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USSR

TRANSLATIONS ON USSR SCIENCE AND TECHNOLOGY
PHYSICAL SCIENCES AND TECHNOLOGY
(FOUO 29/79)

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TRANSLATIONS ON USSR SCIENCE AND TECHNOLOGY
PHYSICAL SCIENCES AND TECHNOLOGY

(FOUO 29/79)

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GEOPHYSICS, ASTRONOMY AND SPACE

NEW RUSSIAN SPACE VENTURE REPORTED

Paris AIR & COSMOS in French 3 Mar 79 p 34

[Article by Pierre Langereux: "Soyuz 32 Has Joined Up With Salyut 6"]

[Text] On 25 February 1979, at 12:54 pm (Paris time), the Soviet Union launched a new manned space ship, "Soyuz 32," with two Soviet cosmonauts on board: the ship's commander was Lieutenant Colonel Vladimir A. Lyakhov (37 years old), a cosmonaut since 1967, and the ship's engineer was Valery V. Ryumin (39 years old), a cosmonaut since 1973.

Valery Ryumin was a member of the first crew which was launched toward "Salyut 6," on 19 October 1977, aboard the "Soyuz 25" which did not succeed its rendezvous operation with the orbiting Soviet space station because of a failure in the guidance system. The other member of that unlucky crew was Vladimir Kovalyonok who last year, on board the "Salyut 6" and together with Alexander Ivanchenkov, broke the world record for space flight with 140 days. The orbiting station has been unmanned since that crew returned to earth on 2 November 1978.

The crew of "Soyuz 32" joined up with the "Salyut 6" station on 26 February, at 2:30 pm (Paris time), when it was gravitating on a 98 minute low orbit of 244-283 kilometers, with an inclination of 56 degrees. The station (which was launched on 29 September 1977) was reactivated and is functioning normally. Upon their arrival, the two Soviet cosmonauts found a message from their predecessors giving them some advice: "Comrades, we congratulate you on your arrival... Do not become irritable and be considerate of one another... You have a difficult road ahead of you, but take it with confidence and serenity."

It is now expected that a new "Soyuz" will be launched with a Bulgarian or a Mongolian, accompanied by a Soviet. These joint flights of the Intercosmos program have already made it possible successively for a Czech (Vladimir Remek), a Pole (Miroslav Hermaszewski) and an East German (Sigmund Jaehn) to be sent into space.

A French experiment concerning the development of alloys and crystals of magnetic materials under zero gravity conditions is to be carried out in the near future in a furnace on "Salyut 6."

V.V. Ryumin (on the left) and V.A. Lyakhov (on the right): in training at the City of the Stars, near Moscow. TASS photo.

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GEOPHYSICS, ASTRONOMY AND SPACE

SALYUT 6 AND THE SOVIET SPACE PROGRAM

Paris AIR & COSMOS in French 17 Mar 79 pp 46-47

[Article by Albert Ducrocq: "With Lyakhov-Ryumin"]

[Text] When Vladimir Lyakhov and Valery Ryumin entered Salyut 6 at 1:30 pm, on 26 February, the Soviet orbital station had already been in space for 515 days...

Such a length of time seemed impressive: as a matter of fact, the time was not so distant when the equipment of a Soviet space station was considered "guaranteed" only for a period of 6 months, while in 1973 the Americans themselves estimated that occupancy of the Skylab would become hazardous after 9 months in space.

You undoubtedly know the story of Johnny's knife of which first the handle and then the blade were replaced: thus it always remained new. Similarly, on board a Salyut it would be sufficient to replace everything that gets used up or worn out, everything that ages in a space atmosphere, and it would be possible to dispose of a station which is permanently kept new. This, in some ways, will be the formula for an orbital station when a systematically modular construction has been adopted, which will make it possible to replace any piece, any equipment, on demand by ordering them to be brought from earth via a Progress.

We are not there yet. We know that the Salyut 6 station, which is well known because of all the studies which the Soviets have published, is not of a specifically modular kind, because originally it was meant to test the Progress vehicle. Only some elements can be replaced.

And in any case, there could be no question of renewing everything on board of a space station. As a matter of fact, one of the objectives of the Soviets is to set up a gradation by distinguishing between those components which could be considered "permanent" in terms of the time span during which the station is to be used, those which will need to be dismantled periodically, and those which are expected to have to be replaced frequently.

As a matter of fact, the opportunity to study the behavior of these systems was one of the major reasons which led the Soviets to reuse the Salyut 6 station, even though they could very well have used another station -- numerous observers had announced the imminent launching of Salyut 7.

