

O. A. Kostina

Moscow Institute of Physics and Technology

On counterexamples to Borsuk's conjecture on a sphere

The classical Borsuk's conjecture is the statement that any set of diameter 1 in the Euclidean space \mathbb{R}^d can be divided into $d + 1$ parts of smaller diameter. This conjecture is proved wrong for $d \geq 64$. In this paper, a generalization of Borsuk's conjecture on the sphere S_r^{d-1} is considered. In particular, we study the function $f_r(d)$ defined as the smallest number of parts of diameter smaller than 1 into which any set $A \subset S_r^{d-1}$ of diameter 1 can be divided. Using the linear algebraic method, we obtain new lower bounds of this function that improves the results of other authors. The optimal choice of parameters in the presented theorems is considered.

Key words: Borsuk's conjecture, linear-algebraic method, graphs of diameters.

F. D. Rukhovich

Moscow Institute of Physics and Technology

Outer billiards outside regular polygons

The outer billiard map outside regular n -gons is considered. The main result of the work is the proof of existence of an aperiodic point for an outer billiard in cases $n = 10, 8, 12$ and also fullness of the measure of periodic points.

Key words: outer(dual) billiard, aperiodic point, renormalization scheme.

Solving optimization problems in the formation of development strategies for a group of gas fields

We consider mathematical apparatus and software, which ensure the formation of the best development strategies for a group of gas fields based on the basis of the joint use of simulation, grid methods, discrete and multicriteria optimization. The continuous task of maximizing the accumulated production for a group of gas fields is reduced to a discrete one by introducing a uniform grid and solved by the branch and bound method. In addition to the approximate optimal solution, all close solutions are found, which allows one to solve multicriteria optimization problems.

Key words: gas output, gas field group, development strategy, grid methods, discrete optimization, multicriteria optimization.

M. M. Myo, E. P. Sheshin, Z. Y. Lwin, L. N. Win, M. A. Kyaw, M. H. Ye

Moscow Institute of Physics and Technology

Cathodoluminescent sources in the range of ultraviolet radiation with a field emission cathode based on carbon materials

Currently, various UV lamps are widely used in various fields. For example, UV is used in laser technology, medicine, ecology, petrochemistry and other fields. Ultraviolet light sources, which are widely used today, have a number of disadvantages and limitations to achieve energy efficient lighting. Therefore, the creation of a new generation of ultraviolet radiation sources is one of the most urgent tasks of modern vacuum electronics. Recently, a new type of lamp is developed, called cathodoluminescent ultraviolet light sources based on field emission cathodes. For the development of a new generation of cathodoluminescent ultraviolet source with a field emission cathode, several promising phosphors with UV radiation with the efficiency of up to 20% and several methods of their synthesis, which affects the grain size and their efficiency, are identified. The features of an autoemission cathode made of polyacrylonitrile carbon fiber and methods for increasing its current density are also studied.

Key words: cathodoluminescent ultraviolet source, field emission cathodes, phosphor with UV radiation.

E. S. Antonov

Lebedev Physical Institute of the Russian Academy of Sciences
National Research Nuclear University MEPhI

First results of MC studies of the process $e^+e^- \rightarrow H(ZZ^*)$, $Z \rightarrow jj$ and $Z^* \rightarrow \mu^+\mu^-/e^+e^-$ at 250 GeV on ILC

This paper is devoted to modeling the process $e^+e^- \rightarrow ZH$ with subsequent decays $H \rightarrow ZZ^*$, $Z \rightarrow jj$, $Z^* \rightarrow \mu^+\mu^-/e^+e^-$ at the future International Linear Collider (ILC). The corresponding signal can be measured using the mass difference distribution $M(jj\ell\ell) - M(jj) + M(Z)$ in the Higgs boson mass region. From an experimental viewpoint, the resolution of the signal includes the width of Z boson, which nevertheless should give a narrow peak in the mass difference compared to a direct measurement of the Higgs boson mass. The study of this channel can be used to determine the width, mass, and coupling constants of the Higgs boson.

