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# Electromagnetic Field Parameters in Different Magnetic Therapy Devices

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**Magnet therapy (MGTH) is a commonly used method in physical therapy. Therapeutic effect is achieved with device-created magnetic fields, which can be described with numerous parameters. The effect of the MGTH depends on the used parameters; therefore it is important to be familiar with them. There are 10 parameters which should be included in studies on biological tissues. Publication of all parameters in studies occurs rarely. We performed measurements of magnetic field parameters in three MGTH devices creating a pulsed electromagnetic field in three different manners - with a solenoid, with Helmholtz coils and with magnetic mattress. In this paper we have discussed and present the measurements of parameters and spatial distribution of MF which we need to be familiar with when applying MGTH.**

**Keywords :** magnet therapy, PEMF, magnetic field parameters, devices

## 1. Introduction

MGTH is a commonly used method in physical therapy. It is used for treating numerous medical conditions. The therapeutic agent of MGTH is a MF acting on the human body. The idea stems from the currents discovered in the body with numerous signalling and regulatory functions. These functions can be stimulated with an external MF which creates appropriate currents in the body.

For centuries MGTH was carried out with a static MF by means of permanent magnets. With the discovery of electricity, development of electrical engineering and later electronics it was possible to artificially create a MF. Using a direct current, a static MF is created, whereas with an alternating current it is possible to create different pulsating MFs.

Different types of MF act differently on the human body and have a different effect on it. A static MF is caused in the body by the eddy current by displacement, the Lorentz force, a magnetic force, magnetic torque and effects on radicals. A pulsating MF acts especially with the induction of electric current in the body (eddy currents) and thermal effect at higher frequencies [1].

The effect of different forms of MF varies extensively - »Different magnetic fields produce different effects in different biotargets under differing conditions of exposure« [2]. The characteristics and intensity of a MF can be compared with the type and dosage of a pharmacological drug. Therefore it is very important to be familiar with the characteristics of the used MFs in studies on the effect of MGTH.

For these reasons, the requirements were set long ago for publishing specific parameters in studies on the effect of the EMF on biological tissues [3].

– type of the field
– magnetic flux density B
– gradient – dB/dt
– vector – dB/dx
– frequency
– pulse shape
– component – electric or magnetic
– localisation
– time of exposure
– depth of penetration.

The following applies to the PEMF. In studies on the static magnetic field, parameters which should be included in the presentation of the study were defined as well [4]. In the present article we present the problems related to PEMF parameters produced by the measured devices.


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Abbreviations: MGTH – magnet therapy, MF – magnetic field, EMF – electromagnetic field, PEMF – pulsed electromagnetic field, B – magnetic flux density, T – Tesla

Specific requirements are outlined, which are mostly not presented by the majority of studies on MGTH and not indicated by the manufacturers selling these specific devices.

A short explanation of individual requires PEMF parameters is provided and measurements performed with three types of MGTH devices with explanations and demonstration of all the required parameters are presented.

## 2. EMP Parameters – Listed Requirements

### 2.1. Type of Field

Magnet therapy is performed with the use of technically created EMF divided into 6 categories [5]:

– static magnetic field
– low frequency 50 or 60 Hz sinusoid EMF
– pulsed EMF of various parameters
– pulsed EMF in a radiofrequency range (e.g. 27.12 MHz)
– transcranial electric/magnetic stimulation - short and intensive impulses
– high-frequency pulsed EMF – millimetre waves.

In the mentioned article [5], a short explanation of all the indicated EMF types is provided. Physical therapy usually uses static MF, low-frequency pulsed electromagnetic field PEMF up to 300 Hz and within radiofrequency spectrum. The Food and Frug Association (FDA) has confirmed the use of low-frequency PEMF for treating unhealed fractures and high-frequency PEMF, 27.12 MHz for treating pain and swelling in the superficial tissue [6].

### 2.2. Magnetic Flux Density B (T)

Magnetic flux density $\boldsymbol{B}$ is a vector physical quantity describing the magnetic field. The unit is T – Tesla or G – Gauss (1 mT = 10 G). The planet Earth has a static MF with the B value ranging from 25 to 65 μT [7]. The therapeutic range of MF regarding B is enormous. There have been articles published on treating neurological issues – multiple sclerosis [8], Alzheimer [9] with PEMF B values in the pT range (Picotesla = $10^{-12}$ T). When treating pain, soft tissue and bone problems, B values are used measuring around mT range. Various B values are used around this range in basic and clinical studies. Data are available on the effective magnetic flux density windows: 50-100 μT, 15-20 mT and 45-50 mT [10]. In textbooks [11] general framework instructions can be found: for acute conditions - smaller intensity (up to 3 mT), for chronic conditions a higher intensity (around 6 mT). The B values of MF emitted from the device are bigger than B values at the target tissue.

