

*Full Length Research Paper*

## **Prudent avoidance in exposure to extremely low frequency (ELF) fields**

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Accepted 12 July, 2010

**The extremely low frequency (ELF) radiation from various laptops and monitors model was investigated using a cell sensor manufactured by Action Electronic, USA that is optimized to measure radiofrequency and extremely low frequency radiation. The ELF measured vary between 0.05 and 2.5 mG for all the laptops/monitors studied however, Hp Pavilion dv6000 laptop was considered to emit highest ELF in all the laptops/monitors studied as it has 1.5 mG at 30 cm and 0.05 mG even at 100 cm from the screen and this value is more than the specified exposure limit of 1 mG at 30 cm. This work reveals that those using laptops/monitors are exposed to ELF radiation the amount now depend on the model of laptops/monitors used. There is need for standard regulation/policy on the brand of monitors and laptops imported to this country in order to reduce the ELF exposure incurred in the use of all these appliances and to avoid health challenges that can result from exposure to ELF radiation obtain from laptop/monitors.**

**Key words:** ELF radiation, laptops, monitors, health challenges.

### **INTRODUCTION**

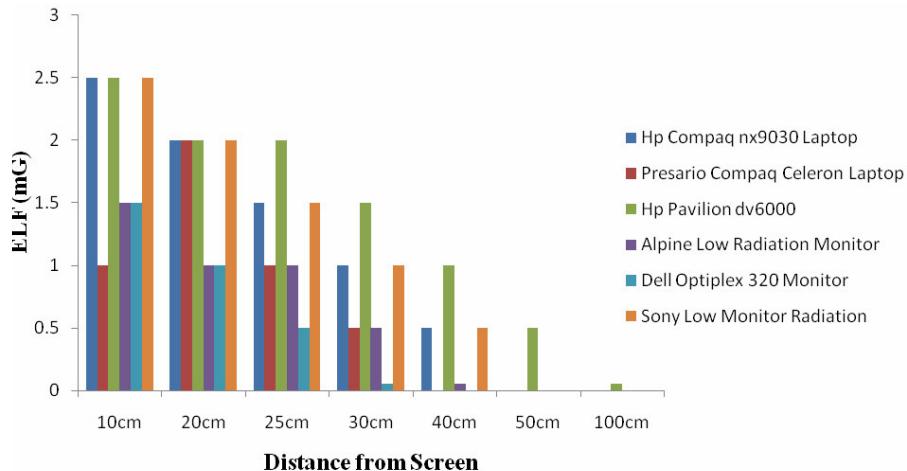
In this modern age of high computer literacy, average knowledge on the radiation emitted by computer monitors, laptops, and other computer components are important for all computer users. This type of radiation is known as extremely low frequency (ELF) electromagnetic radiation. It is essentially the same kind of radiation emitted from electric power lines, television sets and other electrical and electronic appliances. Electric and magnetic fields are produced by any wiring or equipment carrying electric current. This includes overhead and underground power lines carrying electricity, wiring in buildings, and electrical appliances. The strengths of the fields decrease rapidly with increasing distance from the source. The effects of electric and magnetic fields on the body are fundamentally different in their physical nature from true electromagnetic radiation such as radio waves and microwaves. If you are a computer user, computer radiation may be a substantial component of the total electromagnetic radiation which your body is exposed to. Many spend hours working in front of computer monitors, surrounded by electronic equipment, each item emitting ELF radiation. Because of the duration of this exposure

(many hours every day), computer radiation is a great concern. Computers' central processing system (CPU) contain power supplies, fans, drives and other units which generate radiation strong enough to cause concern at distances up to about 50 cm. The magnetic portion of this electromagnetic radiation (which is probably more dangerous than the electric portion) can penetrate just about anything, so it does not help to place a shield or screen between you and the CPU. Another item most likely to cause a health hazard in many offices is the computer monitor, or screen. The box-shaped cathode ray tube (CRT) computer monitors generally have quite high levels of radiation even at 30 cm compared to the modern low-radiation flat screens.

Variety of symptoms, like dermatological symptoms such as redness, tingling and burning sensations, fatigue, headache, concentration difficulties, nausea, heart palpitation have been suggested to be caused by ELF field exposure. Following the initial epidemiological study on childhood, cancer is a great number of other diseases that have been studied in relation to ELF fields. These diseases include cardiovascular disease, neurodegenerative disease and psychiatric disorders. An effect of heart rate variability seen in laboratory studies was the basis for a hypothesis that ELF exposure might affect the risk of cardiovascular disease and some initial epidemiologic

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**Figure 1.** ELF Measurements from the front of the Laptops/Monitors.

results supported this IARC (2002). However, later well controlled studies have dismissed this hypothesis. For several of the other outcomes the support was never strong. Nevertheless, several neurodegenerative diseases are still considered worthy of study in this respect, and this refers particularly to ALS (amyotrophic lateral sclerosis) and Alzheimer disease (Ahlbom, 2001). ELF magnetic fields are known to affect nerve and muscle cells although little evidence was found for effects on the nervous system or behaviour at environmental exposure levels. Several independent studies have suggested effects of ELF magnetic fields on the embryonic development of birds and other non-mammalian species, but the results are inconsistent. The evidence in mammalian species is restricted to minor skeletal anomalies seen in some studies with rats and mice. Minor skeletal variations are relatively common findings in teratological studies on rodents and often considered biologically insignificant ICNIRP (Bernhardt et al., 2003).

