the average conditional background level of magnetic oscillations (central segment in Figure 22-2) almost six times towards "+"; moreover, the amplitude of the oscillations also increased two times. At this point, the most troublesome thing was that the magnetic field sensor's feature for the autocompensation of the constant factor of the  $B_z$  component became turned off, establishing a new conditional background level. So when performing an automatic computer registration of **MF**, this could lead to uncontrollable errors.

In contrast to this, when using the **TS** with the neutralizer attached to it, a quite satisfactory picture was revealed: the corresponding segment of the "call" (central segment in Figure 22-3) was also distinguished by an increase in the oscillations amplitude about 1.5-2 times, but the conditional background level was not displaced and so the sensor's autocompensation feature was not disturbed. Thus, we observed a harmonization of the electromagnetic combination of the apparatus and the surrounding natural background. We believe that this was due to the effect of the Aires protective device. However, further and more detailed experimental and statistical data is needed to enable us to make final recommendations and evaluations.

1) "wait" mode



2) "call" mode



3) "call" mode with the neutralizer

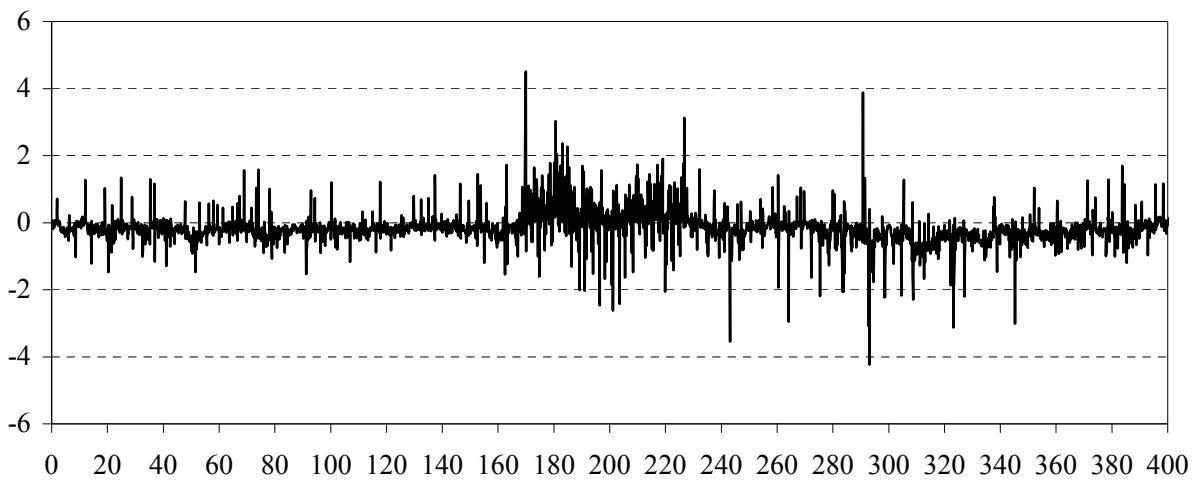


Fig. 22. The chart of the modifications of the vertical EM field component near the cellular telephone

## **Geomagnetic Situation in the North-West Region of Russia**

The geomagnetic situation in the North-West Region of Russia is mainly average statistical, and was propitious in the period when the experiments were conducted. However, the main part of measurements was performed after the third ten-day period of December, 2002, which is characterized by fairly intense (though not dangerous on global scale) geomagnetic disturbance.

According to the Institute of Terrestrial Magnetism, Ionosphere and Radio Wave Propagation of the Russian Academy of Sciences, the effect of the solar activity and geoeffective phenomena on the near-Earth space environment between December 16 and December 20, 2002, was marked by a high level of sun spotting activity (the average weekly value of the relative number of sun spots was  $W=139 \pm 21/-22$ ). Besides, according to the Boulder Observatory, CO USA, the planetary disturbance index K reached 5-6 points on December 27, 2002, and the value of the magnetic disturbance in the North-West Region of Russia was 250 nT.

## **Actual Magnetic Field Situation in the Laboratory**

During the period when short-term measurements of the **TS** were taken, MF monitoring was conducted on the premises of the Laboratory for Electrophysics of Water Ecosystems. The results of the monitoring are showed in Table below. As is seen from the Table, there was a magnetic disturbance in the Laboratory at some time during the measurements. At the other days at which the measurements were performed, either there was no disturbance or the magnetic situation was clear. So we think that no geomagnetic storm nor technogenic sources caused any considerable distortion of the EMR.

## **Main Results of the Experimental Evaluation of the EMR Emitted by Nokia Cellular Phones and of the Efficiency of the Aires Neutralizer of Electromagnetic Abnormalities**

This work was aimed at developing up-to-date techniques for evaluating the physiology of the behavior of water organisms, especially with allowance made for the poorly known effect of the EMR of varying frequency ranges.

- A beginning has been made in the development of a new experimental technique intended for studying the physiology of the behavior of water organisms affected by controllable anthropogenic factors. For example, to investigate into the effect of the EMR emitted by cellular phones, combined with the dynamics of the environmental GMF and EMR, a new method for detecting and reducing unfavorable disturbance was developed. Also, a simple technique for registering behavioral responses of biological organisms was developed. This technique involves performing video observations and carrying out a computer evaluation of the observation results using a new method of signal processing and analysis.

- The structure of the EMF of a modern cellular phone was studied in both statics and dynamics and with or without the use of the Aires Neutralizer. This device was found to be effective in reducing the intensity of the **EMF** of the TS when it was in a mode of active radiation (the call mode or the talking mode).

- The combination of a working cellular TS's EMF and the environment's EM background was evaluated. It was found out that, when the TS was turned on and working, there was an intense distortion of the natural EM background. When the Aires Neutralizer was attached to the TS, the EMR was noted to reduce.

- The study revealed that the EMR emitted by a cellular phone in the range of 900/1800 MHz can adversely affect water organisms, and that the Aires Neutralizer attached to such cellular phones can have a protective effect.