### 2.3. Max. Gradient (dB/dt)

Electric currents in the body can be created with an external PEMF application or by body movement in a static MF. In practice, the first option is used as it also enables a precise MF pulse shape and intensity. The parameters of induced currents and consequently the electric field in the body depends on the speed of B value changing during dB/dt [12]. With fast increase or decrease of MF, higher electric currents are induced in target tissues [6], which is the most important factor responsible for the intensity of the biological response [5].

In a harmonic signal with repeated impulses, the increase or decrease of MF is also impacted by the frequency and amplitude. Certain authors claim that despite all the most important factor of the biological response is dB/dt [13]. The shape of PEMF impulse has a substantial effect on the gradient dB/dt.

### 2.4. Max. Vector (dB/dx)

The MF is composed of magnetic strands aiming in specific directions. The MF is a vector field created by the size and direction of magnetic strands. Structures (collagen, fibrin) and cells (osteoblasts, Schwann cells) are oriented regarding the magnetic strands [14]. When the direction of MF strands were coordinated with the anatomical axis of the elongated bone, smaller impedance, higher current amplitude and narrower impulses (higher dB/dt) were achieved in comparison to transverse MF orientation with regard to the longitudinal bone [15].

### 2.5. Frequency

PEMP also describes the oscillation frequency which has various rates from a few Hz up to MHz.

Low-frequency MGTH is by definition within the frequency range up to 300 Hz. PEMF with a frequency range from 1 to 100 Hz is the most effective and used with most MGTH devices [16]. In this frequency range mostly piezoelectric currents are created in body tissues. Typical frequencies for bone tissue are between 15-30 Hz. Muscle vibrations induce a current with frequencies between 5-30 Hz [17]. Most frequencies are in a similar range and are induced/created by collagen-rich connective tissue: ligaments, hyaline cartilage. Wachtel classificated the low-frequency MGTH within the frequency range between 1 and 60 Hz [18].

Regarding the selection of PEMF parameters in MGTH, a general instruction can be found in a textbook recommending lower frequencies in acute conditions (up to 6 Hz), and higher frequencies for chronic conditions (25-50 Hz) [11].

For MGTH with PEMF in the radiofrequency range, the frequencies are set at 13.56 MHz, 27.12 MHz and 40.68 MHz [2]. Such MGTH is athermic due to short impulse duration and longer pause between the impulses. The temperature increase of the treated tissue is < 0.001 ºC [15]. MGTH with 27.12 MHz radiofrequency was approved by the FDA for treating pain and swelling in superficial tissues [6].

### 2.6. Pulse Shape

For MGTH with PEMF, sinusoid-shaped impulses can be used with the 60 Hz frequency in the USA and 50 Hz in the rest of the world. Because sinusoidal wave motion does not achieve steep enough increases and decreases of B value in time, different impulse shapes were determined for this purposes. Markov transparently presented in his article the development of different impulse shapes [19]. The shape of PEMF impulse emulates the asymmetric-voltage waveforms occurring in fast bone deformation [20]. The specific biphasic low-frequency PEMF was thus confirmed by the FDA for treating unremodeled fractures [21]. In impulse design, the requirement for highest possible value of dB/dt created by unipolar or bipolar rectangular signals is stressed. The Slovenia authors have recommended the use of trapezoidal signal shape [22].

### 2.7. Component (electric or magnetic)

The creation of electrical currents in the body with exterior impact is technically possible in two ways. The body can be exposed to electrical field applied directly to the body surface - skin. The other possibility is contact-free exposure to MF, which induces inside the body the desired electrical currents. A comparison of both methods shows the following characteristics

**Electric current:** electrodes required, skin contact, full barrier limitation, disruptive, possibility of infection, tissue pathway dependent

**MF/EMF:** no electrodes required, non-contact application, some barrier limitations, non-disruptive, no possibility of infection, tissue pathway independent [2].

The use of MF has effortlessly passes the main barrier of the electrical field - the skin. It is contactless and pain-free. It induces the therapeutic electric field directly in the target tissue.

