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# **An Experimental Analysis & Effect of Microwave Radiation to Human Brain Cells and its Ramification using different Anti-radiation strips**

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**Abstract.** The Cell phone radiation is of increasing importance to study biological characteristic variation. The brain waves are measured before and after exposure of cell phone for one minute. Mobile phone is kept in talk mode for 5 minutes minimum. With the help of EEG we measure Brain Wave frequency before use of mobile phone and after use of cell phone. We also test vibraimage color spectrum after the use of cell phone, it show the increase of yellow and green area in this spectrum which shows this increase in frequency. Here we have also verified the effect of mobile phone without any anti-radiation sticker and with anti-radiation sticker such as DTL (Strip C), KINDRED enterprise LLC (Strip A) and pure natural health (Strip B). This analysis determines temperature variation in the tissue because of electromagnetic field. Here we analyse for the frequency range 2GHz to 10GHz. The increase in tissue surface temperature is 3°C for 10 GHz with 100 mW/cm<sup>2</sup>. The increase in tissue surface temperature is up to 1°C for 10 mW/cm<sup>2</sup> field. 10 mW/cm<sup>2</sup> field strength is health standard limit. Transient period is 5 to 7 seconds. Heat effect is drastically reduces with anti-radiation sticker.

**Keywords:** Vibraimage, Electromagnetic, Spectrum, EEG

## **1 Introduction**

When cell phone is in talk mode it generates electromagnetic field in waving which superimposes with brain waves. The research was conducted on 5 persons, the wave are measured one minute before and after use of cell phone. Mobile phone is used for five minutes. The wave are tested with help of EEG. In this paper we are going to focus on brain wave frequency variation due to use of mobile phone. Here we have also verified the effect of mobile phone without any anti-radiation sticker and with anti-radiation sticker such as DTL (Strip C), KINDRED enterprise LLC (Strip A) and pure natural health (Strip B).

Electromagnetic Energy is transfer into heat when tissue is in electromagnetic field. Due to heat energy tissue temperature increases with time. The blood flow can

change tissue temperature [1]. The temperature is exponentially decays; finally tissue temperature is reached to surface temperature [2]. Here we made study state analysis and transient analysis. Steady state analysis gives temperature variation with respect to depth. The transient analysis gives time period to reach surface temperature.

### 1.1. Brain wave Frequency

The electromagnetic radiation is of increasing importance the study biological characteristic variations [3].

**Table 1.** Brain wave Frequency Range

Physiological State	Brain Waves, Hz	Body Vibrations, Hz
Sleep/Exhausted(Delta)	1.5 – 5	0.3 – 1.0
Drowsy/Tired(Theta)	5 – 9	1.0 – 1.8
Relaxed(Alpha)	9 – 15	1.8 – 3.0
Excited/Working(Beta)	15 – 40	3.0 – 8.0

**Table 2.** Brain Wave Color Spectrum

Color	Range in related units
Purple	0-30
Deep blue	30-80
Light Blue	80-120
Green	120-180
Yellow	180-220
red	220-255

### 1.2. Heat Induced in Tissue

The electromagnetic radiation is of increasing importance in the study of the biological characteristic variations, when more complex heterogeneous objects like skin with non-flat surface are radiated the additional picks in the surface filed patterns are possible. In order to have deep understanding about the effects of biological cells the theoretical study of heat transfer in the tissue is essential. Now, we analyze one dimensional heat transfer equation from fundamental equations.

## 2 Analytical Treatment

Here we analyze heat transfer equation for steady state analysis and transient analysis [4].

### 2.1 Steady state Analysis

The heat transfer formula in tissue is given by

$$pc \frac{\partial T'}{\partial T} = \frac{k(d^2 T')}{dx^2} - V_s(T' - T_o) + Q(x, t) \quad (1)$$

Where,

P= tissue concentration in gm/cm<sup>3</sup>,

C= spe. heat of tissue cal/gm<sup>0</sup>C,

K= coe. of heat in cal/cm/s<sup>0</sup>C,

V<sub>s</sub>= flow multiply by heat capacity ,

Q(x,t) = input heat because of microwave,

T(x,t) = temperature of tissue ,

T<sub>o</sub>= initial temp of tissue

The microwave induces heat in the tissue. Heat due to microwave is given by

$$Q(x, t) = \frac{I_o T}{JL} \exp\left(-\frac{x}{L}\right) u(t) \quad (2)$$

Where J indicates equivalent of heat, L is distance at which heat reduces to e, r is the part of energy transmitted. (r is 0.4 at 2.4 GHz)

Here we use reduced equation as follows

$$\mu \frac{\partial T}{\partial t} = \frac{\partial^2 T}{\partial x^2} - \lambda T + q \quad (3)$$

Here we observed tissue temperature variation by considering effect of microwave radiation.

