

Nonthermal Mechanism of Low-Level Microwave Effect on the Human Brain

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ABSTRACT

This book presents a systematic description of the physical mechanisms and properties of low-level microwave radiation effects. It introduces the concept of nonthermal mechanism of microwave radiation effects, with special reference to the nonlinearity of neurophysiological and biological processes. With insights into electromagnetism, bioelectromagnetism, and nonlinear dynamics, this comprehensive volume proposes new ideas for updating the health protection limits for radiofrequency radiation and recommends following the precautionary principle to minimize health risks.

Features:

- Explains how cumulative minor disturbances from coherent microwave radiation overcome thermal noise limits, enabling low-level microwave impact on biological processes.
- Confirms that dielectric polarization triggers small initial changes that produce significant alterations in nonlinear living systems, causing nonthermal effects.
- Demonstrates that predominantly positive results across multiple tissues and cells from numerous independent studies support the capability of low-level radiation to cause biological effect.
- Shows why modulation frequency is crucial in microwave effects, with the impact directly dependent on modulation frequency.
- Concludes how brain effects vary between individuals, with only a minority experiencing significant impact.
- Emphasizes that the body's repair mechanisms prevent biological effects from becoming health effects, due to nonlinear chaotic nature of the processes with unpredictable outcomes.

This book is aimed at graduate students, researchers, specialists, and academics in biomedical engineering, physics, medicine, medical physics, microwave engineering, health protection, biophysics and biochemistry.

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This chapter presents knowledge of the dielectric properties of biological tissues, which is essential to understanding the interaction of electromagnetic radiation with the human body. Human tissues can be considered lossy dielectrics at microwave frequencies. Two electric parameters, electric permittivity and conductivity, determine the electrical properties of tissues. Dielectric permittivity describes dielectric polarization, the primary effect of external radiofrequency radiation in tissues. The electric permittivity and conductivity of tissues are

measurable parameters. The presented general picture of frequency dependence of dielectric permittivity and conductivity of the tissues at microwave frequencies determines the frequency dependence of the effect. Dielectric polarization is a linear process. The high content of water in the biological tissues is crucial in determining the electrical properties of tissues. Due to reflections between the tissues of high water content (muscle, brain, skin) and higher permittivity and low (fat, bone) water content tissues with lower permittivity, maximums and minimums appear in the distribution of electric field strength inside the body. This knowledge contributes to the understanding of exposure conditions and behaviors of the radiation inside the brain.

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