

关于生物神经系统物理机理的若干猜想

刘国治

西北核技术研究所, 西安 710024

E-mail: liuguozhi60@163.com

作为一名不懂生物的科技工作者, 一直试图从物理的角度探讨生物神经系统物理机理, 如生物神经信息载体的物理场及频率、生物神经信号是如何产生和传输等. 提出主要猜想如下:

猜想之一: 生物神经信号的物理场应为太赫兹 (THz) 到红外的高频电磁场, 最可能频率范围应在 THz 到百 THz. 可以把 0.5~100 THz 的电磁波称为太赫兹电磁波, 把有关研究可称为太赫兹生物学.

猜想之二: 生物神经中电磁信号的产生、传输和耦合等是微纳尺度上的, 有些甚至是单分子结构水平上的, 应符合电磁场和量子理论. 神经系统中离子和分子的量子能态是信号产生、放大和耦合的重要因素, 生物信息存储也应以分子量子态为载体的. 有关量子理论的研究应为重点.

猜想之三: 生物神经系统中轴突上的朗飞结是一具有较强自动调节特性的神经信号“中继放大器”, 其应是神经系统中的能量主要消耗点; 神经细胞体应是具有信息储存、处理和交换等功能一体的基本单元.

猜想之四: 环境温度对神经系统中 THz 信号产生及传输等具有重要影响. THz 信号在神经系统中的传输速度随温度变化, 当温度过高或过低时, 生物神经系统中的 THz 信号将不能有效传输.

猜想之五: 生物体内应有丰富的 THz 电磁信息,



刘国治 中国科学院院士, 中央军委科技委主任. 西北核技术研究所研究员, 清华大学双聘教授, 博士生导师. 1983 年毕业于清华大学工程物理系, 1986 年和 1992 年分别获得清华大学硕士和博士学位. 主要研究方向是高功率微波、太赫兹生物学.

这些 THz 电磁信息的探测表征将可以用于生物状态 (如健康状态等) 的诊断, 并将会有诸多新的发现和新的诊断方法发明, 包括有源诊断和无源诊断. 无源诊断不会对生物体产生干扰和扰动, 具有其他方法不具有的优势. 同时 THz 电磁信号在一定条件下将与生物体发生相互作用, 很可能成为未来治病的一个重要手段, 也应是致病并应注意防护的一个重要物理因素.

猜想之六: 人体神经系统, 应是最科学高效、有机一体的网络信息系统. 人类应特别重视向人体学习借鉴, 把研发出类人体神经系统这样的科学高效网络信息体系作为研究追求的目标.

以上猜想, 因精力有限, 没有做太多具体深入研究工作, 发表主要是希望能引起大家的讨论, 也希望生物领域的研究人员能更多地从物理角度开展研究.

引用格式: 刘国治. 关于生物神经系统物理机理的若干猜想. 科学通报, 2018, 63: 3864–3865

Liu G Z. The conjectures on physical mechanism of vertebrate nervous system (in Chinese). Chin Sci Bull, 2018, 63: 3864–3865, doi: 10.1360/N972018-01143

Summary for “关于生物神经系统物理机理的若干猜想”

The conjectures on physical mechanism of vertebrate nervous system

Guozhi Liu

Northwest Institute of Nuclear Technology, Xi'an 710024, China

E-mail: liuguozhi60@163.com

As a scientific researcher not professional on biology, I tried to discuss the physical mechanism of vertebrate nervous system in physical aspect, such as the physical field and frequency of information carrier of vertebrate nerve, the generation and transmission of neural signals. The main conjectures are proposed as the followings:

One of the conjectures, the physical field of vertebrate neural signals should be the high frequency electromagnetic field from Terahertz to infrared, with the most possible frequency range from 0.5 to 100 THz. The electromagnetic wave from 0.5 to 100 THz could be named as the generalized Terahertz electromagnetic wave, and the related researches could be called as THz Biology.

Two of the conjectures, the generation, transmission, and coupling of electromagnetic signals in biological nerves are on the micro-nano scale, some even at the level of single-molecule structure, which should conform to electromagnetic fields and quantum theory. The quantum energy states of ions and molecules in the nervous system are key factors for signal generation, amplification and coupling. The storage of biological information should also be supported by molecular quantum energy state. Research on quantum theory should be the focused.

Three of the conjectures, Nodes of Ranvier on the axon of the nervous system are the “Relay Amplifier” for neural signal with strong automatic regulation characteristics, which should be the main energy consumption in the nervous system. The nerve cells are the basic unit with the functions of information storage, processing and exchanging.

Four of the conjectures, ambient temperature has an important influence on the generation and transmission of THz signal in the nervous system. The transmission velocity of THz signal in the nervous system varies with the temperature. When the temperature is over high or low, the THz signal in the nervous system could not be effectively transmitted.

Five of the conjectures, there are abundant THz electromagnetic information in organisms, which can be detected and characterized to diagnose the biology statuses such as health status, so as to discovery and invent new diagnostic methods, including active diagnosis and passive diagnosis. The passive diagnosis will not interfere with organisms which has the distinguished advantage compared with other methods. Besides, the THz electromagnetic signal will interact with the organisms under certain conditions, which is likely to become an important means for future treatment, as well as an important physical factor that should be paid attention to and protected from diseases.

Six of the conjectures, the human nervous system is the most scientific, efficient and organic integrated network information system in the world. The scientific researchers should pay special attention to learning from human body to develop scientific and efficient network information system with the characteristics of human nervous system.

Based on limited research, there are not sufficient studies on the above conjectures. The main purpose of paper is to arouse discussion, and I also hope researchers in the field of biology can do more research from the perspective of physics.

nervous system, terahertz, conjecture

doi: 10.1360/N972018-01143