Key words: International Linear Collider, ILC, properties of Higgs boson, Monte-Carlo simulating.

V. S. Bulygin

Moscow Institute of Physics and Technology

Cumulant analysis transforms of a complex signal in the linear physical system

The method for finding the output signal determined by the convolution of an entrance signal and the Green function of a physical system in the Gram-Charlier form whose coefficients are expressed by the sum of an entrance signal cumulants and Green function cumulants is considered. The expression for a minimum duration of the output signal determined by the properties of the Green function is obtained.

Key words: cumulant, Hermite polynoms, Gram-Charlier series, Green function.

A. S. Gordey, N. S. Chechueva

Moscow Institute of Physics and Technology

Hydrochemical conditions in the south-eastern part of the Baltic Sea in 2018

In this research the hydrochemical data obtained in the coastal waters of the Baltic Sea in the Sambian Peninsula region in June-August 2018 is analyzed. The concentration of dissolved oxygen, phosphates and silicates in the surface layer corresponds to typical values for a given time and region. Hydrogen sulphide is found at a depth of 90 m and more. An assumption of the reasons for the fast development of anaerobic conditions in this area is made.

Key words: biogenic elements, hydrochemistry of the Baltic Sea, hydrosulphuric contamination, dissolved oxygen, mineral phosphorus, mineral silicon, hydrogen sulphide.

I. V. Lilienberg¹, R. N. Chistov²

¹Moscow Institute of Physics and Technology

²P. N. Lebedev Physical Institute of the Russian Academy of Science

Physics of beauty hadrons in CMS experiment at Large Hadron Collider

The review of recent achievements in CMS experiment at Large Hadron Collider in beauty hadron physics is presented. Recent works on search of lepton universality violation and rare decays, studies of exotic hadrons and charm and beauty hadrons spectroscopy are surveyed.

Key words: hadron spectroscopy, beauty hadrons, exotic hadrons, large hadron collider, lepton universality violation, rare decays.

V. V. Vyshinsky^{1,2}, Kyaw Zin¹

¹Moscow Institute of Physics and Technology (national research university)

²FSUE «TsAGI» named after prof. N. E. Zhukovsky

Numerical simulation of the aerodynamic characteristics of the returned aircraft

The method developed in the framework of the engineering approach is used to determine the adiabatic index in the equation of state. The estimates of the effect of the adiabatic index on the aerodynamic characteristics of the returned aircraft are given. The results obtained can be used in higher level models based on grid methods.

Key words: aerospace vehicle, wind tunnels, numerical simulation, high altitude plane, hypersonic speed.

R. A. Plavnik, I. N. Zaviyalov, E. V. Plyashkov

LLC «Oil and gas centre of MIPT»

Effect of concentrations of reacting substances on the stability of the flow through a chemically active skeleton with release of a gas phase

In laboratory conditions the flow of an acid solution through a chemically active porous medium is studied with account taken of the occurrence of a chemical reaction with the release of a gas phase. It is known that this process can be unstable, viz. pressure fluctuations can be observed in the reaction area. The experimental work is carried out in a flat cell filled with a mixture of sodium bicarbonate and glass beads. Mineral oil is used as a highly viscous fraction, a solution of citric acid simulates a displacing fraction. As a result of the experiments, it is found that for the occurrence of a periodic process some critical concentrations of a reducing agent and an oxidizing agent are needed, and with a deficiency of at least one of them the periodic process does not occur.

Key words: in-situ combustion via the injection of oxidizer, porous media, reactive displacement, self-oscillatory mode.

V. K. Pham

Moscow Institute of Physics and Technology (National Research University)

Nonstationary processes in a hypersonic boundary layer

Nonstationary processes in conditions of strong viscous inviscid interaction are studied. A phase shift is detected in the upstream propagation of disturbances due to the finiteness of the upstream transmission rate of disturbances. The distribution of pressure and skin friction on the plate at different phases of the bottom pressure are investigated.

Key words: asymptotic theory of viscous gas flows, nonstationary processes, upstream propagation of disturbances.