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AZ CORP COMMISSION
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To: The Arizona Corporation Commission

From: Paul H

Since the smart meter uses the 900 MHz microwave frequency I am submitting a published study, from Israel, showing that this frequency makes the human skull resonant and could be the reason why so many are experiencing migraine headaches. Antennas used to measure this frequency are tuned to a width of 6.5 inches and a height of 3.25 inches. These are the same dimensions of the average adult human brain. This is a very dangerous wavelength especially since microwave frequencies are absorbed by water and the brain is approximately 77-78 percent water.

Summary "Headache and other neuropsychological symptoms occur in users of cellular telephones, and "controversy exists concerning risks for brain cancer. We hypothesize these effects result from the head serving as an antenna and brain tissue as a radio receiver. The frequencies for transmission and reception by cellular telephones, about 900 MHz for analog and 1800 MHz for digital transmission, have wavelengths of 33-35 and 16- 17 cm, respectively. Human heads are oval in shape with a short axis about 16 to 17 cm in length. Near the ear there will be a cross-section in the head with an axis half the wavelength of RF/MW transmissions of 900 MHz and equal to the wavelength of RF/MW transmissions at 1800 MHz. Therefore, the human head can serve as a lossy resonator for the electromagnetic radiation emitted by the cellular telephone, absorbing much of the energy specifically from these wavelengths. Brain cells and tissues demodulate the cell-phone's audio frequencies from the radio frequency carrier. Low audio frequencies in the ranges of a and b waves affect these waves and thereby influence brain function. These effects state the case for a precautionary policy. 2002 Published by Elsevier Science Ltd."

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2 Cellular telephones and effects on 3 the brain: The head as an antenna 4 and brain tissue as a radio receiver

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8 **Summary** Headache and other neuropsychological symptoms occur in users of cellular telephones, and
9 controversy exists concerning risks for brain cancer. We hypothesize these effects result from the head serving as
10 an antenna and brain tissue as a radio receiver. The frequencies for transmission and reception by cellular
11 telephones, about 900 MHz for analog and 1800 MHz for digital transmission, have wavelengths of 33–35 and 16–
12 17 cm, respectively. Human heads are oval in shape with a short axis about 16 to 17 cm in length. Near the ear
13 there will be a cross-section in the head with an axis half the wavelength of RF/MW transmissions of 900 MHz and
14 equal to the wavelength of RF/MW transmissions at 1800 MHz.

15 Therefore, the human head can serve as a lossy resonator for the electromagnetic radiation emitted by the
16 cellular telephone, absorbing much of the energy specifically from these wavelengths. Brain cells and tissues
17 demodulate the cell-phone's audio frequencies from the radio frequency carrier. Low audio frequencies in the
18 ranges of α and β waves affect these waves and thereby influence brain function. These effects state the case for
19 a precautionary policy. © 2002 Published by Elsevier Science Ltd.

20

21 HYPOTHESIS

22 There have been case reports of headache, nausea, diz-
23 ziness, sleep disturbance, short-term memory problems,
24 and fatigue in users of cellular telephones (1,2). Labo-
25 ratory studies have reported alterations in permeability
26 of the blood brain barrier, brain electrical activity,
27 membrane permeability, and DNA breaks (3). Three
28 epidemiologic studies have not found excess prior use of

cell phones in persons with brain cancer (4–6), but their 29
negative findings reflect short periods of follow-up and 30
small numbers of individuals with cancer who actually 31
had prior cell phone use (7). So far, there is absence of 32
consensus as to a plausible mechanism to explain re- 33
ported adverse health effects (8) from sub-thermal ex- 34
posures to electromagnetic radiation at microwave 35
frequencies (RF/MW) of cellular telephones. 36

The reason for the absence of a consensus is that the 37
energy potential of cellular telephone frequencies is low 38
compared to potentials from ionizing radiation. Local 39
heating (estimated to be 0.11 °C rise in brain) due to the 40
non-ionizing radiation from cellular telephones ab- 41
sorbed in the head is too weak to account for the health 42
effects (2). 43

Frohlich has suggested that brain cells are far from 44
being in a state of equilibrium, so that even low energy 45
non-ionizing radiation at appropriate frequencies can 46
trigger non-trivial effects in brain function (9). We pos- 47
tulate that the size and shape of the head acts as an 48

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[†] No financial interest related to topic.