T is the differential temperature

$$\mu = pc/k, \quad \lambda = V_s/k, \quad q = Q/k. \quad (4)$$

Here we made steady-state solution on the above eqn.

In the steady-state, (dT/dt=0)

$$\frac{d^2 T}{dx^2} = \lambda T - q_0 \exp(-x/L) \quad (5)$$

Where

$$q_0 = I_{oT}/JLk. \quad q_0 = I_{oT}/JLk. \quad (6)$$

### 2.1.1 Steady State Analysis Results

These two results are analyzed at I<sub>0</sub>=100 mW and I=10mW as shown in Fig 1&2 respectively.

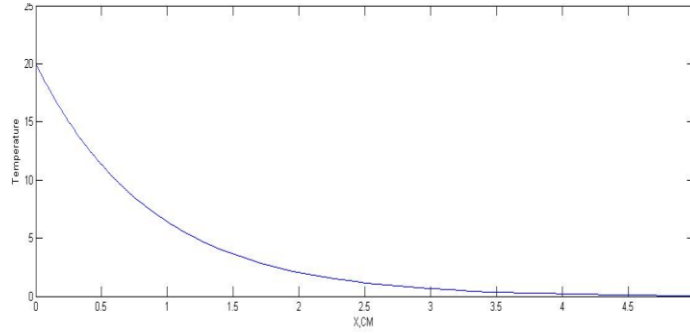


Fig.1 Steady state analysis with L=0.1 & F=10GHz

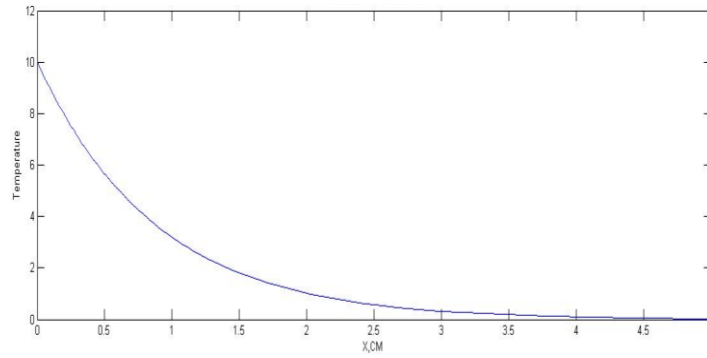


Fig.2 Steady state analysis with L=0.1, f= 10 GHz

## 2.2 Transient Analysis Result

With help of Fourier transform we get solution of transient analysis,

$$\frac{d^2 T_\omega}{d\omega^2} - k^2 T_\omega + q_0(x) T_\omega(i\omega) = 0 \quad (7)$$

Fig.3 shows the transient analysis results.