Two recent animal studies have provided evidence that ELF magnetic field exposure may affect melatonin production by modifying the response of dairy cows to the length of photoperiod (Rodriguez et al., 2004) and by affecting the sensitivity of mice to circadian light variations (Kumlin et al., 2005). The results of two new studies are interesting biological observations suggesting EMF interactions with the effects of light (photoperiod) on melatonin production. The World Health Organization recommended usage of exposure guidelines on Non-Ionizing Radiation Protection, along with low cost measures to reduce exposures where this can be readily achieved. This study aimed at assessing the ELF radiation from various laptops and monitors for the purpose of establishing the presence of ELF above the background level and to suggest ways of limiting the radiation in order to limit the health hazard associated with such radiation.

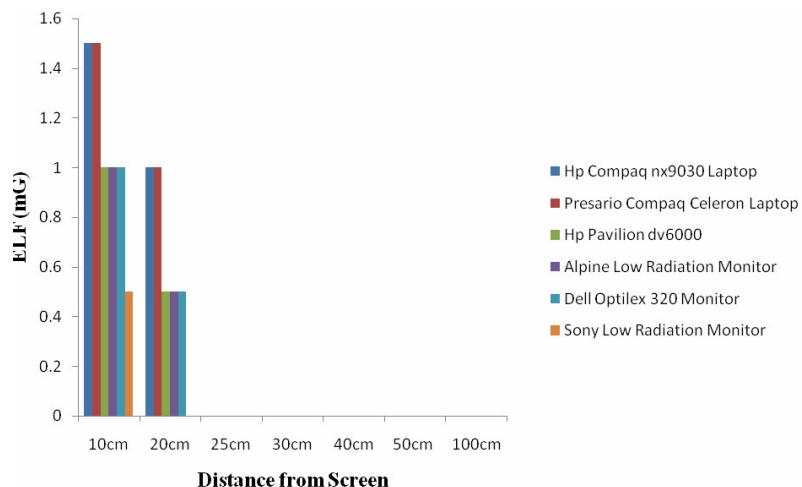
## MATERIALS AND METHODS

Different brands of computer monitor and laptop were collected from members of staff and students of Covenant University for the measurements. The computer monitors used were Alpine Low Radiation Monitor, Dell Optiplex 320 Monitor and Sony low radiation monitor and the laptops used were Presario Compaq Celeron laptop, Hp Compaq nx9030 and Hp laptop. Cell sensor manufacture by Action Electronics, USA was used to measure the ELF radiation from the systems at various directions since ELF is a three-dimensional in order to obtain a more accurate measurement of the field, it is done in the three axis, x, y, and z (horizontally, vertically and sideways) at distances ranging from 10 - 100 cm from the system. All the monitors and laptops were ON for one hour with Microsoft office running on them before taking the measurement. The measurements of ELF's radiation in milliGuass (mG) from the laptops and monitors at different distances from various parts of the systems were taken.

