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**ET Docket Nos. 03–137 and 13–84; FCC 13–39**

**Background:**

I am currently Editor of the Journal of Experimental and Clinical Medicine, President of the Turkish Society for Stereology, Director of Health Sciences Institute and Head of the Department of Histology and Embryology at Ondokuz Mayıs University, Samsun, Turkey.

I have conducted research in Neurology for over twenty years. I received my M.Sc. in 1987 and my PhD in 1991 from the Dept. of Histology and Embryology, Medical School, Ondokuz Mayıs University, Samsun, Turkey. The title of my PhD thesis was “Neuronal asymmetry in the hippocampus of 4 and 20 weeks old male and female rats.” I have been a Professor since 2000 at the Dept. of Histology and Embryology, Medical School, Ondokuz Mayıs University, Samsun, Turkey. My research and professional experience focuses on Stereology, Obesity, Neurotoxicity, Peripheral nerve regeneration, and Electromagnetic fields (EMF).

I have helped produce four research reports showing that exposure to 900MHz EMF significantly damaged neuronal development in the rat brain. These published studies include:

- Chronic prenatal exposure to the 900 megahertz electrical field induces pyramidal cell loss in the hippocampus of newborn rats (Bas et al., 2009)
- Effects of prenatal exposure to a 900 MHz electromagnetic field on the dentate gyrus of rats: a stereological and histopathological study (Odaci, et al., 2008)
- Purkinje cell number decreases in the adult female rat cerebellum following exposure to 900 MHz electromagnetic field (Sonmez et al., 2010)
- 900 MHz electromagnetic field exposure affects qualitative and quantitative features of hippocampal pyramidal cells in the adult female rat (Bas, et al., 2009).

**Summary of Related Research**

**Effects of prenatal exposure to a 900 MHz electromagnetic field on the dentate gyrus of rats: a stereological and histopathological study.** Prenatal exposure to 900MHz EMF fields affect nerve cell development in the rat brain. The research report

details how prenatal 900 MHz exposure caused a statistically significant decrease in the number of granule cells in the dentate gyrus of rat offspring. These neurons are an important source of inputs to the hippocampus. The hippocampus is a part of the brain that controls behavior and cognitive functions such as spatial learning and working memory. For this study we used state of the art high precision design based stereological techniques to investigate the impact of 900 MHz exposure on pregnant rat offspring.

We found that exposure caused a progressive postnatal decline in the number of granule cells of dentate gyrus. This suggests that exposure during critical periods of embryonic development damages the normal rat hippocampus development and exposure may also induce neurodevelopment retardation. While animal studies cannot be directly translated to humans, this research would correspond to the third trimester in a human pregnancy. This research showed neural cell loss in the dentate gyrus due to prenatal electromagnetic exposures.

### **Chronic prenatal exposure to the 900-megahertz electrical field induces pyramidal cell loss in the hippocampus of newborn rats.**

Prenatal exposure to 900 MHz decreases pyramidal cells in the hippocampus. This research report details how pregnant rats were exposed to 60 minutes of 900 MHz EMF fields a day for the duration of their pregnancies and later the brains of their offspring were analyzed at four weeks old using the optical fractionator technique. The exposed offspring showed a significant reduction in the total number of pyramidal cells.

The pyramidal cells are located in the cornu ammonis of the hippocampus, which involves short-term memory and learning. This research suggests that electromagnetic fields could disturb the development of the cornu ammonis, which could result in impaired short-term memory and learning.

### **900 MHz electromagnetic field exposure affects qualitative and quantitative features of hippocampal pyramidal cells in the adult female rat.**

900 MHz EMF exposure induces neuronal damage and cell loss in the rat hippocampus. The report documents our research exposing female rats to 900 MHz from 12 weeks to 16 weeks of age.

Stereological analyses using the optical fractionator technique were done blind to obtain unbiased results. The results showed a statistically significant decrease in the pyramidal cells of the hippocampus and also showed an increase in dark cells. This research again shows impacts on the part of the brain involved in memory and learning. Sixteen-week-old rats are comparable to the age of human teenagers.

### **Purkinje cell number decreases in the adult female rat cerebellum following**

**exposure to 900 MHz electromagnetic field.** 900 MHz EMF effects neuron number in the cerebellum. The cerebellum is a region of the brain that is thought to be involved in cognitive functions such as attention and language (and in regulating fear and pleasure responses) in addition to its role in motor control (coordination, precision and equilibrium). This research report documents our research on the effect of 900 MHz EMF on the number of Purkinje cells in the adult female rat cerebellum. Purkinje cells are important neurons in the cerebellum. In this study we exposed rats to 900MHz for one hour a day from 12 to 16 weeks of age and blind analyzed their Purkinje cells with the

optical fractionator technique. Results showed the exposed rats had significantly lower total numbers of Purkinje cells in their cerebellum. This suggests that long-term exposures to 900 MHz EMF leads to decreases of Purkinje cell numbers in the female rat cerebellum. Sixteen-week-old rats correspond to human teenagers for developmental stage comparison.

