which take place10 GeV and higher energies. The effect of acceleration of electromagnetic showers development in crystals is of the widest interest when it manifests itself in crystalline scintillators used in electromagnetic calorimeters of detectors used in high-energy physics and orbital gamma-telescopes. Besides the development of compact crystalline detectors and gamma-telescopes, among the presently studied applications are the production of intense positron beams intended for further acceleration in the designed linear and ring colliders, the process of absorption of gamma quanta by crystals in order to weaken the unwanted background in the experiment to search for a violation of the Standard Model of fundamental interactions in the decays of neutral K-mesons, as well as the use of crystals to facilitate the production of secondary beams of gamma quanta and high-energy positrons at proton accelerators. A newly developed program for the full simulations of high-energy electromagnetic showers in the oriented crystals that combines the methods for describing coherent processes of scattering, radiation, and pair production in a crystal lattice at high energies and small deviations of particle momenta from the crystalline directions with the GEANT4 toolkit algorithms for simulating similar processes in the approximation of an amorphous medium at low energies and large deflections is announced.

Electric field of a charged ring located in the equatorial plane of Kerr black hole

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Electric field of a static charged ring that is located in the equatorial plane of Kerr black hole is calculated by numerically solving the Teukolsky equation. Lines of electric force are constructed and its structure analyzed for different values of the radius of the ring, mass of black hole and the angular momentum of black hole. The applications to astrophysical models of active galactic nuclei are discussed.

Studying the properties of ratchet systems by the Green's function method

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The Green's function method is an effective tool that a researcher can use to analyse the properties of systems being disturbed by external perturbations. For ratchet systems, such perturbations are fluctuations of the spatially periodic potential energy of a Brownian particle, which can initiate a particle directed motion. To obtain analytical expressions for the average velocity of an overdamped motion of a ratchet, one should use Green's function of diffusion in a stationary periodic potential and construct a perturbation theory in small fluctuations [1]. Nontrivial frequency and temperature dependences of the average velocity of the ratchet with a stationary sawtooth potential, dichotomously modulated by a spatial harmonic perturbation, were obtained in Ref. [2]. This presentation reports on the obtained Green's function of diffusion in a stationary stepwise potential and the properties of ratchets with various functional forms of dichotomous fluctuations of nanoparticle potential energy. The results obtained clarify what distortions in the shape of the stepwise potential lead to the ratchet motion in one direction or another.

[1] V. M. Rozenbaum, I. V. Shapochkina, L. I. Trakhtenberg. Green's function method in the theory of Brownian motors. Physics Uspekhi 62, 496 (2019)
[2] V. M. Rozenbaum, T. Ye. Korochkova, I. V. Shapochkina, L. I. Trakhtenberg. Exactly solvable model of a slightly fluctuating ratchet. Phys. Rev. E 104, 014133 (2021).

Bound states in the continuum in non-Hermitian layered structures

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Bound states in the continuum (BICs) are localized nonradiating modes of open resonators providing numerous new effects and applications in modern nanophotonics. In this talk, I start with