### 2.8. Localisation

The possibility of more precise concentration of action on the target tissue is the main advantage of MGTH compared to medication therapy which requires an input of large quantities into the body to achieve the necessary therapeutic concentrations in the target tissues [6]. Therefore it is important to identify the location of the target tissue, spatial distribution of MF density of the utilized MGTH device and the depth of MF penetration in the human body. The fundamental purpose is to expose the target tissue with the functional MF density, which can be achieved with the choice of induction/creation method of PEMF (solenoid, Helmholtz, flat mattress). The spatial distribution of MF strands and decrease in B density related to the distance from the coil is demonstrated in measurements of the presented devices.

### 2.9. Time of Exposure

Time of exposure sets the time of action of therapeutic EMF. The duration of MGTH is defined with the duration of a single therapy and the number of repetitions. By increasing the time of MF action, we can imagine a larger "dosage" of therapy and consequently better therapeutic effect. When selecting the appropriate duration of the therapy, it is required to consider the expected impact of MGTH on the pathophysiological process. The positive effect on unremodeled fracture healing was achieved in studies with a longer MGTH - e.g. minimally 12 hrs/day; minimally 3-4 months [23]. The chondrocytes also increase cartilage formation under the influence of PEMF. Longer duration of MGTH is required for the formation; therefore the Cochrane study review on the effect of MGTh on knee osteoarthritis included only studies with MGTH lasting at least 4 weeks [24, 25]. Pain, as the main disturbing symptom of numerous pathological conditions, can be treated with shorter therapies. Increased threshold for pain was proved with a single exposure to PEMF for 30 minutes [26]. Better functional recovery of artificially damaged nervus ischiadicus in rats was achieved with MGTH for 5 days 4 hours a day [27]. For all the mentioned conditions, different duration of MGTH was used in other studies. The recommendations of MGTH device manufacturers regarding the duration of the therapy range from a few minutes up to a few hours of therapy daily [13].

### 2.10. Depth of Penetration

A relatively homogeneous MF penetrates the human body undisturbed as long as the frequencies are not too high. Penetration of PEMF into the human body is possible because it is made of non-magnetic material with low specific conductivity. Up to 1 MHz frequency, PEMF penetrates through the human body, i.e. the human body does not change the primary distribution of MF created with a magnetic therapeutic device.

The distribution of EMF depends on the manner of MF creation. The study presents the distribution of MF in solenoid, between Helmholtz coils and above the flat mattress. If a part of the body is positioned in the MF created by solenoid or Helmholtz, it is relatively homogeneous and passes through the body undisturbed.

MF created by flat mattress coils decreases with the square of the distance from the coil in the air and likewise in the body. It equally decreases in B of static MF - Khoromi studied the effectiveness of treating radiculopathy in chronic low back pain by means of static magnetic field with the intensity of 200G, placed on the skin of the lumbar area. In affected structures 9 cm deep the calculated B was only 6.5G [28].

## 3. Measurements of EMF in Therapeutic Devices

PEMF is technically possible with the use of three EMF sources [6]:

– solenoid - spherical coil
– Helmholtz - two flat round coils placed parallel to the half coil diameter distance
– flatmattress - with multiple in-built/installed coils

The distribution of EMF in all three sources differs extensively. We performed measurements on all three devices; in one from each group.

All PEMF measurements for the selected magnetic therapeutic devices were performed at the Laboratory for applicative electromagnetics of the Faculty of Electrical Engineering and Computer Science, University of Maribor. The following measuring equipment was used:

– Teslameter Magnet-Physik FH 54
– Axial Hall probe: HS AGB5-4805
– Transverse Hall probe: HS-TGB5-104005
– Oscilloscope Tektronix DPO3014 100 MHz 4 Analog Channel

In time courses, the current B value is displayed and in location courses the mean B value.

### 3.1. Solenoid – PMT Quattro PRO

Figure 1 shows the PMT Quattro PRO device (ASA, Arcugnano, Italy) intended for performing magnet therapy in numerous medical conditions. The Figure of the device contains a drawn coordinate system, whereas the tables and graphs demonstrate the characteristics of the therapeutic MF.

Table 1 shows the measured parameters recommended in the MF use for research purposes. Parameters were measured for program 49 - pseudoarthrosis therapy (50 Hz, $B$ = 70 % baseline device power).

The shape of PEMF impulse is essential for the clinical effect of magnet therapy. The ASA Quattro Pro device


**Fig. 1.** (Color online) The device for physical therapy PMT quatro PRO with a marked coordinate system origin in the coil centre.