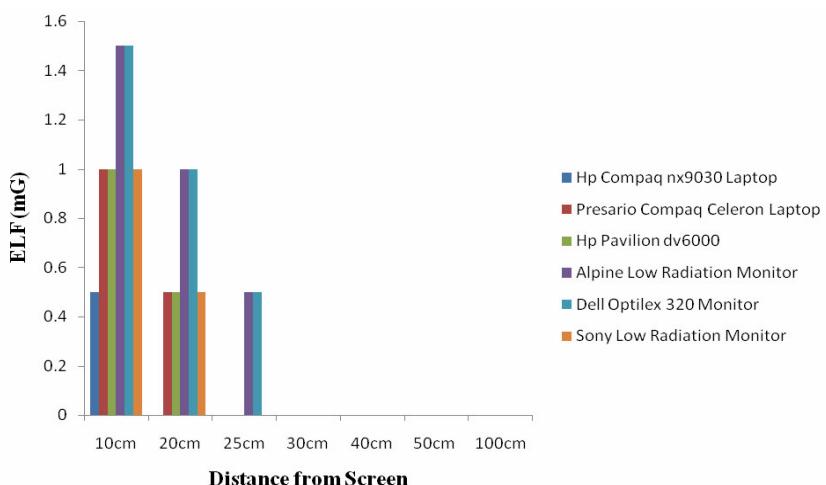
## RESULTS AND DISCUSSION

The results from this study confirmed the presence of ELF radiation above the background level, to a minimum distance of 50 cm from all the laptops and monitors studied (Figures 1 - 4). The comparison study made as displayed in Figures 1 - 4, showed the measurements of ELF's radiation from the laptops and monitors at different distances from various directions to the systems. The ELF radiation obtained for front side ranged between 0.05 - 2.5 mG for distance of 10 - 100 cm. Sony low radiation monitor, Hp Compaq nx9030 and Hp Pavilion dv6000 laptop have the highest radiation level of 2.5 mG. Even at distance 100 cm Hp Pavilion dv6000 laptop still has ELF radiation of 0.05 mG above background. The ELF measured from the right and left sides are the same with Alpine Low Radiation Monitor and Dell Optiplex 320 Monitor (box-shaped CRT) having the highest ELF both at 10, 20 and 25 cm from the screen.

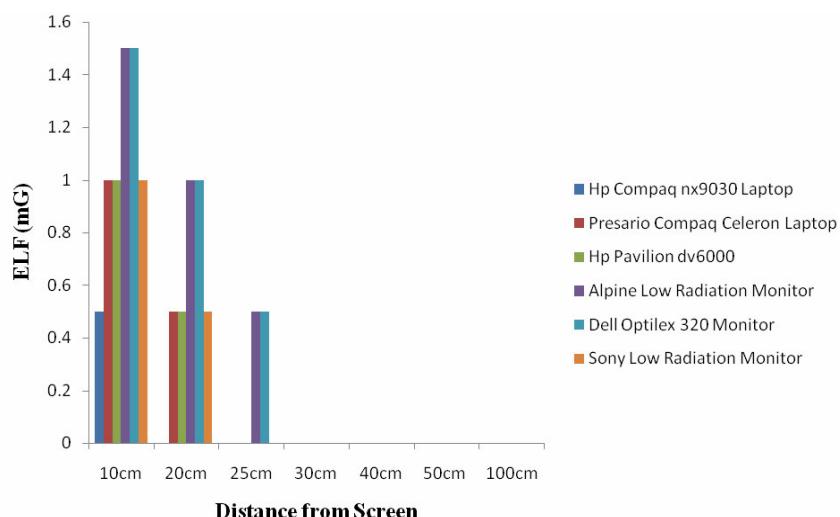
The radiation measured from the back sides was the



**Figure 2.** ELF Measurements from the back of the laptops/monitors.



**Figure 3.** ELF Measurements from the right side of the laptops/monitors.



**Figure 4.** ELF Measurements from the left side of the laptops/monitors.

lowest but it is not possible to stay at the back operating the system. It was observed from the measurements that laptop have highest ELF from the front in particular Pavilion dv6000 laptop which still have radiation above background at a distance of 100 cm from the screen. This effect can be linked to the thermal effects as a result of heat generated from various laptop parts (CPU, battery, etc.) that are compressed under the keyboard, because at times the users feel the heat when the laptop is ON especially for long period of time. The monitors used were the recent type "flat screen" that are made using LCD screens but it was obvious from the measurement that the monitors emit highest radiation from the sides when compared to laptop however, the ELF radiated is within the limit because at a distance of 25 cm the radiation obtained is less than 1 mG. All the monitors and laptops studied meet the guideline regulation of 1 mG at 30 cm except Hp Pavilion dv6000 laptop which have 1.5 mG at 30 cm, also 0.05 mG at 100 cm.

## Conclusion

This work has confirmed the presence of ELF radiation from the monitors and laptops studied above the background level and that ELF radiation reduces with distance. The highest radiation was obtained from two laptops and one monitor Hp Compaq nx9030 Hp Pavilion dv6000 laptop and Sony low radiation monitor (2.5 mG) but Hp Pavilion dv6000 laptop still have ELF radiation above background (0.05 mG) even at distance of 100 cm. Among the laptops studied Presario Compaq Celeron laptop was considered to be safest with respect to ELF radiation, it has lowest radiation while Dell Optiplex 320 monitor has the lowest among monitors from result obtained. Laptops should be used at least 25 cm from side because lower radiation was measured from the sides as at 25 cm all the laptops do not have any ELF radiation while LCD screen monitors are considered safe as from 30 cm either from sides or front.

The results also show that radiation from monitors and laptops is likely to produce health effects on the users as the radiation obtained is far above the background couple with the fact that, the users can spend considerable hours a day on the systems. It is necessary to reduce radiation receiving from monitors and laptops as it is certain that the ELF emitted by them is above the background. Prudent avoidance involves limiting exposures which can be avoided with small investments of money and effort, but not doing anything drastic or expensive. Here are some hints on achieving acceptable monitors and laptops radiation levels: sit or stand at least 30 cm from sides for laptops, front of monitors and only LCD screen monitors should be used, move beds, chairs and study areas at least 75 cm away from laptop/monitor and other computer accessories (printers, UPS, CPU etc.) and there should be basic regulations/policies on the type of monitors/laptop imported into this country.

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