Apparently, this decision was made after numerous hesitations, under the emblem of a mission which more than ever had to be considered open.

Evaluation of the Equipment

Thus, the Soviets sent a third maintenance crew on board Salyut 6. Everything was handled like a retake of the 1978 scenario...

We recently noted that the Russians will have to achieve many new things in order to be able to create the technologies which the manufacturing during the next decade of a modular station, assembled section by section, will require. It is still not certain today whether the Soviets intend to test these technologies in the near future: they have obviously given priority, for reasons of the evaluation of the equipment, to a continued exploitation of the Salyut 6 for a period of time, the length of which cannot be estimated by anyone.

If the use of Salyut 6 can be continued for a long time, this would obviously result in the delay of the later operations -- although there is nothing to prevent two stations from being occupied simultaneously by crews; there is nothing against it and we have stressed the possible interest of such a formula -- but, on the other hand, an extension of the missions with Salyut 6 will be evidence of the quality of the equipment, and this could only cause the managers of the Soviet space program to congratulate themselves with regard to the future of their program.

Of course, Soyuz 32 was coupled with the forward docking section of Salyut 6. It should be noted in passing that it was the /12th time/ [printed in boldface] that a ship docked with the station. And this single performance demonstrates the imperviousness of the docking sections which, up to now, do not seem to be showing any signs of fatigue. Eight times, ships -- automatic or piloted -- have docked at the rear section of the station, while four ships docked at the forward section which is, in principle, limited to the Soyuz carrying maintenance crews; up to now, this forward section has been used:

- by Soyuz 27, on 11 January 1978 (vehicle brought there by Dzhanibekov and Makarov to be left at the disposal of the first maintenance crew, made up of Romanenko and Grechko);
- by Soyuz 29, on 16 June 1978 (the vehicle which brought the second maintenance crew, comprised of Kovalyonok and Ivanchenkov, on the spot);
- by Soyuz 31, on 7 September 1978 (transfer to the forward section of the vehicle which the second maintenance crew would use for its return);
- by Soyuz 32, which on 26 February brought the third maintenance crew with Lyakhov and Ryumin.

Checking of the Instruments

After having entered Salyut 6, Lyakhov and Ryumin first made an on the spot check of the instruments while at the same time reactivating the station.

As a matter of fact, it had not been put to sleep all that much. The Russians only talked about a state of waiting and a certain number of instruments had continued to function, among which the system of orbital conformation which, after some eight years of efforts on the part of the Soviet technicians, now seems to be working well with Cascade and Delta machines: the erosion of the orbit is measured by means of a globe, the movements of which, within a confined space, can be considered to be perfectly ballistic. It is thus possible periodically to create the necessary impulses to allow the orbital parameters to maintain the same values. In fact, a reduction of altitude has been recorded, apparently a voluntary one, as if -- knowing that with the Progress they are no longer obliged to save fuel -- the Soviets have decided to fly their Salyut on a lower orbit, which would allow for a better observation of earth.

In any event, Soyuz 32 is going to be used for a locomotive: on 1 March, the Soviets announced that the ignition of its engine transferred the spatial complex onto a 308/338 kilometer orbit.

As of 28 February, the cosmonauts have weighed themselves using the mass meter shipped on board the Salyut 6. The Russians have confirmed that, like last year, they have retained the principle of a daytime synchronisation with Moscow time: systematically, the crew's work day begins at 8 am and ends at 11 pm.

The checking of the instruments turned out to be particularly time consuming as the Soviet bulletin issued on 5 March, when Lyakhov and Ryumin started their second week in space, announced that the checking operations would continue after the two men had spent their first weekend in orbit in active rest on the basis of televised reporting and gymnastic exercises. They cleaned up aboard the station which, apparently, needed it very badly. They were able to vote by radio. In a message addressed to the central electoral committee and broadcasted by Radio Moscow, the ship's commander stated that the crew was voting for Mr Leonid Brezhnev, candidate for the Soviets of the Union -- who, one should not forget, has first responsibility for the Soviet space program -- as well as for Mr Alexey Kosygin, candidate for the Soviet of Nationalities.

Biological Experiments

At the flight center, the conducting of biological experiments by the crews has also been alluded to.