**Table 1.** Parameters of PEMF for PMT quattro PRO measured in the central area of solenoid.

| PMT quattro PRO | |
|---|---|
| Type of field | PEMF |
| Magnetic flux density B (mT) | $B_{max}$ = 2.095 mT, $B_{mean}$ = 1.134 mT, $B_{RMS}$ = 1.216 mT |
| Max. gradient (dB/dt) | 1,057 T/s |
| Max. vector (dB/dx) - mean | 0,02 mT/cm |
| Frequency | 45 Hz |
| Pulse shape | Figure 3 |
| Component (electric or magnetic) | Magnetic |
| Localization | »Body target« |
| Time of exposure | »... minutes ... working days in … weeks« |
| Depth of penetration | At 50 Hz this is not relevant information. |

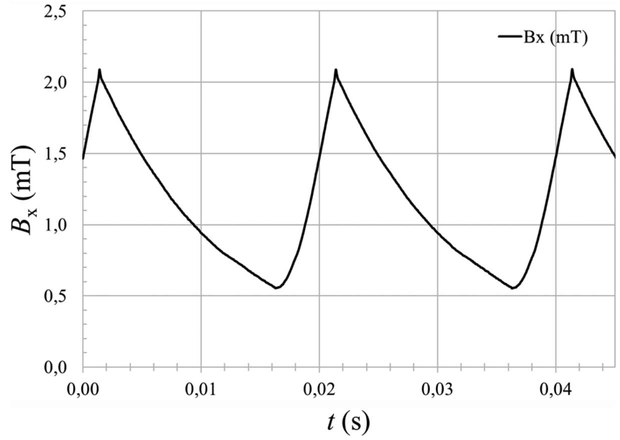


**Fig. 2.** Changing the magnetic flux density $B_x$ in relation to time, at a frequency 50 Hz and intensity 100 % for the program 49 on the ASA Quattro Pro device.

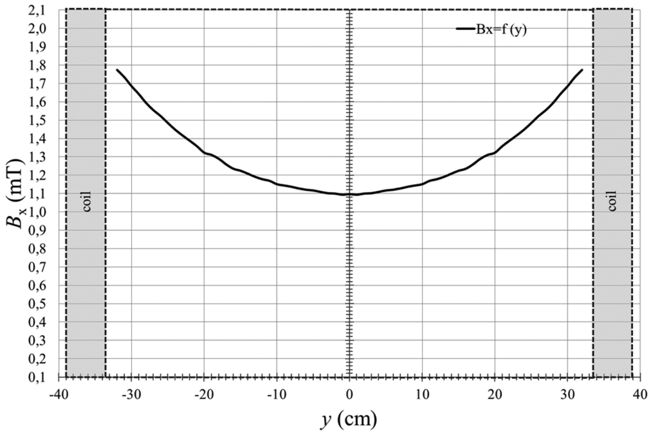


**Fig. 3.** Spatial distribution of the mean $B_x$ value inside the coil of ASA Quattro Pro device on the line matching the $y$ axis and $x = 0$. Due to symmetry, the magnetic field distribution is the same on any line passing through the coordinate system origin $x = 0$ and $y = 0$.

produces PEMF with quasi-triangular shape (Fig. 3). B value is constantly positive - it fluctuates from the minimum vale 0.55 mT up to maximum 2.09 mT. The impulse reaches the highest dB/dt value 1.057 T/s during the increasing phase of B.

When using a coil, the therapeutic MF is inside the coil. It is not completely homogeneous, the highest B values, 1.77 mT are present on the outer rim of the coil near the internal rim, and the lowest in the centre of the coil, 1.1 mT (0.65 %). Figure 4 shows the distribution in the direction from the centre to the rim of the coil.

### 3.2. Helmholtz – Cosmogamma MG-Port

The Cosmogamma MG-Port device (Cosmogamma, Cento, Italy) is intended for magnet therapy in smaller areas of the human body. Figure 5 shows individual device parts and a drawn coordinate system for the purpose of transparency of the measured results. Complete measurements of the magnetic field between both coils were performed, in the direction of the $z$ axis and $x$-$y$ plane at the frequency of 45 Hz in intensity 100 %. Because the main axis of the magnetic field is in the direction of the z axis, we measured only this component of magnetic flux density and marked it with $B_z$.