^{††} EDR has served as an expert witness on behalf of a patient with
brain cancer and prior exposure to cell phones, but this paper is
based on a draft which predates his first connection with the suit by
more than a year.

49 antenna for the MW frequencies of mobile telephones.
50 We also postulate that un-modulated MW frequencies
51 will not affect perturbations in brain function but mod-
52 ulated RF/MW frequencies will. This bio-resonance may
53 be the mechanism underlying sub-thermal effects (8,9).
54 The frequencies for transmission and reception by
55 cellular telephones (800–900 MHz and 1800 MHz) in-
56 clude wavelengths of 33–35 cm and 16–17 cm, respec-
57 tively. Human heads are oval in shape, and near the ear
58 there will be a cross-section in the head with an axis
59 either half the wavelength of RF/MW transmissions at
60 900 MHz or equal to the wavelength in the case of fre-
61 quencies at 1800 MHz. Therefore, the human head can
62 serve as a lossy resonator for the electromagnetic radi-
63 ation emitted by the cellular telephone, as illustrated in
64 Fig. 1. Joines and Spiegel have, in fact, analyzed the
65 possibility of resonance absorption of microwaves of
66 human skull at frequencies ranging from 100 MHz to

67 3000 GHz, but without addressing the specific effects of
68 cellular telephone's wavelengths at multiples of the di-
69 ameter of the human skull (10). Their mathematical
70 analysis, in 1974, focused on resonance from frequen-
71 cies 'near' 2100 MHz from leakage from microwave ovens,
72 but not from resonance from cellular telephones,
73 which did not then exist commercially. Their results
74 lend support to the first hypothesis.
75 A more recent numerical analysis of absorption by
76 model human heads performed by Schornborn et al. (11)
77 also verifies the hypothesis. Model heads of adults and
78 children based on MRI scans of an adult and, two chil-
79 dren were digitized using averaged values of the electric
80 properties of white and gray brain tissue. The results of
81 their numerical analysis are that at 900 MHz the adult
82 head absorbs 80% of the radiation emitted by a cellular
83 telephone, whereas the head of a seven-year-old child
84 absorbs only 69% of the radiation. We attribute this