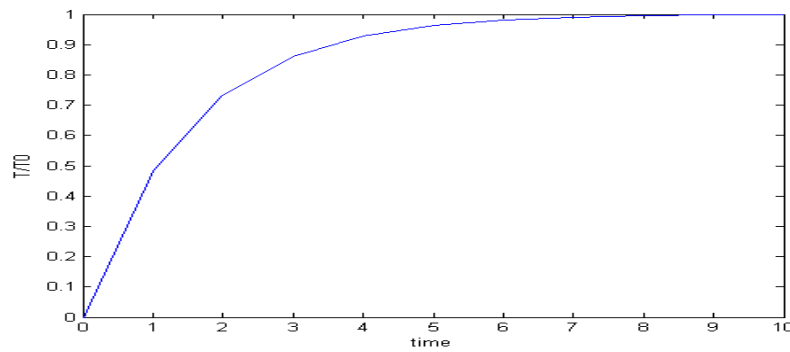


Fig.3 Transient analysis with L=1, f= 8 GHz Io=100mW

### 3 Brain Wave Frequency Analysis

The experiment is conducted on 5 persons for brain wave analysis. The waves are measured one minute before and after use of cell phone. Mobile phone is used for five minutes. The waves are tested with the help of EEG machine. In this paper we are focused on brain wave frequency variation due to use of mobile phone [5]. Further we have also verified the results of frequencies and the effect of mobile phone without any anti-radiation sticker and with anti-radiation sticker such as DTL (Strip C), KINDRED enterprise LLC (Strip A) and pure natural health (Strip B). The anti-radiation stickers are used for further analysis given in subsequent stages.

#### 3.1 Histogram During Testing

Fig.4 shows the plot of amplitude (mv) of brain waves with respect to frequency. The plot gives details about amplitude variation with respect to frequency before use of mobile, after use of mobile and mobile use with strip A.

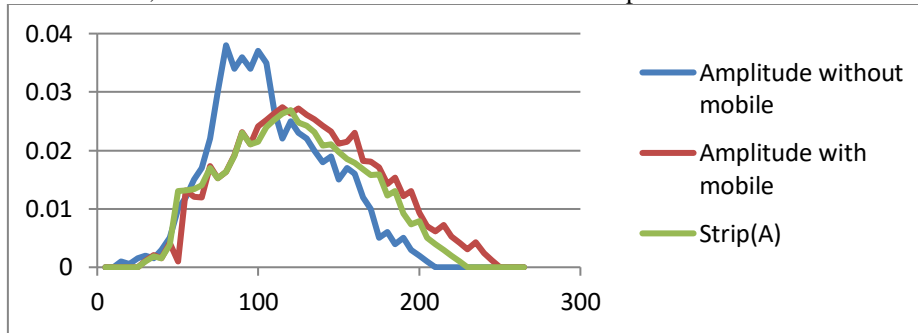


Fig.4. Person Histogram before and after 5 Minutes Exposure with strip A.

Fig.5 shows the plot of amplitude (mv) of brain waves with respect to frequency. The plot gives details about amplitude variation with respect to frequency before use of mobile, after use of mobile and mobile use with strip B.

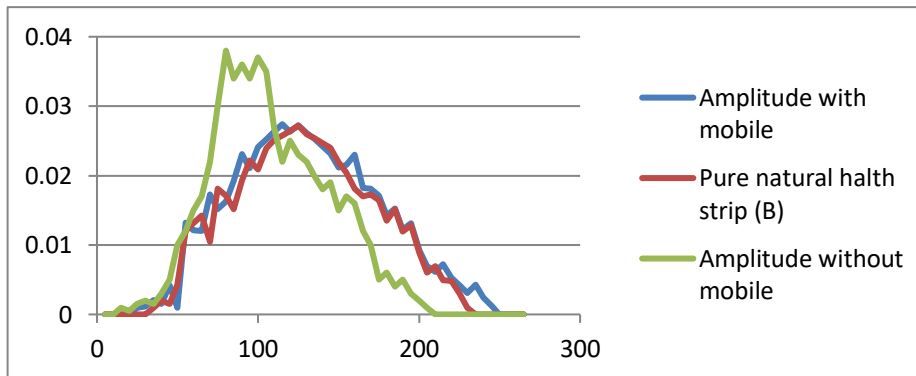


Fig.5. Person Histogram before and after 5 Minutes Exposure with strip B.

Fig.6 shows the plot of amplitude (mv) of brain waves with respect to frequency. The plot gives details about amplitude variation with respect to frequency before use of mobile, after use of mobile and mobile use with strip C.