**Table 2.** Parameters of PEMF for Cosmogamma MG-Port measured in the central point between two parallel positioned solenoids.

| Cosmogamma MG-port | |
|---|---|
| Type of field | PEMF |
| Magnetic flux density B (mT) | $B_{max}$ = 6.302 mT, $B_{mean}$ = 1.090 mT |
| Max. gradient (dB/dt) | 11.4 T/s |
| Max. vector (dB/dx), (dB/dy) - mean | 0.018 mT/mm |
| Frequency | 45 Hz |
| Pulse shape | Fig. 7 |
| Component (electric or magnetic) | magnetic |
| Localisation | »body target« |
| Time of exposure« | »… minutes ... working days in ... weeks« |
| Depth of penetration | At 49 Hz this is not relevant information. |

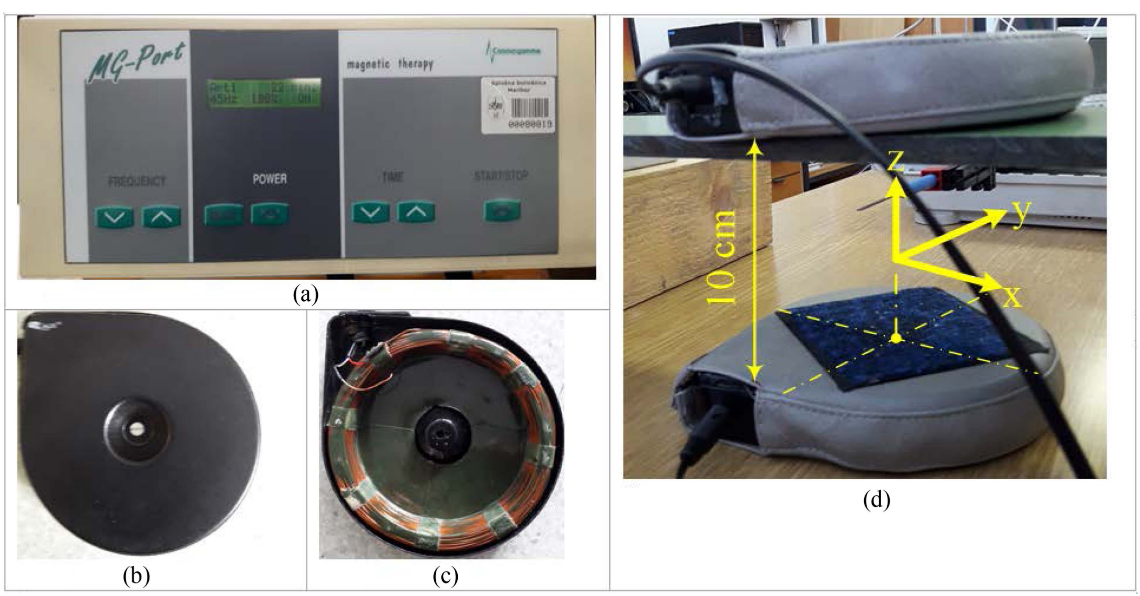


**Fig. 4.** (Color online) The Cosmogamma MG-Port device with a demonstration of its parts and drawn coordinate system in parallel Helmholtz coil positioning.

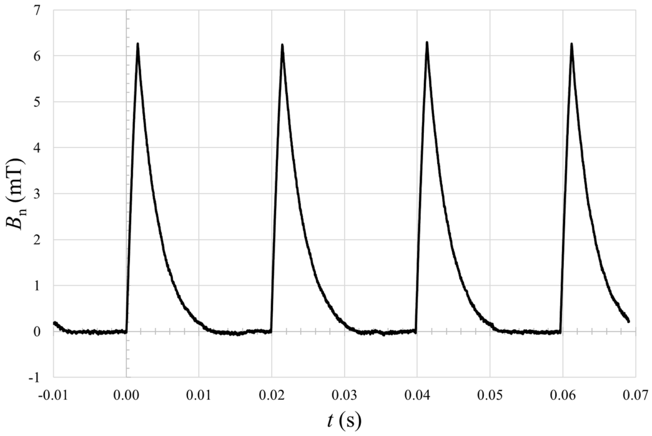


**Fig. 5.** Impulse shape at Cosmogamma MG-port - changing the magnetic flux density $B_z$ against time at frequency 45 Hz and 100 % intensity.

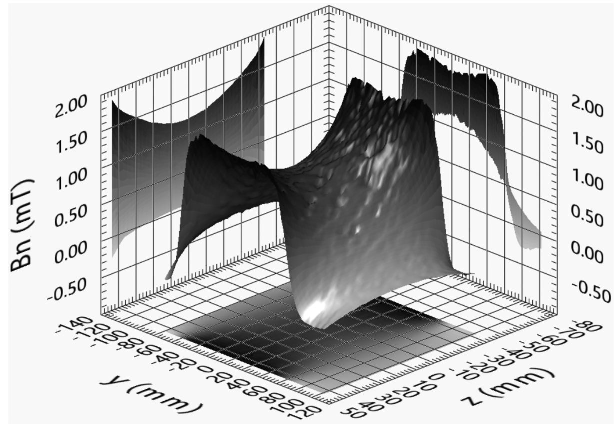


**Fig. 6.** Spatial distribution of the mean $B_z$ value between coils Cosmogamma MG-Port in the $y$-$z$ plane with $x = 0$. Due to symmetry, the magnetic field distribution is the same on any line passing through the coordinate system origin $x = 0$ and $y = 0$.

