

# Low Intensity Millimeter Waves Reduce the Brain Bioelectrical Activity Reactions, Arising from the Mobile Phone EMF

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## Abstract

The protection action of millimeter wave electromagnetic irradiation is demonstrated for the case of mobile telephone communication. Antenna-coupled Gunn diode or FET oscillator were used as a source of the irradiation. *Double blind* testing was performed with 54 volunteers. A microminiature EHF generator, inserted to the handset, can reduce the negative effects of the mobile telephone electromagnetic field.

## 1. Introduction

Electromagnetic millimeter (MM) waves ( $\lambda = 1 - 10$  mm) correspond to the extremely-high-frequency (EHF) band ( $f = 30 - 300$  GHz), which lies between the super-high-frequency (microwave) band and the optical (infrared) band. These waves are of the special interest for scientists because they were unlikely to take part in phylogenesis of terrestrial beings. The point is that MM-wave radiation is virtually absent in natural conditions due to its strong absorption in the Earth's atmosphere, mostly by water vapor.

The first wideband oscillator, appropriate for medical applications, was developed and brought into production in the U.S.S.R. under the leadership of Academician N.D. Devyatkov and Professor M.B. Golant in the mid 1960s. The oscillator was called as O-type backward-wave tube and was originally employed for the radio systems and measurements. The creators of this MM-wave oscillator also suggested an idea to study the biological effects of MM-wave radiation.

Nowadays, scientists all over the world discuss the possible applications of electromagnetic waves in nontraditional field, such as biology and medicine. It is particularly shown, that low-intensity (nonthermal) MM-waves might have a nonspecific effect on biological structures and organisms [1,2]. Foreground investigations, which have been performed during last 35 years, made it possible to enunciate a hypothesis that vital functions in the cells are governed by coherent electromagnetic MM-waves. The alternating electromagnetic field of these waves maintains interaction between adjacent cells to interrelate and control intercellular processes in the entire being. This hypothesis formed the basis for a new scientific area that was originated at the turn of several branches of the science: biophysics, radio electronics and medicine. This area was thereafter named *millimeter electromagnetobiology*. Large body of experimental and theoretical data has been amassed on the biological effects of MM-waves. The most essential facts are: the low-intensity EHF radiation is strongly absorbed by water and aqueous solutions of organic and inorganic substances; MM-wave absorption violates the additivity law of a solvent (water) and solutes; EHF radiation excites acousto-electric oscillations (the Frohlich oscillations) in plasma membranes; MM-waves stimulate production of biologically active substances by immunocompetent cells; EHF radiation changes microbial metabolism; MM-wave radiation stimulates ATP (adenosine 5' -triphosphate) synthesis in green-leaf cells; MM-waves change the rheological properties of blood capillaries; EHF radiation excites CNS (central nervous system) receptors and induces bioelectric responses in the cerebral cortex; EHF radiation increases the hydration of protein molecules.

In the early 1970s the special program was initiated by Acad. N.D. Devyatkov for clinical uses of MM-waves at some of our medical centers with the object of treating various diseases. It was upheld by the USSR Ministry for Public Health. The method has been tested at the leading medical centers of the country (Oncological Research Center of RAM, the Central Institute of Traumatology and Orthopedics) and hospitals. Medical doctors confirmed the high effectiveness of therapy suggested for cardiovascular diseases (persistent and nonpersistent stenocardia or angina pectoris; hypertension myocardial infarction); neurological diseases; urological cases (pyelonephritis, impotence, prostatitis); gynecological disorders; skin diseases; gastroenterological maladies; stomatological and oncological diseases – for protecting the hematopoietic (blood-making) system and eliminating the side-effects of

chemotherapy. The clinical practice of thirty five years attests to the absence of remote aftereffects of our method. This therapy agrees well with other procedures (medication, physiotherapy) and is now widely used both in treatment and prevention.

Our recent investigations (1992-1997) have demonstrated the considerable increase of electroencephalogram (EEG) global correlation dimension obtained during (15 min) and after (30 min) the exposition of low-intensity EMF produced by cellular phone (in comparison with Placebo) [3] and the disturbance of sleep stages during 8-hour day sleep under the influence of the electromagnetic field of a GSM-standard mobile phone was noticed [4]. In this work we have tried to use MMW irradiation from the small-size oscillator to protect these negative enforcements. Inserted into a mobile telephone handset, MMW oscillator should be switched on with the beginning of talk and irradiates active points on the floor of the auricle.

## 2. Experimental

MMW oscillator was performed as an antenna-coupled module, consisted of active semiconductor chip (Gunn diode or field-effect transistor), directly bonded to the log-periodical microstrip antenna [5]. In the case of transistor-based oscillator the cylinder type metallic resonator was also used, despite this the full size of MMW radiation source was not more than 9x4 mm. In the experiments 0,1–1 mW output power was obtained with efficiency near 10% at the frequency ~42 GHz.

54 practically healthy both sex volunteers aged from 17 to 60 years participated in the experiments. All subjects were divided in two experimental groups (the order of the experiments was randomized) and received respective tubes: I group (*basic*) – 29 volunteers who used the mobile phones *without MM oscillator* inside the tube; II group (*Experimental*) – 25 volunteers who used mobile phones *with MM oscillator* inside the tube. No volunteers knew what phone they use. No researchers (except the head of the experiments) knew, to what group each volunteer belonged (*double blindtesting*). During 9 weeks 4 EEG records have been done with each volunteer: the first record - before beginning of telephone call (*background*) and three records – each three weeks after the phone usage.

## 3. Results

Processing of EEG records by methods of nonlinear dynamics with the calculation of the multichannel (global) correlation dimension allows to evaluate the changes of the functional state of the brain at whole. The measure obtained as a result of such processing is highly sensitive to the effects of low-intensity EMF produced by cellular phone. It was noticed, that the presence of MMW-oscillator in the mobile phone tube compensates the negative effects of mobile phone EMF. The absence of elasticity and brain reactivity decrease in the subjects of experimental group shows the **protective action** of MM-waves.

## 4. References

1. Betskii O.V., Lebedeva N.N. Low-intensity Millimeter Waves in Biology and Medicine – In: “Clinical Application of Bioelectromagnetic Medicine”, USA, N-Y, Marcel Dekker, Inc., 2004, 30 pp.
2. Lebedeva N.N., Betskii O.V. Application of Low Intensity Millimeter Waves in Medicine. – BEMS Seventeenth Annual Meeting, Boston, USA, 1995, Abstract book, p.14.
3. Lebedeva N.N., Sulimov A.V., Sulimova O.P., Kotrovskaya T.I. Cellular Phone Electromagnetic Field Effects on Bioelectric Activity of Human Brain. – J. “Critical Reviews in Biomedical Engineering”, N.-Y., 2000, Vol.28, N1, pp.323-337.
4. Lebedeva N.N., Sulimov A.V., Sulimova O.P., Kotrovskaya T.I. Investigation of brain potentials in sleeping humans exposed to the electromagnetic field of mobile phones-in: J. Critical Reviews in Biomedical Engineering”, N.-Y., 2001, Vol.29(1), N1, pp.125 -133
5. V.E.Lyubchenko, E.O.Yunevich. Active Millimeter Wave Microstrip Antenna. Proc. of the XV Int. Conf. on Microwaves, Radar and Wireless Communications. Warsawa (Poland), 2004, pp.336-339