This chapter has been mentioned relatively little since the beginning of the Salyut 6 flight. As a matter of fact, the Soviets have developed the habit of placing biological samples on practically all of their piloted ships, on all the stations. This time, because of the duration of the flight, one would imagine that the experiments have assumed an exceptional importance. The samples which were sent out at the same time as the station have now been in space for more than /a year and a half/ [printed in boldface]!

Long duration flight for human beings, here it is...

And as far as can be determined by the information released by the Soviets, the biological program of Salyut 6 is an extremely complex one.

Some samples indeed seem to have been put in the station at the beginning. Others were brought by the manned ships. Thus, independently of the Cytos experiment, the cosmonauts of Soyuz 26 brought "chorelle" algae, tadpoles, fertilized fish eggs, as well as drosophila flies on board the station. These flies were obviously supposed to stay in their container. Now, it will be remembered for the sake of minor history that as a result of an incident, several flies managed to escape and that thus a "first" was achieved completely involuntarily to the great annoyance of the four cosmonauts who were then occupying the station: they suddenly saw the flies flying around in the Salyut! Their first reaction was consternation and their first reflex was to try to get a hold of the insects, if possible without killing them, by using the vacuum cleaner. But, when they thought about it, the cosmonauts realized that they had the unique opportunity of making a totally unique study: the flight of flies under conditions of weightlessness...

Biological packages were also entrusted to the Progress flights. And apparently new samples arrived on board the Soyuz 32...

Weeks go by and Lyakhov and Ryumin still occupy the Salyut 6.

One wonders how long their flight will last and what operations will distinguish it.

Will the role of the two men be restricted to a few weeks of checking the station, somewhat in the manner of the mission entrusted to Gorbatko and Glazkov in February 1977? Or could the Soviets have decided, circumstances permitting, simply to double the mission of Kovalyonok and Ivanchenkov who, as we know, withstood their 139 day flight surprisingly well and whose readaptation to earth conditions was remarkably rapid? Was this an exceptional case or was it a logical result of the measures taken in relation to Soviet space medecine?

Many observers are wondering whether Lyakhov and Ryumin themselves will not remain some four-and-a-half months in space. After all, as long as the Salyut 6 station is capable of taking crews, it is technically interesting for it to be visited, and space medecine can only benefit from a repetition of the long flight of 1978...

Four Kinds of Operations

One can in any case imagine the nature of the operations which could take place during a mission.

In terms of Soviet intentions, no less than four kinds of experiments could be realized by the ships docking at the rear section of the Salyut 6:

1.- First, Soyuz ships manned by two Soviets, for the achievement of a certain number of technical experiments, in the manner of what was done in 1978 with Soyuz 26. The Franco-Soviet experiment ELMA [expansion unknown] could constitute a response to Cytos 1.

2.- Progress vehicles, to supply the station regularly with fuel, air, water and food, according to the formula we are familiar with.

Thus, on 14 March Progress 5 docked at the Salyut 6, bringing fuel, food, mail, scientific equipment and, the Soviets told us, various pieces of maintenance equipment to the cosmonauts.

3.- Intercosmos flights. It was in March 1978 that the training of the cosmonauts of five countries belonging to the Intercosmos organization, began in the City of the Stars. Following a preparation period of 1 year, this training has now come to an end and at least 5 flights are expected. In the following order, if we are well informed, a Bulgarian, a Hungarian, a Cuban, a Mongolian, and a Romanian are supposed to fly at the side of a Soviet cosmonaut on board that many Soyuz ships. We are saying at least five flights, because we would not be surprised if a Vietnamese were to be put in orbit also. They will be standard flights lasting 8 days, the realization of which will in any event take much longer than 48 days, taking into account at the same time the necessary long delays in preparation and the even longer time required to unload the Progress vehicles in charge of taking up supplies between two Intercosmos flights.

It would be surprising if all these Intercosmos flights could take place on board the Salyut 6 -- even though this would not be fundamentally impossible -- it would be even more extraordinary if they all occurred in 1979. Apparently, the missions will be spread over a period of 2 years...

4.- Specialized automatic vehicles of a new type, recently announced by Shatalov. Like the Progress, these vehicles would have the Soyuz engine room. However, the rest of the vehicle would not consist of a load, but of a specialized compartment which could, for a while, turn into an annex to the Salyut for the purpose of carrying out experiments of a particular nature. Specifically, it may be expected that this technique will be used in 1981 for the Gamma Telescope, developed under the sign of a Franco-Soviet cooperation program.