The required MF parameters are shown in Fig. 6.

MF is in the shape of monophasic quasi-triangular impulses. A characteristic of this PEMF is that it follows the pulse reaching a maximum value of 6.3 mT and lasts approximately half of the period, period with the value $B_z \cong 0$ mT until the end of the period. Therefore the mean value of $B_z$ is very low regarding $B_{z,max}$. The vertical course of the rising curve indicates a very high gradient dB/dt 11.4 T/s.

Figure 8 shows the spatial distribution of MF between both flat coils. The magnetic field is the largest along/around the coils in decreases towards the mid-position between the coils. The magnetic field is concentrated in the area between both coils, which is cylinder of sort with a diameter the same as the diameter of the coils. The maximum $B$ value near the coils is approximately 1.9 mT (darker colour), and the lowest in the centre between coils, 1.2 mT (63 % max). By distancing from the connection between the coils centres, $B$ decreases rapidly.

### 3.3. Flat Mattress – Magus

The mattress Magus (Magus terapija d.o.o., Ljubljana, Slovenia) is intended for magnet therapy in numerous indications. It can be performed in a medical or domestic setting. On Fig. 9 the positions and relative positions of all six coils inside the mattress. All have a diameter of 16 cm. Complete measurements of the magnetic field were performed along the mattress (on the longitudinal line through Segment 1 to Segment 6, which included three coils) and transversely on the mattress (on the longitudinal line through Segment 1 to Segment 6, which included two neighbouring coils) for program 3 – intended for muscle relaxation.

PEMF parameters measured for program 3 on the

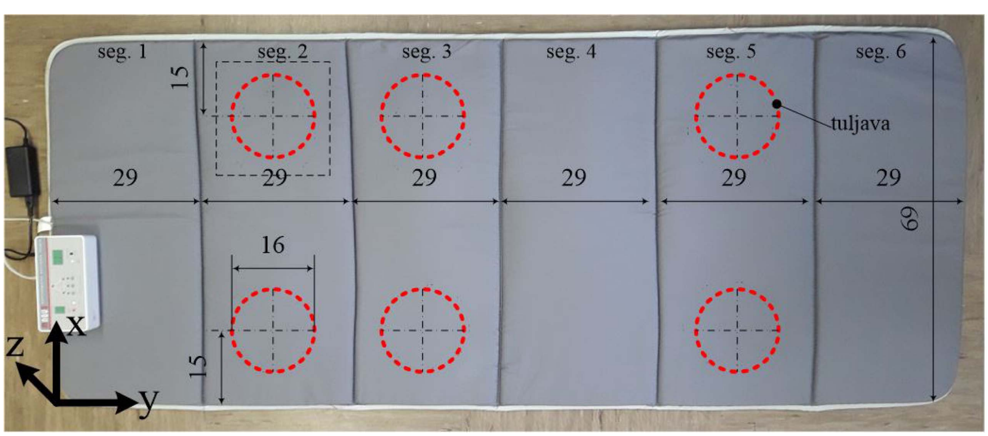


**Fig. 7.** (Color online) Coil distribution on the Magus mattress with approximate dimensions (cm), drawn positions of coils and a coordinate system.

**Table 3.** Parameters of PEMF for MAGUS measured in the central area of solenoid for program 3.

| MAGUS | |
|---|---|
| Type of field | PEMF |
| Magnetic flux density B (mT) | $B_{max}$ = 0.45 mT, $B_{mean}$ = 0.405 mT, $B_{RMS}$ = 0.426 mT |
| Max. gradient (dB/dt) | 4,473 T/s |
| Max.vector (dB/dx), (dB/dy) - mean | dB/dx = 0,354 mT/mm, dB/dy = 0.345 mT/mm |
| Frequency | Bursts frequency 21 Hz, impulse frequency 92.94 Hz |
| Pulse shape | Fig. 11 |
| Component (electric or magnetic) | Magnetic |
| Localization | »body target« |
| Time of exposure | »… minutes ... working days in ... weeks« |
| Depth of penetration | At 21 Hz this is not relevant data |

mattress surface above the coil centre are shown in Table 3.