**900 MHz EMF exposures at a SAR of 2W/Kg seem to have significant non-thermal biological effects.** In the two research studies of 900 MHz exposures to the adult rat brain the specific energy absorption rate (SAR) varied between 0.016 (whole body) and 2W/kg (locally in the head). In the two research studies on prenatal exposure a 900 MHz continuous wave electromagnetic energy generator SAR of 2W/kG was used on the pregnant mice.

This research provides useful data on the possible toxic effects of EMF exposure on the Central Nervous System during critical periods of brain development. We conducted our research with 900 MHz EMF based on the fact that so many mobile phones operate at this frequency. In our research, the body weight of the rats did not show any effects from exposure, so there was no outward visual abnormality. However, the significant negative impact on neuron production in the hippocampus and cerebellum raises serious questions about the possible non thermal effects of electromagnetic fields on the parts of the mammal brain that involve attention, learning and memory.

**The non-thermal biological effects of EMF exposure are of increasing concern to scientists.** The research our lab has done fits into a larger context of research showing electromagnetic fields have adverse effects on animal tissue. (Dutta et al., 1989; Odaci et al., 2008; Bas et al., 2009a,b; Ragbetli et al., 2010, 2009; Ammani et al., 2010; Maskey et al., 2010). Several studies indicate that EMFs emitted by mobile phones could affect body tissue, systems and their physiologic activities (Mausset et al., 2001; Mausset-Bonnefont et al., 2004; Salford et al., 2003; Koyu et al., 2005; Yildiz et al., 2006; Manikonda et al., 2007).

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### **Specific Comments on the FCC's Notice of Inquiry**

In its Notice of Inquiry the FCC asks: "...whether its current limits are appropriate as they relate to device use by children." (p.2, Item 53).

The answer is a No. Current limits may not be appropriate as they relate to device use by children due to their vulnerability and developing bodies. Over the past few decades, several experimental studies have emerged which indicate electromagnetic fields could affect brain activity and neurons at the cellular level. The research from our laboratory shows that chronic exposure to electromagnetic fields can have long-term effects in brain morphology. The use of mobile phones by children and teenagers deserves special concern because this group will experience much higher cumulative exposure to EMF than previous generations.

Research on the mammal brain such as I have documented in this submission raises the question as to whether children and the developing fetus are more sensitive to EMF exposure than adults. The brain is particularly vulnerable during the growth process, which begins at conception and continues through the teen years. The research I have documented in rats corresponds to EMF exposure during the human developmental stages of the embryo and the teen years. Neuron production begins during gestation, through the early postnatal period and then continues at a slower rate into adulthood. Environmental insults during the early growth stages can have profound impacts later in life. While animal studies cannot be directly translated to humans, similar effects in humans would have far reaching consequences for future generations.

B. On p.4, Item 63 of the Inquiry the Commission requests comment on "*whether the Commission should consistently require either disclosure of the maximum SAR value or other more reliable exposure data in a standard format, perhaps in manuals, at point-of-sale, or on a Web site.*"

Again, the answer is YES. Consumers should know the details of exposures that are possible from the phone or device they buy. Consumers should be provided with this information in order to make informed decisions.

In the introduction to FCC 13-39 Section 5 Inquiry, the FCC asks, "*whether our exposure limits remain appropriate given the differences in the various recommendations that have developed and recognizing additional progress in research subsequent to the adoption of our existing exposure limits.*"

The answer is NO. Recent research is raising questions as to the appropriateness of the current exposure limits. The research I have presented shows significant non-thermal biological health impacts from lower intensity electromagnetic fields. While further research is critical to fully understand the possible effects on brain development, this research adds to accumulating evidence that the current exposure levels may not protect from non-thermal biological health effects. Exposure limits should protect humans from adverse biological effects.

Respectfully submitted,

Dr. Suleyman Kaplan

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**Citations:** Ammari, M., Gamez, C., Lecomte, A., Sakly, M., Abdelmelek, H., De Seze, R., 2010. GFAP expression in the rat brain following sub-chronic exposure to a 900 MHz electromagnetic field signal. *Int. J. Radiation Biol.* 86, 367–375.

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