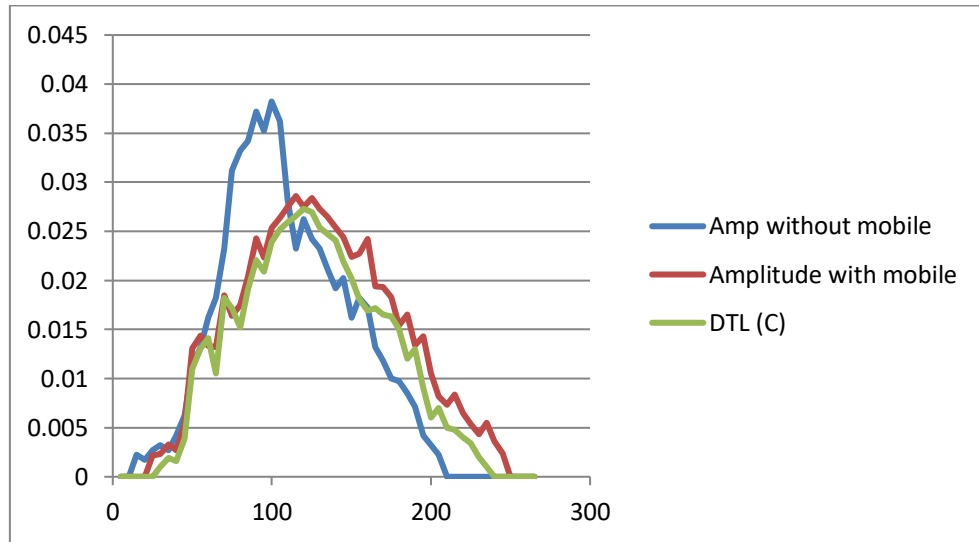


Fig.6. Person Histogram before and after 5 Minutes Exposure with strip C.

#### 4 Results

With the help of experimental setup we measure frequency of brain wave before use of mobile, with use of mobile & mobile with strip A, strip B and strip C. where frequencies are given in table 3.

Where,  $\Delta$ MVF is the Change in mean value frequency.

**Table 3.** Mean Value of Freq. in Hz along with strip A, B & C.

Sr. No.	Person	Without Mobile Frequency (Hz)	With Mobile Frequency (Hz)	Mobile with strip A` Frequency (Hz)	Mobile with strip B` Frequency (Hz)	Mobile with strip C` Frequency (Hz)
1	Person 1	105.8	120.3	110.3	112.2	115.1
2	Person 2	102.8	115.2	111.3	113.2	113.3
3	Person 3	101.1	116.7	109.8	112.9	113.4
4	Person 4	103.4	116.4	112.3	113.2	113.8
5	Person 5	104.8	117.4	113.5	114.9	115.4

**Table 4.** Normalized Changes of Mean Value of Frequencies in Hz ( $\Delta$ MVF)

Sr. No.	Person	With mobile	Mobile & strip A	Mobile & strip B	Mobile & strip C
1	Person 1	14.5	4.5	6.4	9.3
2	Person 2	12.4	8.5	9.4	10.5
3	Person 3	15.6	8.7	11.8	12.3
4	Person 4	13.1	8.9	9.8	10.4
5	Person 5	12.6	8.7	10.1	10.6
	Average	13.64	7.86	9.5	10.62

**Table 5.** Normalized Changes of power in microWatt

Sr. No.	Person	With mobile	Mobile & strip A	Mobile & strip B	Mobile & strip C
1	Person 1	87.2	25.6	38.2	56.4
2	Person 2	91.9	58.4	65.1	71
3	Person 3	109.9	79.6	86.7	89.8
4	Person 4	85.4	59.7	65.3	69.1
5	Person 5	85.4	60.9	69.7	72.9
	Average	91.7	56.8	65	71.6

As per the analysis made and given in table 4 & 5, we observe mean value of frequency increase when we use cell phone. But by using anti-radiation stickers, the frequency and power dissipation is decreased as compared to without sticker. Using anti-radiation sticker, heating effect on brain cells is reduces.

Fig. 7 shows changes in mean value of frequency with mobile, with strip A, strip B and strip C

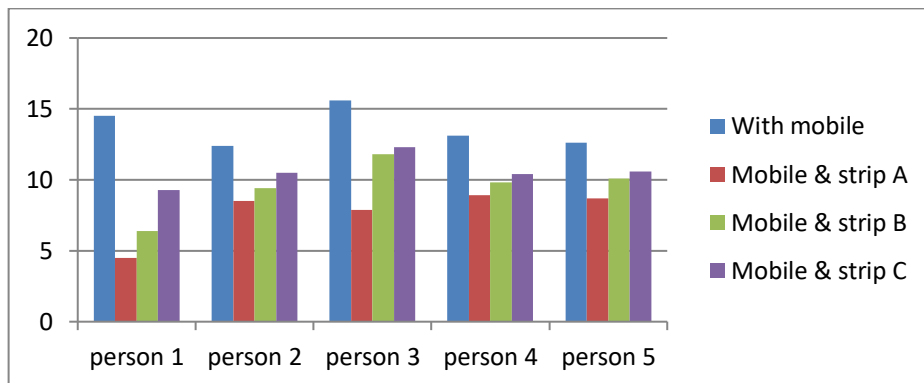


Fig.7. Mean Value of Frequencies changes 5 minutes exposure to the cell phone& Strip