B value is mostly positive, and impulses are directed towards zero value (Fig. 8). Impulses are monophasic, quasi-rectangular, very short and negatively oriented towards 0 mT. $B_n$ again reaches the maximum value 0.45 mT, which is then constant for the larger part of the period. Therefore also the mean $B$ value is very high - approximately 0.41 mT. The frequency of electric current supply and $B_n$ frequency measures 21 Hz for a pulse package (2 pulses), and the frequency of an individual pulse is 93 Hz.

MF is created above the coil in the shape of a cone with a crater (Fig. 9). The largest B values are above the coil rim 0.36 mT and decrease above the centre to 0.28 mT

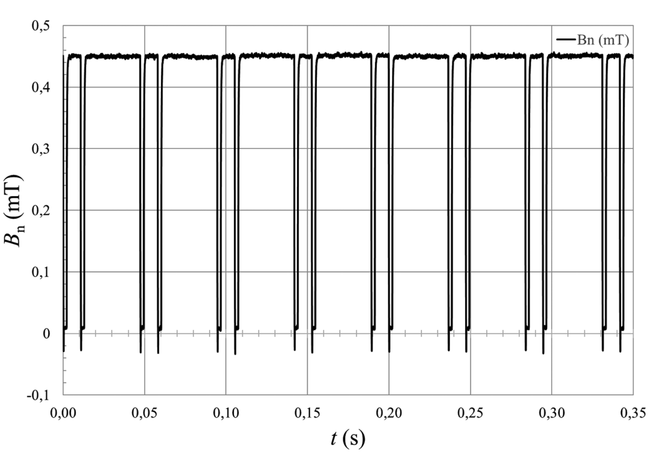


**Fig. 8.** Changing magnetic flux density B against the time for the program 3 of the MAGUS mattress. Because we measured a normal B component, i.e. B in a direction orthogonal to the mattress, the label $B_n$ is subsequently used.

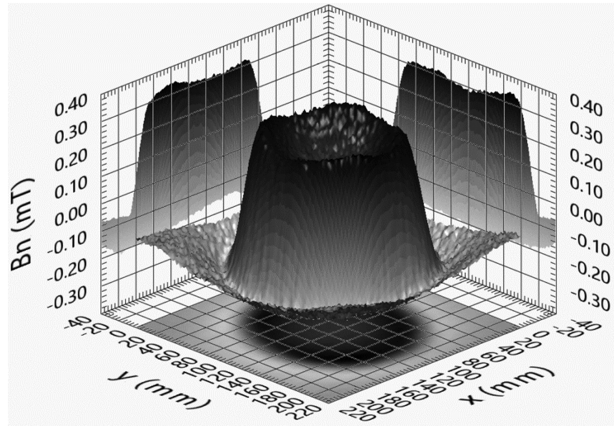


**Fig. 9.** Spatial distribution of mean $B_n$ $(x, y)$ on the surface of the mattress above the coil of the MAGUS mattress.

(77.8 %). In the horizontal plane, $B$ markedly decreases when distancing from the coil rim. The largest part of the mattress in on the surface outside the coil area and has a negligible B value.

$B$ rapidly decreases also in the vertical direction above the coils. On the surface of the mattress above the coil centre, the maximum measured mean $B$ was 0.316 mT, and vertically above that at a distance of 10 cm only 0.048 mT (15.2 %).

Spatial distribution of mean $B_n$ $(x, y)$ on the surface of the mattress above the coil is shown inside rectangular area indicated by a dotted line on Segment 2 visible on Fig. 9 by means of a 3D graph. The largest $B_n$ is above the coil turn area (darker colour), and the value decreases towards the coil centre. Decreasing of $B_n$ is even more pronounced when distancing form coil edges, which is visible on the projection of this distribution in the *x-y* plane. Lateral projections enable a more precise numeric evaluation of changes in $B_n$ value in $x$ or $y$ direction. It is notable that $B_n$ inside the coil changes from the maximum value along the coil edge/rim 0.36 mT to 0.28 mT (77.8 %) in the coil centre.