In terms of the future of astronautics, the interest of this formula is obvious. It will be possible to send, from the earth to a modular station, equipped with numerous free docking sections, all the compartments necessary for the execution of experimental programs, these compartments being assured of having the station's energy sources at their disposal and, in a general sense, the whole infrastructure which it has to offer.

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PUBLICATIONS

DESIGN OF CONTROL MECHANISMS FOR NUCLEAR REACTORS

Moscow OSNOVY PROYEKTIROVANIYA MEKHANIZMOV UPRAVLENIYA YADERNYKH REAKTOROV in Russian 1978 signed to press 14 Feb 1978 pp 1-5, 270-272

[Annotation, table of contents and preface from the book by I. Ya. Yemel'yanov, V.V. Voskoboynikov and B.A. Maslenok, Atomizdat, 2900 copies, 272 pp]

[Text] This book considers problems of designing control mechanisms for nuclear reactors and shows the prospects and trends in the automation of nuclear power installations.

The domestic and foreign experience in designing, developing and operating SUZ [control and protection systems] drives is generalized and systemized. A description of control systems for atomic power plants and of optimal constructions of control mechanisms and their individual units if presented, methods of designing them are given. In this work special attention is given to long-range trends in the field of development of control mechanisms, and in particular to discrete electromagnetic SUZ drives. Problems of reliability and economical and technological effectiveness are discussed.

The book is intended for engineers and technicians engaged in designing and operating control mechanisms. It can be used by students of colleges and technical schools taking a course in nuclear reactor design.

Tab. 21. Fig. 140. Bibliography 140 titles.

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Preface

The development of atomic power engineering is inseparably linked with the progress in the field of control and further automation of nuclear power installations. The reaction zones of the reactors of large AES [atomic power stations] have a complicated structure with a great number of heat-generating assemblies and controlling members working under strained conditions. In order to solve the problem of optimization of the energy generation in such reaction zones and to increase the operation effectiveness of the AES, special automation equipment and devices had to be worked out, ensuring control and operation of such nuclear reactors. This equipment should allow equalizing the energy generation along the radius and altitude of the reaction zone to cope with the instabilities arising in large reactors while adhering to all requirements of nuclear safety and preventing a shut-down of the AES, since this is connected with considerable economic losses.

Perfection of control and automation equipment has been attained also in other fields of reactor construction. At present, nuclear power installations are in use in shipbuilding, for scientific research purposes and in exploration of outer space. In regulating and controlling nuclear reactors of such installations the specific requirements of their operation have to be taken into account.

One of the basic and most complex problems solved in the automation of nuclear power installations is the development of control mechanisms. This is explained by the fact that the control mechanisms are included immediately in the equipment complex of the reactor and its reaction zone. The elements of these mechanisms often work at considerable pressures and temperatures under conditions of radiation and vibration and shock loads. The operation of such mechanisms in ship reactors is coupled to the ship's heels and trims.

In space nuclear installations the actuator mechanisms of the control systems have to operate without servicing in a high vacuum with considerable overloads at high temperatures. The structural execution of the control mechanisms is closely connected with the construction of the reactor elements and with the conditions of their operation. Thus, for example, the control mechanisms of channel-type reactors may be exchanged during operation on a working reactor, while for an exchange of the sealed control mechanisms of body-type reactors with water under pressure, stopping of the reactor and unsealing of the first loop is required. Of course, the attitude toward the economically justifiable reliability of these mechanisms is totally different. The space for mounting of control mechanisms is often very limited. On the other hand, the control mechanisms are also a constituent part of the control system of the reactor installation and must satisfy a number of requirements imposed by that system, such as securing a certain speed or several speeds of motion of the controlling member, ensuring the necessary precision in placing the controlling member in a required position, the time of its emergency operation etc. Thus, in developing control mechanisms, usually a complex problem is solved on securing the requirements of control under the conditions of a concrete reactor. Besides, it should be noted that the control mechanisms connected directly with the controlling member are the crucial element of the system, ensuring the nuclear safety of the installation.

Many control mechanisms for nuclear reactors have been designed using different energy sources (electric, hydraulic etc.) and having diverse construction, but performing the same functions in the control system. However, with all that diversity in the construction of mechanisms, at present definite trends are outlined in the field of control mechanisms in connection with the abovementioned impetuous development of the reactor and, in particular, power reactor building. The more important of the trends are improvement of reliability; increase in operation speed; creation of universal mechanisms having the same structure, but performing different functions in the control system; creation of discrete control mechanisms; creation of linear mechanisms (especially of discrete action) without conversion of modes of motion.

