It has been hypothesized that cell phones present a health hazard because biological cells can demodulate an RF carrier and thereby expose tissue to low frequency signals. We have shown definitively that this does not occur.

**INTRODUCTION**

**Doubly Resonant Cavity**
- Cavity made at University of Maryland for HPA.
- Radius = 12.35 cm
- Length = 27.22 cm
- Unloaded Q = 1250
- Dominant modes
  - $TE_{111} = 883$ MHz
  - $TE_{113} = 1766$ MHz

**Cavity Quality Factor and SAR**
DEFINITION of $Q$: Energy stored / Energy dissipated per signal cycle.

$$Q = \frac{P_{in}}{P_{loss}} = \frac{E_{in}}{E_{loss}}$$

$$P_{in} = \frac{E_{in}}{Q}$$

**Resonance Curve Lorentzian**

**Measurement of Load Factor**
- Measure Input Power vs. Frequency
  - (Resonance Curve) with Network Analyzer and Input Power $P_i$ (Resonance) and $P_o$
- Lorentzian Fit: Resonance Curve Provides the Cavity $Q$

$$Q = \frac{P_i}{P_o}$$

- Frequency of Minimum Reflection
- $f_o$ = Band of Return Loss < 3 dB

**Load Factor of Test Cavity**

$$LF = (1/Q - 1) = (Q_{1} / Q_{0})$$

$$LF = (a_1 / a_0) X R_i / R_o - 1 = R_i / R_o$$

$$a_1 / a_0 = 1$$

**Range of Measured SAR 0.5-15 W/kg**

**Equipment Setup**

**Evaluation of Nonlinear Response of Cell Samples**
- Measure Power Level of Second Harmonic (2$f_i$) of Incident RF Signal ($f_i$) with Spectrum Analyzer
- Measured Levels < -155 dBm with 1mW Input (20dB RF Amplifier at 2$f_i$)
- Measure Cavity $Q$ and RF Power Dissipated ($P_d$) at $2f_i$
- Energy of Second Harmonic $E_{2f_i}$ Amplitude, $Q = 1000$ at $2f_i$, $P_i = 185$ dBm
- Second Harmonic Generation Coefficient $\chi^{(2)}$ $N(2a) = a_2 \chi^{(2)} E_i$ (a)

**Conclusions**
- Cell nonlinear response not above noise floor = -85 dBm for 1mW and -195 dBm for 0.1 mW input power
- Nonlinearity coefficient $\chi^{(2)} < 10$ mw$^{-2}/$V$^2$
- Coherent rectification of RF CIV carriers by individual cells not found.
- No cooperative rectification by cells
- Second harmonic probably detectable with strong pulses

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