With the help of experimental setup we measure frequency of brain wave before use of mobile, with use of mobile & mobile with strip A,B&C. Here we have calculated mean square deviations of frequency. It is shows in table 6.

**Table6.** Mean Square Deviation of Frequencies in Hz for Strip A, B & C

Sr. No.	Person	Without Mobile	With Mobile	Mobile with strip A	Mobile with strip B	Mobile with strip C
1	Person 1	54.89	63.29	57.81	61.2	61.3
2	Person 2	52.5	61.89	55.56	58.9	60.49
3	Person 3	51.89	60.78	56.09	57.49	58.59
4	Person 4	53.18	62.98	57.25	58.91	59.53
5	Person 5	53.65	61.25	57.59	59.5	60.36

**Table7.** Normalized Changes in the Mean Square Deviation in Hz

Sr. No.	Person	With mobile	Mobile& Strip A	Mobile & Strip B	Mobile & Strip C
1	Person 1	8.4	2.92	5.31	6.41
2	Person 2	9.39	3.06	6.4	8.09
3	Person 3	8.9	4.2	5.6	6.7
4	Person 4	9.8	4.07	5.72	6.35
5	Person 5	7.6	3.94	5.85	6.75
	Average	8.82	3.64	5.78	6.86

From above table 6 & 7, we observe mean square deviation of frequency increase when we use cell phone. But by using anti-radiation stickers, the frequency decreased as compared to without sticker.

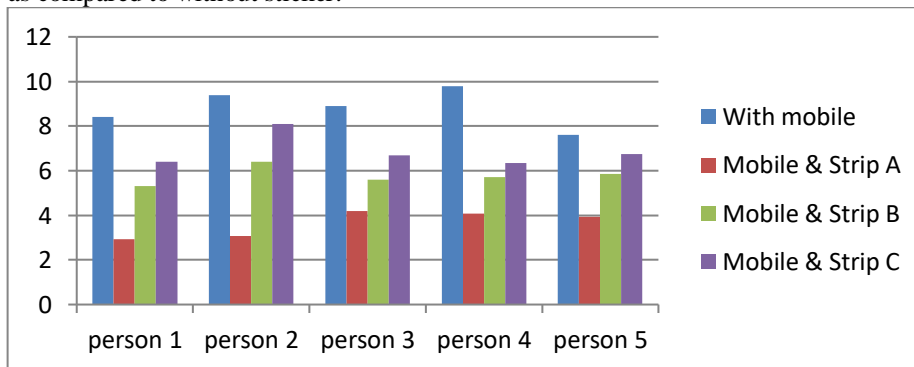


Fig.8. Normalized Changes in the Mean Square Deviation in Hz

## Conclusion

In this paper we have analyzed by using experimental set up for five persons, it is observed that brain wave frequency variation takes place after exposing to cell phone. The average mean value of frequency increases to 13.65Hz & Mean square deviation up to the 8.81Hz. Also we analyzed for strip A, Strip B & Strip C. With strip A, mean value of frequency increases by 7.86 Hz and mean square deviation is 3.6 Hz. With strip B, mean value of frequency increases by 9.5 Hz and mean square deviation is 5.8 Hz. With strip C, mean value of frequency increases by 10.62 Hz and mean square deviation is 6.89 Hz. Comparative to other strips, Strip A gives better performance. The increase in tissue temperature is 1°C for 10GHz with radiation power 10mW/cm<sup>2</sup>. The 10 mW/cm<sup>2</sup> fields is standard limit mankind. In transient analysis, it is observed that transient period is 5 to 7 seconds. Finally we claim that heat effect is drastically reduces with anti-radiation sticker and minimise the damage caused to the biological cells.

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