Lately the linear discrete control systems are more and more widely adopted, in which forces of an electromagnetic field are employed in moving the controlling member. The characteristic feature of such mechanisms is the absence of mechanical transmissions in the first reactor loop, which considerably increases their reliability. In designing control mechanisms the constructor has to solve complex problems connected with the construction of reactor elements, heat transfer, choice of materials, technology of manufacturing etc. The creation of a mechanism is usually preceded by scientific research and experimental construction work of considerable volume.

At present both in the Soviet Union and abroad some experience has been accumulated in developing, testing and manufacturing control mechanisms; some statistical material on the reliability of individual elements of those mechanisms has been collected as well. Also patent materials in this field are of great interest. However, so far a generalization of the accumulated experience on the development of control mechanisms is not found in the literature and there are no solutions to a number of problems on the theory and methodology of designing these mechanisms. A classification and analysis of the structure of control mechanisms is practically non-existent. The goal of this book is to make up this deficiency to a certain extent. The book examines the structure of control mechanisms (of any construction) and gives designs and examples of execution of the basic elements. The principle of operation of individual mechanisms is set forth in detail. Special emphasis is laid on the consideration of progressive and recent trends in the field of development of control mechanisms and, in particular, mechanisms with stepping electromotors and of hermetic linear discrete mechanisms which become more and more widespread in reactor construction.

The book presents the operating conditions and basic construction requirements of control mechanisms, gives a description and construction of the basic types of control mechanisms, considers problems of their operation dynamics, reliability, effectiveness, manufacturing technology and a number of others. The book is based on the data of both domestic and foreign literature and on the research and development carried out by the authors as well.

Chapter 1 and 2 is written by I. Ya. Yemel'yanov, chapter 3 and 8 jointly by I. Ya. Yemel'yanov and V.V. Voskoboynik, chapter 4,5,7,9.10 and 11 by V.V. Voskoboynik, chapter 6,12,13,14 and 15 by B.A. Maslenok.

The authors express gratitude to B.N. Strizhov for kindly placing at their disposal material on the control mechanisms of the RBMK reactor. The authors acknowledge their pleasant obligation to express their appreciation to A.F. Linevaya who was of great assistance in performing electromagnetic calculation and designing the book; they also thank Ye. A. Starostin, A.I. Klyomin, V.V. Gerasimov, M.D. Labzin for valuable remarks offered in the revision of separate chapters of the manuscript and V.V. Dl'nov for technical assistance in selection of the material.

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PUBLICATIONS

NUCLEAR CASCADE PROCESS IN DENSE MATTER

Moscow YADERNO-KASKADNYY PROTSESS V PLOTNOM VESHCHESTVE in Russian 1977 signed to press 12 Apr 1977 pp 3-8, 202-203

[Annotation, table of contents and introduction from the book by A.I. Dem'yanov, V.S. Murzin and L.I. Sarycheva; Izdatel'stvo "Nauka", 1250, 203 pp]

[Text] This monograph is written on the basis of the experimental material obtained from cosmic rays, with inclusion of data on acceleration and with a Monte Carlo calculation of the nuclear cascade process.

It is shown that up to energies $\sim$1000 BeV the behavior of cascade in a dense matter (absorber of an ionization calorimeter) is determined mainly by the mechanism of successive interactions of a "surviving" particle, in which the decisive influence on the dynamics of the cascade development is exerted by the fluctuations of energy transfer (coefficient of inelasticity) in the first interaction. The publication is of interest to specialists in the fields of high-energy physics and cosmic rays.

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Introduction

The discovery and study of the nuclear cascade process in the atmosphere [1] contributed very much to the understanding of the interaction of hadrons with nuclei at high energy.

Numerous calculations of the nuclear cascade process in the atmosphere have been carried out, in particular in connection with the analysis of the evolution of broad atmospheric showers [2-4].

Because of the very large radiation length, the successive electron-nuclear cascades in the air overlap, and a direct observation of the structure of longitudinal evolution of the shower is impossible. An essential difficulty is also caused by the practical infeasibility of constructing a system of detectors (it would have to have a height of $\sim$20 km) which would allow observances of separate nuclear cascades on many levels in the atmosphere. The study of the nuclear cascade process has therefore a statistical character based on the measurement of the ranges of a number of particles and on the energy fluxes of various particles participating in the cascade evolution.