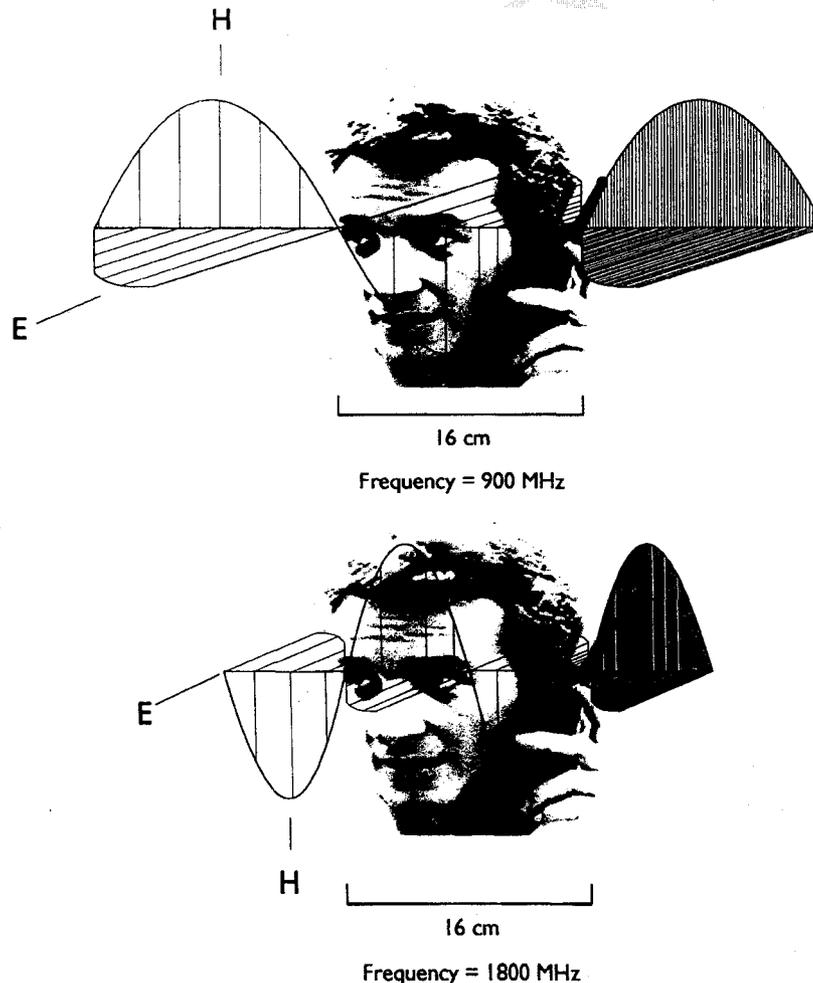


Fig. 1 Wavelengths of cellular telephones in relation to diameter of head for 900 and 1800 MHz: E, plane of electrical field; H, plane of magnetic field.

85 difference in absorption efficiencies to the difference in
86 size between the adult head and the child's. A 900MHz
87 frequency implies a half-wavelength of about 16–17 cm.
88 The adult head will resonate at this wavelength, whereas
89 the child's head may not have resonance at this wave-
90 length because of smaller head dimensions.

91 These facts suggest the hypothesis that the head itself
92 serves as an antenna and receiver for RF/MW from cel-
93 lular telephones and will absorb much of the energy
94 radiated by the cellular telephone.

95 We now consider our second hypothesis. Bawin et al.
96 have shown that chicken and cat brain tissue act to de-
97 modulate square wave RF radiation in the same way that
98 a radio receiver acts to demodulate carrier radio fre-
99 quency waves to audio frequencies (12). Calcium efflux
100 from brain sections is strongly influenced by modulation
101 frequencies in the 6–20Hz band, e.g., low audio fre-
102 quencies, but not by un-modulated frequencies. If so,
103 then adverse health effects from cellular telephones
104 could result from bio-resonance in brain cells and tissue
105 specifically by absorption of the radio-frequency trans-
106 mission signals in the near field and their demodulation
107 to audio frequencies. We suggest that the audio fre-
108 quencies mediate the reported effects on α waves (8–14
109 cycles per second) and β waves (14–60 cycles per sec-
110 ond). Von Klitzing has reported that EEG brain α waves
111 (8–14 cycles per second) and β waves (14–60 cycles per
112 second) are altered when exposed to cellular phone
113 signals at field strengths as low as 0.1 uW/cm² (13), a
114 level substantially lower than field strengths in the near
115 field of cellular telephones (14). If our hypotheses are
116 true, then laboratory studies based on exposures of
117 small animals with small heads to un-modulated trans-
118 mission frequencies used by cellular telephones cannot
119 predict risks for neurobehavioral and possibly other ef-
120 fects in humans with larger head sizes from 'low' (i.e.,
121 sub-thermal) exposures. The same qualification applies
122 to assessments of risks and standards based on simple
123 linear models of relationships between wave frequency
124 and energy potential.

125 We can test functional disturbances of brain function
126 by modulated and un-modulated RF/MW on primates by
127 using transmission frequencies in the range of 1850–
128 1990MHz. The half-wavelengths of these frequencies
129 are between 7.5 and 8 cm, e.g., the head size of small
130 monkeys.

131 In summary, since mobile phones broadcast specifi-
132 cally at frequencies at which the head serves as an an-
133 tenna and brain tissue serves as a demodulating radio
134 receiver, then it is reasonable to expect effects—adverse
135 and otherwise—from bio-resonance at field strengths
136 and specific absorption rates well below current thresh-
137 olds. We call for reexamination of the assumptions un-

derlying the US FCC's statement that 'permitted 138
exposure levels based on past studies carried out at fre- 139
quencies both higher and lower than those used for r 140
cellular and PCS phones have led expert organizations to 141
conclude that typical RF exposures from these devices 142
are safe' (15). We suggest that past studies of higher and 143
lower frequencies are not applicable to the frequencies of 144
present cellular telephones for which the head, because 145
of its size and shape, behaves as a lossy resonator. 146
These effects state the case for a precautionary policy. 147

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