we study the relevant system of four radial equations and analyze behavior of eigenvalues of corresponding deviation curvature tensor. We found that the real parts of the eigenvalues are positive near the horizon, but at infinity the eigenvalues tend to $1 - (M / \varepsilon)^2$ / so they are positive for all physically interpreted energy values bigger than the particle mass. The Newman-Unti-Tamburino parameter does not influence on the character of geodesics behavior.

Resonant tunneling in QCD

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Tunneling processes in QCD described by classical solutions of field equations in Euclidean space (instantons) are considered. It has been shown that the exponential suppression of such transitions is removed due to resonance effects. Thus, energy bands are formed by analogy with the effects in crystals. The results are consistent with phenomenological considerations obtained by E. Shuryak, D. Dyakonov and others and also from the analysis of the Shifman–Weinstein–Zakharov (SWZ) sum rule. There are very strong arguments in favor of the fact that instantons in QCD provide the existence of quark and gluon condensates. Moreover, such non-perturbative fluctuations of gluon fields appear enough often. There are very strong arguments in favor of the fact that instantons in QCD provide the existence of quark and gluon condensates. Moreover, such non-perturbative fluctuations of gluon fields appear often enough (the density of instantons is estimated at 1 per Fm^4 in 4-dimensional Euclidean space). So, instanton tunneling transitions will not be suppressed even for medium energies 1 – 10 GeV, i.e. energies that will be achieved at the SPD facility (NICA, JINR). At the LHC accelerator, the range of kinematic regions is much wider, which significantly expands the variability of the task of searching for instantons.

Testing single micro-particles as individual luminescent upconversion probes

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Upconversion nano(micro) crystallites doped with rare earth ions are promising luminescent probes in a wide range of applied and fundamental problems. Particular attention should be paid to the biomedical area: visualization of biological objects, biosensing, therapy and diagnosis of cancer, drug delivery, etc. As a rule, the methods presented in the literature use a large ensemble of upconversion particles. Note that modern confocal optical microscopy makes it possible to detect the luminescent response of single phosphors. Thus, a attractive prospect arises for the development of single particle technology allows one to use an individual probe for monitoring the parameters of the local state of the environment (temperature, viscosity, pH, electric and magnetic fields, etc.). In problems of this kind, the decisive role is played by the features of the photophysical parameters of a single particle chosen as a probe. It should be noted that the parameters of a particle can differ greatly from the values averaged over a large ensemble of similar particles. The report presents studies of the luminescent upconversion response of various single oxide and fluoride submicroparticles, analyzes the multiphoton activation mechanisms of rare earth ions emission and the sourses of luminescence significant polarization. Examples of using single phosphors as temperature and orientation sensors are demonstrated. The prospects for their use in biological objects are discussed.

Vizualization and Probing the Surface of Isolated Nervous System of Grape Snail Using Luminescent Nanoparticles

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Of particular interest is the problem of visualization in biomedicine, when the position of probes introduced into living tissue is registered remotely and noninvasively by optical methods in real

time. Simultaneously with visualization of individual organs, luminescent probes can be used for drug transport, selective action on individual areas of biological tissue, in test systems, etc. Nanoparticles $[[Ru(dipy)_3]^{2+}+@SiO_2$, coated with L-cistein molecules, as well as fluoride particles $NaYF_4$:Yb,Er in a SiO_2 shell and $NaYF_4$:Yb,No, coated with PEI polymer were tested as luminescent probes. The Ru-based particles are ~50 nm spheres with a downconversion luminescence mechanism that converts 405 nm laser radiation into visible light with a broad emission band. The fluoride particles are ~200 nm hexagonal plates with upconversion luminescence, when laser light with a wavelength of 980 nm, absorbed by Yb^{3+} ions, is transferred to Er^{3+} and Ho^{3+} ions, which emit in the visible region as well. Using these particles, topographic mapping of living tissues of an isolated nervous system of a grape snail was carried out. Their position in a three-dimensional coordinate system was determined using optical confocal microscopy with a lateral resolution of 10 μm with subsequent mathematical processing. Demonstration experiments were also conducted to measure local temperatures on the surface of individual neurons, accessed using the obtained three-dimensional surface models.

Multifunctional up- and downconverting fluorescent $NaYF_4:Yb^{3+}/Tm^{3+}@NaGdF_4:Ce^{3+}/Tb^{3+}$ nanoparticles

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Fluorescent materials with rare earth ions as activators have attracted much interest recently as pure optical probes for the parameters of local environment. We report the synthesis and photophysical analysis of $NaYF_4$:Yb/Er@$NaGdF_4$:Ce/Tb nanoparticles that can be utilized as multifunctional microscopic optical devices.

These core/shell nanoparticles exhibit visible fluorescence both via upconversion process with a quantum yield of 0.19% when excited by infrared light at 980 nm, and downconversion with a quantum yield of 96% upon ultraviolet irradiation at 266 nm. The presence of $NaGdF_4$:Ce/Tb shell was shown to heal defects in $NaYF_4$:Yb/Er core, enhancing the emission of Er^{3+} ions.

As Er^{3+} emission is known to be temperature-dependent these particles could be considered as fluorescent nanothermometers. An experiment illustrating this application was conducted with the nanoparticles spread over unevenly heated surface. The temperature distribution was mapped with 10 μm lateral resolution and 1.6 K accuracy. And as the excitation wavelength falls within biological tissues transparency window these particles could be potentially used as microscopic temperature sensors in living systems. At the same time, these particles could be useful in creating fluorescent inks activated under specific light irradiations, offering novel anti-counterfeiting measures. Furthermore, the presence of Gd^{3+} ions results in MRI contrasting properties, suggesting the use of these kinds of nanoparticles as multifunctional agents in advanced biomedical imaging and sensing applications.

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Linear and nonlinear multivariate fluorescence thermometry with MPy(OPrOH)2 porphyrin

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Fluorescence thermometry is promising to study biological activity down to the subcellular scale with high thermal, temporal and spatial resolution. Previously MPyPP(OH)2 porphyrin was successfully demonstrated as a subcellular ratiometric thermal sensor in different types of cells. In this work the multivariate strategies are applied for temperature calibration with fluorescence