From this viewpoint the study of the nuclear cascade process has considerable merits. We can choose such absorber substances in which the radiation length of a t-unit is small compared with the nuclear range. Therefore the electron-photon avalanches from separate interaction do not overlap and it is possible to observe the structure of the longitudinal evolution of the cascade. Also it is not difficult to employ absorber thicknesses equivalent to the thickness of the atmosphere. The geometric length of such an iron or lead "atmosphere" is about 2 m ($\sim$ 12 interaction ranges).

Particularly great possibilities were opened after creation of the ionization calorimeter which permits seeing the instantaneous ionization distribution along the whole nuclear avalance. This makes practicable the study of the shape diversity of the nuclear cascade curves (of the dependence of the particle number on the depth in the absorber), i.e. the investigation of fluctuations in the evolution of a nuclear cascade, which yields supplementary information about the process.

The calorimeter by itself does not yield the possibility of observing the elementary interaction, since only the secondary electron-photon component arising in the collision act is recorded. And for this reason it is comparatively little known that with the help of only one calorimeter it is possible to study sufficiently the fine features of the processes of multiple production. Naturally, special methods are necessary for this, and the present work is devoted to their development. The methods described below are useful mainly in cosmic-ray experiments, although they may prove effective also in accelerator work.

The ionization calorimeter, as a device consisting of many rows of ionization detectors interlaid with matter, is applicable only to the study of interaction of particles with sufficiently heavy nuclei. This is due to the fact that the resolving power of the calorimeter improves as the ratio t/λ decreases, where t is the unit radiation length and λ the interaction range of the hadron. The minimum condition is $t/\lambda \lesssim 10$. Placing thin targets of various substances above the calorimeter makes possible the investigation of interaction with practically all nuclei.

The investigation of interactions with nuclei is now, according to general opinion, one of the most important tasks of high-energy physics. The mechanism of multiple particle production in the interaction of hadrons with atomic nuclei contains information highly essential for the understanding of the fundamental properties of nuclear matter.

Experiments conducted with cosmic rays and on accelerators indicate the absence of a dependence of the mean coefficient of inelasticity on the atomic number of the target nucleus, or a very weak dependence which cannot be explained on the basis of the model of successive collisions with the nucleons of the nucleus. The theoretical treatment of the data regarding multiplicity and angular and impulse distribution of secondary particles is connected with calculation of the intranuclear cascade or with the Glauber approach and also faces certain difficulties as the nature of the processes taking place in the nucleus is not clear. Attempts to achieve agreement with the experiment have given rise to a number of totally new ideas, for instance, the hypothesis that a nucleon which has undergone an interaction "shakes off" the magnetic field and cannot interact effectively until the field is restored [5,6]

The same consequence follows from the ideas of the parton theory according to which the interaction efficiency is conditioned by the presence of low-energy partons; after the interaction these partons turn into real particles and some time is needed for the formation of new low-energy partons [7].

It can be expected that the indicated effects appear in a time $\sim 10^{-24} - 10^{-23}$ sec in the proper coordinate system of the incoming particle; consequently (with energy available) they should be noticeably manifest at distances comparable with the dimensions of the target nucleus.

However, until recently not too much attention was paid to the study of the phenomena accompanying the interaction of hadrons with nuclei. More or less systematic investigations using accelerators are restricted to energies of the order of tens of BeV. At high energies the data on hadron-nuclear interactions are obtained mostly from cosmic rays. These data are far from complete and in many cases conflicting [8, 96].

Such is the specific character of cosmic-ray experiments that the direct methods of measuring these or other characteristics of the interaction often proves to be impractical. There exists an extensive experimental material obtained on the basis of observation of electron-nuclear showers at high energies in matter (mainly in air). In the region above $10^5 - 10^6$ BeV wide atmospheric showers (ShAL) are the basic source of information on the mechanism of hadron-nucleus interactions.

Still a ShAL is a highly complicated phenomenon including processes of diverse nature, about which much remains unclear as yet [9]. Therefore the interpretation of experimental data requires all kinds of supplementary assumptions and the conclusions are not always unequivocal. Somewhat simpler is the situation in the study of nuclear cascade processes in dense matter. In this case there is no necessity to take into account the effects connected with the disintegration of the comparatively long-lived secondary nuclear-active particles ($\pi^{\pm}$ and K mesons) and the appearance of muons and neutrinos. The spatial divergence of the cascade electrons is not large and for the solution of a number of problems we may limit ourselves to the examination of longitudinal evolution of the cascade.

