RadioBio: DARPA To Explore Cell-to-Cell Communications

Investigating "Natural Antennas" Sending and Receiving Messages at kHz to THz Frequencies

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The Pentagon wants to know more about how cells use electromagnetic radiation to talk to each other.

The Defense Advanced Research Projects Agency, better known as DARPA or ARPA, is embarking on a new program, called RadioBio, to determine whether cells are able to exchange information with EM signals and, if so, what the cells are saying and how they do it.

DARPA is the high-risk, high-reward research arm of the Department of Defense. It was created in 1958 after the Soviets launched Sputnik, the first man-made satellite. DARPA bills itself as "creating breakthrough technologies for national security." Over the years, it has been instrumental in developing the Internet, weather satellites, GPS and drones among many other high-tech tools. Even Siri, Apple's virtual assistant, has its roots in DARPA.

"DARPA develops the weapons of the future," says Sharon Weinberger, the author of *The Imagineers of War: The Untold Story of DARPA, the Pentagon Agency That Changed the World,* which will be published next month by Knopf. "It funds everything from basic science to advanced technology, though the ultimate goal is always to develop something that can be used by the military," she told us in an interview.

The RadioBio program "will determine the validity of electromagnetic biosignaling claims and, where evidence exists, learn how the structure and function of … natural 'antennas' are capable of generating and receiving information in a noisy, cluttered electromagnetic environment," DARPA states in its announcement issued yesterday, February 15.

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DARPA notes that some of these interactions are “well known,” citing as examples vision, photosynthesis, bioluminescence, neural networks and magnetic navigation.

Those awarded DARPA grants under RadioBio will propose “specific EM signaling mechanisms” and then experimentally test those hypotheses. The program will be divided into two phases, each lasting two years. The first will focus on the theoretical models and the second on testing their validity.

DARPA is open to investigating a broad range of frequencies from kHz to THz in the far infrared (1 THz = 1,000 GHz), and possibly as high as PHz (1 PHz = 1,000 THz). “We are not excluding any frequencies from consideration if a proposal has a good approach for definitely determining whether purposeful signaling occurs in a biosystem,” a DARPA spokesman told *Microwave News* on behalf of Mike Fiddy, a program manager in DARPA's Defense Sciences Office.

When asked about the size of the RadioBio, the spokesman was non-committal, saying only that the budget will be determined, in part, by the number and quality of proposals received.

DARPA will host a Proposer’s Day on February 21 to brief those interested in submitting proposals (advance registration required).

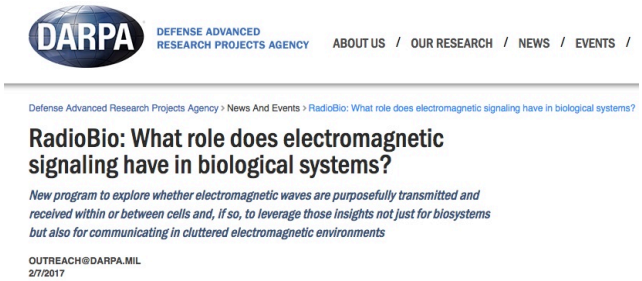
Memories of Project Pandora

Many of these ideas about cell-to-cell signaling are not new. Twenty-five years ago, Ross Adey described how cells “can whisper together across the barrier of cell membranes.” Such messages, he believed, could control complex biological processes. Further, Adey maintained that external EM radiation could also activate, overwhelm or muddle such processes. These are more commonly known as non-thermal effects.

Back in the 1960’s, Adey worked on a top-secret DARPA project, called Pandora, to investigate the effects of low levels of microwave radiation. The project was initiated after the U.S. government discovered that the Soviets were beaming microwaves at its embassy in Moscow.

In her new book, Weinberger calls Project Pandora, “One of the more bizarre episodes in the history of Cold War science.”

For more information on RadioBio, see the full announcement and the news release from DARPA’s public affairs office. Those interested in seeking funds are on a tight schedule: Full proposals are due on April 12.



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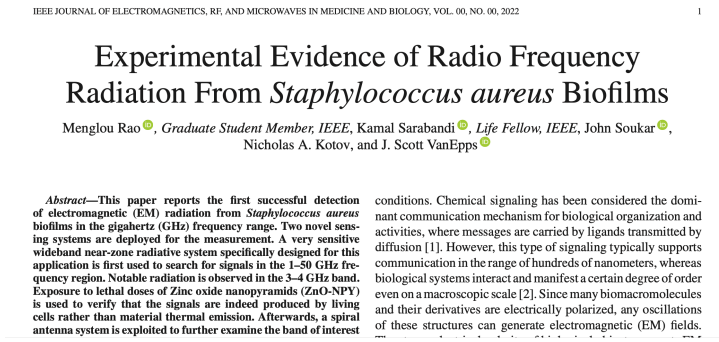
New program to explore whether electromagnetic waves are purposefully transmitted and received within or between cells and, if so, to leverage those insights not just for biosystems but also for communicating in cluttered electromagnetic environments

OUTREACH@DARPA.MIL
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EM Signals Among Cells Detected

May 22, 2022

A team at the University of Michigan is reporting what it calls “the first convincing evidence” that biological cells may transmit and receive electromagnetic signals. The work was carried out with funding from the RadioBio program.



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Experimental Evidence of Radio Frequency Radiation From *Staphylococcus aureus* Biofilms

Menglou Rao, *Graduate Student Member, IEEE*, Kamal Sarabandi, *Life Fellow, IEEE*, John Soukar, Nicholas A. Kotov, and J. Scott VanEpps

***Abstract*—This paper reports the first successful detection of electromagnetic (EM) radiation from *Staphylococcus aureus* biofilms in the gigahertz (GHz) frequency range. Two novel sensing systems are deployed for the measurement. A very sensitive wideband near-zone radiative system specifically designed for this application is first used to search for signals in the 1–50 GHz frequency region. Notable radiation is observed in the 3–4 GHz band. Exposure to lethal doses of Zinc oxide nanopyramids (ZnO-NPY) is used to verify that the signals are indeed produced by living cells rather than material thermal emission. Afterwards, a spiral antenna system is exploited to further examine the band of interest**

conditions. Chemical signaling has been considered the dominant communication mechanism for biological organization and activities, where messages are carried by ligands transmitted by diffusion [1]. However, this type of signaling typically supports communication in the range of hundreds of nanometers, whereas biological systems interact and manifest a certain degree of order even on a macroscopic scale [2]. Since many biomacromolecules and their derivatives are electrically polarized, any oscillations of these structures can generate electromagnetic (EM) fields.

DARPA, ARPA, cell-to-cell communication, mechanism, Sharon Weinberger, Ross Adey, Project Pandora, RadioBio,

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