

Optical spectroscopy study of oscillation of pathogenic bionanoobjects

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The pathogenic bionanoobject - Virion, the extracellular infective form of a virus, is considered as a nanoparticle, consisting of an inner core of nucleic-acids (RNA or DNA) and outer protective protein coat called a capsid. Core-shell models of spherical and cylindrical geometries for virions of icosahedral, prolate or helical morphology are used as the first approximation of shape-structure. The shape, inner/outer diameters of capsid, nucleic acid- related and protein-related dielectric permittivities are proposed as the main parameters determining the set of oscillation frequencies, the prior-parameters defining the spectra signatures of VLPs, virions. The single-particle level preliminary study of electromagnetic (EM) wave and VLP interaction based on Maxwell EM theory, separation of variables method for solving Helmholtz equations is considered. Analysis of analytical and numerical results obtained by computer simulation show the possibility to appreciate the set of oscillation frequencies (eigenvalues) of VLP model using the system of algebraic equations, alongside of defining the quantitative graphs of scattering cross sections and radiation patterns of system. Investigation of VLP model for un-enveloped TMV, T7 viruses demonstrates the strong dependence of physical/spectroscopic characteristics of system on core-shell related geometric, electric parameters and frequency modes/harmonics, which enable to consider the radiated field distribution as the possible spectral signature specific for shell or core as well as whole virion. Proposed theoretical basis for elaboration of frequency spectra model, investigation of spectroscopic properties of virions in complement with spectroscopic experimental study should be the best way for defining the fingerprints of viruses applicable for detection and identification sensory systems.

Biography

Professor, Doctor of Sciences and Dr.-Eng. Paata J. Kervalishvili is Professor at department of Engineering Physics within Georgian Technical University, as well as visiting Professor of faculty of exact and natural sciences of Tbilisi State University.

Dr. Kervalishvili has served in several directions of physics and technology such as: condensed matter, molecular and quantum physics, nuclear and laser technologies, nanoscience and nanotechnologies, novel materials, energy and sensory systems, information science and technologies. He is author of more than 450 scientific publications, books, manuals, and inventions.

P. Kervalishvili received his B.S. and M.S. in engineering physics from Georgian Technical University. The Research and technological Centre "Institute Giredmet" awarded him the title of Ph. D., and Dr.-Eng. in 1978, and Soviet atomic centre "Kurchatov Institute" – degree of Doctor of physics and mathematics (1985). He got USSR State Professor title in 1989.