Finally, as was already mentioned, the favorable ratio of the nuclear range λ to the cascade unit (t-unit) in substances with intermediate atomic numbers allows studying the cascade structure.[1] Since there exists a sufficiently developed theory on the electromagnetic cascade process [10], it is possible to trace more or less clearly the connection of the characteristics of the observed cascade with the characteristics of the elementary act of interaction of hadrons with various substances.

[1] In iron, for instance, the length of an electromagnetic cascade is of the order of the nuclear range.

Chapter I contains an examination of general properties of the nuclear cascade process in dense matter. In Chapter II a theoretical investigation of the nuclear cascade process is conducted by the method of statistical tests and a substantiated method for studying hadron interactions with the help of ionization calorimeter is given. Chapter III brings a description of calorimetric set-ups with which the basic experimental results were obtained; these are given in the subsequent chapters (IV, V and VII), In Chapter VI some aspects of the cascade process inside the nucleus are considered.

It is our pleasant duty to thank our colleagues A. I. Anoshin, G. L. Basinjagyan, L. I. Belzer, I.N. Vardanyan, A.V. Gus'kov, Ye. N. Denisov, I.N. Yerofeyev, V. I. Zalomayev, N.P. Karpinskaya, V.D. Kobrin, V.V. Pronin, V.A. Roshchin and N.B. Sinyov; and also the workers of the Yerevan Physical Institute V.V. Avakyan, M.O. Azaryan, E.A. Mamijanyan, with whose participation the data of the Large Calorimeter were obtained. We thank I.P. Ivanenko and A.A. Komar who read separate chapters of this book and made a number of valuable remarks. Finally we thank G.I. Gorchakow for help in putting the manuscript into shape.

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PUBLICATIONS

RADIATION EFFECT ON NUCLEAR REACTOR GRAPHITE

Moscow DEYSTVIYA OBLUCHENIYA NA GRAFIT YADERNYKH REAKTOROV in Russian 1978 signed to press 2 Dec 1977 pp 1-8, 271-272

[Annotation, table of contents and introduction from the book by V.V. Goncharov, N.S. Burdakov, Yu.S. Virgil'yev, V.I. Karpukhin and P.A. Platonov: Atomizdat, 1400 copies, 272 pages]

[Text] In the present book data on domestic carbonic structural materials are systematized for the first time. Technological factors, general porosity and degree of crystallinity, which determine the graphite properties and their radiative change, are analyzed. Special attention is given to the dimensional stability and oxidation resistance of graphite.

On the basis of a generalization of both domestic and foreign data a model of radiative changes in the properties of carbon materials is proposed and formulas are given for calcualtion of these changes. Experimental devices employable in reactor research are described. Various types of brickwork of uranium-graphite reactors are considered.

The book is intended for scientists, engineers and constructors working in the field of atomic engineering.

Fig. 168. Tab. 69. Bibliography 241 titles.

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Introduction

The development of social production is directly linked to the increase of consumption of energy in all its forms and above all of electric energy. The demands for it are met basically by putting into operation electric power stations working on organic fuel. However, the rate of growth of consumption of electric energy is so rapid that even at present an acute deficiency of fossil fuel is manifest in some economic regions of the USSR. Thus, predictions show that in the long term until 1990 the electric power consumption will be concentrated in the European part of the USSR, even taking into account a shift of productive forces to the eastern areas of the country. And the energy balance can be ensured only under the condition of extensive construction of atomic power stations in the European part of the country [2].

Employment of atomic engineering in the production of electric energy and of heat for the metallurgic and chemical industry and for heating purposes allows to replace organic fuel and to meet any deficit in the fuel balance.

The Soviet Union is the country that initiated the use of atomic energy for peaceful purposes. The first atomic power station in the world was put into operation in 1954 in the Soviet Union. Through the experience of the First AES and other atomic power stations built thereafter, the possibility of their reliable and stable operation within a general power system was proved.

In conformity with the resolutions of the 24th CPSU Congress a program of extensive construction of atomic power stations is being carried out. This program was further developed in the "Basic Directions for the Development of the USSR National Economy for 1976-1980" approved by the 25th CPSU Congress, in which specifically construction of AES's is envisaged with reactors of the individual power of $1.5X10^6$ kW. The transition to creation of economic, powerful industrial AES's contributes appreciably to the energy supply of the national economy.

The basic types of atomic power stations built in the Soviet Union are AES's with water-water body-type power reactors (VVER) and channel-type uranium-graphite high-power reactors (RBM-K). An important place in the development program for atomic engineering in the USSR is assigned to AES's with channel-type uranium-graphite reactors. This is due to the high reliability of their operation as well as to the possibility of obtaining a very considerable individual power (10^6 kW and above).

