Influence of pulsed electromagnetic waves On the Electrical Acti

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EEG

The possible effect of high-frequency electromagnetic fields on the human organism is discussed controversially time and again. But only serious scientific studies can illuminate the real risk potential. In this context it is necessary to determine possible effects of the electromagnetic fields used in mobile communication under reproducible and realistic experimental conditions. In accordance with these research findings, institutions as the WHO or the ICNIRP recommend limits for the protection of the public, which are subject to constant revision and adequately adapted if needed.

Yet the test results are often incoherent and partly contradictory, for instance, in the question about the effect of pulsed high-frequency electromagnetic waves on the electrical activity of the human brain. In 1992 the medical physicist Lebrecht von Klitzing from Lübeck observed direct as well as long-term effects on the electroencephalogram (EEG) of several test persons and he therefrom concluded a detraction from brain capacity.

In contrast, the psychiatrists Joachim Röschke and Klaus Mann from Mainz found no effect on the EEG in the awake state when they in 1997 exposed 34 test persons to the field of a D-system mobile phone for several minutes. An overview study about neurological effects of high-frequency electromagnetic waves of the same year concludes that neither the exposure to continuous nor pulsed fields constitutes an increased health risk in the non-thermal area to the brain.

The Federal Office for Radiation Protection (BfS) has recently dealt with possible EEG modifications due to microwave exposition. The main interest of the investigation, which was carried out together with neurologists of the Großhadern University Clinic, was exclusively focussed on such effects that occur in direct and simultaneous connection with the microwave radiation. However, it cannot finally be said by means of an EEG investigation, whether a measurable effect means a health risk, though its occurrence would at least suggest extrapolating studies.

The electroencephalogram records the chronological development of the electric processes which accompany the cerebral activity and are measured by means of electrodes in the head area. The waves generated by the brain are divided into five frequency ranges according to their wavelength: delta waves (0.5 to 3.5 Hz), theta waves (3.5 to 7.5 Hz), alpha waves (7.5 to 12.5 Hz), beta-1 waves (12.5 to 18 Hz) or beta-2 waves (18 to 30 Hz).

Each frequency represents a characteristic reflection: some waves correlate to certain states of consciousness as, for example, tiredness or sleep, some correlate to pathological changes such as coma, brain injury or poisoning. The analysis of the diagram therefore enables conclusions to the present state of health and efficiency of the test person. As the „conventional“ EEG is in the end a „summation“ of simultaneously occurring processes, the scope of any statement as the condition of individual, functionally connected areas of the brain, will be limited. This limitation can only be overcome by measuring so-called evoked voltages where a test person

ivity of the Human Brain

is repeatedly exposed to a specific, e.g., optical or acoustic stimulus.

39 healthy test subjects - of whom 21 were women, aged between 16 and 58 years took part in the BfS study. In the test usual mobile phones of the D-system (frequency 902.4 MHz, tested on 23 subjects) and the E-system (1760 MHz, tested on 16 subjects) were used. The phones were placed directly against the right ear of the subject. Even at maximum transmission power none of the limits was exceeded.

In several test procedures first an EEG at rest and afterwards evoked voltages were recorded. For this purpose, the test persons had to watch alternating patterns and listen to audible clicks. Simultaneously, the electrical activity of the brain was measured. The acoustic stimulation served as a test for the reaction time. The test procedures were repeated several times whereat in one of the tests the pulsed field was switched on undisclosed to the test subject.

In the D-system field at the EEG at rest two of the 23 test subjects showed a reaction in the alpha band. One of the test subjects showed an increase in activity during the exposition, all other conditions (evoked voltages) were not noticeable. Another test subject showed a marked increase in activity already before the exposure phase, so that an effect due to the influence of electromagnetic waves can be excluded (see graphics).

In the E-system field three of 16 test subjects showed reactions in the alpha band of the EEG at rest. Two persons showed an increase, one a decrease in activity, the other conditions showed no response again.

The evaluation of the evoked voltages gave no indication of a change in EEG activity. The same picture appeared in the context of the measurement of the reaction time, in which the test subject had to respond to an acoustic impulse by pressing a button.

Conclusion

The current study neither indicated, that the electromagnetic high-frequency waves transmitted by mobile phones modify the activity of EEG at rest, the electric activity of the brain under the influence of optical and acoustic stimulus nor that they influence the reaction time.

It has, however, to be noted, that in the interpretation of the results of neuro-physiological tests in connection with electromagnetic fields, the extreme variation within and between the findings must be taken into consideration. At long last the measured EEG activity results from the interaction of a series of factors, which partially can neither be found in the basic conditions of the experiment nor be controlled within its course. A considerable influence on the shaping of the EEG have, for instance, variations in concentration and degree of relaxation of the test subjects.

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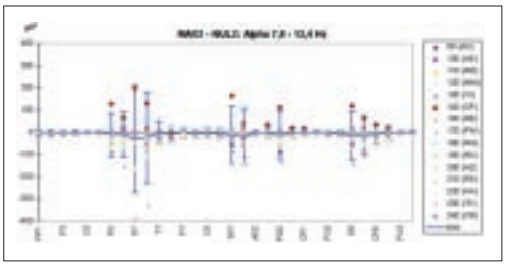
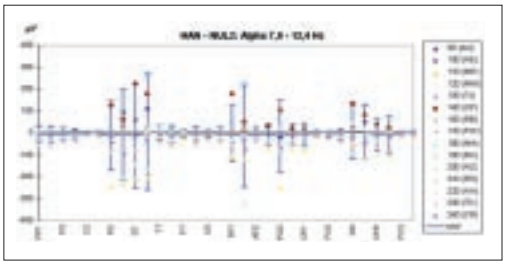
For 15 test subjects (test sequence II) it is shown in the following figure (difference diagram of the exposition and placebo conditions of the EEG at rest in the alpha band). The line pulled through represents the average value of all single differences above the 32 test electrodes. The scattering bars show the double standard deviation (confidence interval)of the test collective. If the difference line of the average value strongly deviates from the zero line (more than the double standard deviation), a significant difference is present above the corresponding electrode. As the difference line of the average value does not deviate from the zero line, it is already observable from the graphics, that the electromagnetic field of the hand-held mobile phone (emitted with a power of 2 W) has no measurable effect on the EEG at rest. The difference between exposition and placebo condition remains near the zero line.





The line of the average value does not deviate from the zero line, no effect can be recognized. The electromagnetic field of the hand-held mobile phone – emitted with a power of 2 W, or the car telephone (8W) – has no measurable effect on the EEG at rest.