

Biomorphism and electromagnetic signaling in biological structures

By

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Host: Prof N. Zheludev

Abstract

In 1959 A.G. Gurvich and L.D. Gurvich reported the first experimental observation of photon emission during cellular mitosis. Such emission was reported to be originated by both free-radical reactions and organized morphogenetic field at the basic of life. After this pioneering work, biophoton emission by many biological systems was reported in literature. In plants (as well as animals and humans) specific emissions were correlated to stresses and injuries. Moreover, statistical analysis of biophoton temporal distributions revealed incoherent as well as coherent correlations between them, as a signature of the organized quantum states of the emitters.

Biophoton emission by germinating seeds was also recorded: recently, it was determined that such emission is partially produced by the bean coat, which acts as a sensor of the environmental conditions. According to the oxygen-carbon dioxide-humidity-temperature levels, the seed coat emits light at specific chromatic bands for internal signaling. In dicotyledon seeds, the shape acts like an optical resonator, whose asymmetric morphology is optimized to focus such emitted light onto the embryo plumula. Even if biophotons are usually reported as an “ultraweak emission”, the light refocusing from the bean shape might generate quite intense fluxes. Beans seem to use such emission to transmit the germination information to the plant embryo. Consequently, electromagnetic signaling could play an important role in nature, and biomorphism could take into account it. Light in nature has three main functionalities: it transmits information, transmits energy and acts like a clock, i.e. a temporal trigger for all biological activities. In germinating seeds (at least in dicotyledon ones) all such functionalities seem to be present, as it should be for isolated systems

Short Biography

Eugenio Fazio is a professor of Optics and Experimental Physics at Sapienza Università di Roma, and since 1992 directs the Ultrafast Photonics Laboratory at the Department of Fundamental and Applied Sciences for Engineering. He is also one of the founders and the technical director of OptSensor s.r.l., a spin-off company of Sapienza Università di Roma.

His research interests are: Nonlinear optics, self confinement, spatial solitons and soliton waveguides in photorefractive media; Linear and nonlinear nano-photonics; Natural photonics: optical biomorphism, analysis of biophotons emitted by germinating seeds and electromagnetic signalling, interaction of DNA-RNA macro-molecules with photons; Opto-electronic devices for medical investigations, environmental monitoring and industrial process controls. He has published about 150 scientific papers on international journals and several book chapters on linear and nonlinear optics, both integrated in waveguides or in bulk materials. He is topical editor of many scientific journals and acts as referee for the most prestigious physical and optical journals.

He is one of the chairs of Optical MicroSystems, the series of Topical Meetings of the European Optical Society. Within the framework of the UNESCO's International Year of Light, he organized in Roma Fiat-Lux, the first philosophic and scientific conference on the nature, meaning, understanding and use of Light.