## 4. Discussion

MGTH uses the MF, which represents energy affecting the human body. The effect of the therapy depends on the used MF parameters. The connection between MF parameters and the effect is very complex - »Different MF produce different effects in different biotargets under differing conditions of exposure« [2]. The term MGTH without defining the parameters is equally general as the prescription of unspecified drug dosage. Already in 1994 parameters were published which every study on EMP should state [3]. Studies were also performed identifying *B* ranges and frequencies having the largest desired therapeutic effect in magnetic therapy. The terms »window«, »resonance«, »stages« were introduced already in 1975/76. The authors described amplitude and frequencies values with the highest MGTH biological effect. The therapeutic effect depends on the intensity of the used magnetic field *B*. The literature lists *B* ranges with a therapeutic effect. The target tissue has to be exposed to the MF within a set window of action to achieve a therapeutic effect. »In magnet therapy more does not necessarily mean better« [29]. The indicated windows of action in MGTH for B are 50-100 μT, 15-20 mT and 45-50 mT [10]. In all three devices the measured B values were outside this range. The spatial distribution of MF strands differs regarding the selection of device technique. Three different manners of creating therapeutic MF were presented – solenoid, Helmholtz coils and flat mattress. When choosing solenoid and Helmholtz, the MF inside the coils is relatively homogeneous. The size of solenoid allows the positioning of large body parts into the MF (trunk, both knee joints etc.). The measured Helmholtz coils have smaller dimensions. The measured mattress has a therapeutic MF directly above the six inserted coils which approximately correspond to the positions of the shoulders, hips and knees in a lying patient. The second most stressed PEMF parameter is frequency. Regarding the selected type of pulsed MF, the frequency range can be low (up to 300 Hz), high (MHz - radiofrequency range) or extremely high (GHz - millimetre waves). In MGTh with PEMF, frequencies up to 100 Hz are used, which is possible with all three measured devices. The creation of induced currents in the body increases if PEMF has a higher speed of changing *B*, i.e. higher dB/dt value. Among the measured devices, Cosmogamma has the highest dB/dt (11.4 T/s), MAGUS somewhat lower (4.5 T/s) and ASA Quattro Pro significantly lower (1.1 T/s). A comparison of other MF parameters with data from the literature is poor as most studies do not report them. In analysis of 56 double-blind clinical static MGTH studies there were only 39 % of them with accurately reported of the selected parameters [4]. In PEMF MGTH studies the result are definitive worse. The reason lies in the inadequate technical documentation of the devices, which mostly contains data on the type of field, outlet magnetic flux density and frequency. Observance of the set requirements after the display of the listed parameters when using MGTH for research purposes would enable transparency, comparability and repeatability of studies. Simultaneously data would be available for setting windows for all the indicated technical MF parameters. The clinicians are practically dependent on the work of technicians, engineers and computer experts who develop MGTH devices. Everyday physical therapy uses technical and program contents of the device, which sets all the MGTH parameters after the clinician marks the medical condition to be treated. In conventional medicine the used method of treatment is required to have effectiveness. The selection of treatment method thus depends on the positive results of methodologically quality studies. Comparisons of MGTH effectiveness with different devices are questionable due to hardly comparable MF parameters. If two devices match in one or two parameters, this still does not represent equal MF characteristics. There are a lot of possible combinations of different parameter values. Already in 1898 Basset described more than 30 physical and biological factors (field characteristics, orientational factors, passive electrical properties of target, state of cell function, electromagnetic events modifying applied EMF) influencing the effect of MGTH [15]. The calculation of permutations for all 30 factors provides an incredible number of $2.65 \times 10^{33}$. An unthinkable number practically makes it impossible to compare treatment effectiveness among different devices (and patients as well). When treating a patient with a certain medical condition with a MGTH device, a specific question arises. We need to know whether MGTH has a proved effectiveness for this condition and also if studies exist proving the effectiveness of the specifically used MGTH device. From this two urgent tasks follow:

– when purchasing MGTH devices it is necessary to request form the manufacturer proof on the effectiveness of the specific device for certain medical condition we would like to treat;
– the clinician is required to use own experience and research work to obtain data on the effectiveness of the used device.

## 5. Conclusion

MGTH is a commonly used method in physical therapy. The therapeutic medium is the MF which can have very different technical parameters. The effect of different parameters on treating different medical conditions varies. We have to be familiar with the general evidence on the effectiveness of MGTH for specific medical conditions. Unfortunately, this evidence does not necessarily apply to the specifically used device and its MF parameters. It will be necessary to request from the manufacturers of the devices for clinical use to conduct studies to confirm the effect of MF in the specific device for a specific medical condition. At the very least, we would expect from the manufacturers to clearly indicate evidence or only the theoretical treatment effectiveness for the numerous listed indications for MGTH with a specific device. Currently, we are still dependent on the empirical experience and eventually performed studies on the used MGTH device. As clinicians, we are required to know the characteristics of the prescribed therapy and therefore we expect from the manufacturers an indication of the required MGTH requirements. The displayed measurements have required cooperation of the technical team and provide a review of the parameters and spatial distribution of MF in three technical manners of creating therapeutic MF.

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