One of the basic assemblies of a high-power uranium-graphite reactor is the many-tons graphite brickwork which must work reliably during the whole operation of the AES, reaching 30 years. Hence arise stiff demands on the graphite as a structural material.

Soviet physicists faced the reactor graphite problem for the first time in the years of the Great Patriotic War in the process of creation of a nuclear reactor. At that time the question of the greatest importance was whether it was possible to obtain graphite of sufficient purity in the necessary quantity. The demands on the graphite purity were very rigid. It suffices to say that, for instance, the admixture of boron in graphite was tolerated in the quantity of a few millionth parts. The situation was complicated by the circumstance that the need for graphite amounted to hundreds of tons.

Owing to measures taken by I.V. Kurchatov, a method of obtaining high-purity graphite was worked out and the industrial production of the necessary quantities of it was organized within a comparatively short time*. Under the immediate direction of I.V. Kurchatov the successful start of a nuclear reactor with graphite moderator, the first on our continent, was accomplished on 25 December 1946. For the brickwork of the first domestic reactor 450 tons of graphite were needed.

The exceptionally valuable experience acquired in the operation of the first reactor and the investigations carried out on it made possible the design and construction of other reactors. "After the necessary experience was obtained in the first post-war years in the USSR in making and mastering reactors for plutonium production, and many complex technical problems were solved, Soviet scientists started the next stage in the utilization of the chain reaction, that is, the practical solution of the problem of power utilization of atomic energy" [133].

Parallel investigations were conducted under the direction of I.V. Kurchatov, in the course of which highly interesting phenomena were discovered of great importance for the reactor operation and for the understanding of the effect of radiation on matter. In studying the physical properties of graphite under intensive neutron radiation, considerable changes were detected in them: decrease of thermal and electric conduction, change of volume and mechanical strength. It was furthermore established that in annealing radiated graphite the latent energy, stored in the crystal lattice, is released. These investigations allowed clarification of the nature of the radiation defects in graphite permitted the solving of a number of problems which had arisen in designing and operating nuclear graphite reactors.

*Patent of G.K. Bannikov, N.I. Aleksandrov, N.F. Pravdyuk, V.V. Goncharov, A.V. Kotikov.

The most valuable results in the study of graphite properties were obtained after, on the initiative of I.V. Kurchatov, a very bold experiment was carried out in disassembling the brickwork of the $5X10^4$ kW uranium-graphite reactor IR after four years of operation.

At present when graphite is employed as the structural material of the core and reflector in powerful reactors at higher parameters, additional demands on its properties have been raised. This situation requires the conducting of special experiments and theoretical investigations with the purpose of developing scientific foundations to ensure prolonged durability of the brickwork in power reactors.

Graphite will be in even wider use in the near future due to the creation of high-temperature reactors with gas cooling whose employment in various field of the economy is planned.

The specific properties of graphite--such as small neutron absorption cross-section, good moderating power, comparative easiness of obtaining chemically pure material, exceptionally high thermal qualities and sufficient strength--were the reason for its wide use. However, the properties of graphite are changed considerably during radiation in a nuclear reactor because carbon atoms are displaced from their points in the crystal lattice by fast neutrons, and structural changes in it are thereby produced.

The radiative change of graphite properties is aggravated by the nonuniformity of the field of fast neutrons and considerable temperature gradients within a graphite block, the basic element of the brickwork of a uranium-graphite reactor. The above-mentioned factors acting continually produce various dimensional changes in the cross section of a graphite block and lead to strains which may cause fracture of some blocks in the course of operation.

In predicitng the durability cf the elements of graphite structures in contemporary nuclear installations it is necessary to know the laws of the radiative change of graphite properties in a wide temperature range and with a fluence of fast neutrons up to 0^{23} cm^{-2} and more. The basic properties are, in this context, stability of linear dimensions, strength, creep, elastic modulus, coefficient of thermal expansion and thermal conductivity as well as the oxidation resistance of graphite.

In the last thirty years thousands of investigations on the effect of radiation on graphite have been conducted. Despite an abundance of such experimental and theoretical research work, the interest in graphite is not diminishing: more than that, the number of experimental and theoretical studies has considerably increased in recent years. This is due to new technical demands on the durability of graphite in radiation field, called forth by the trend to increase individual reactor power and, in connection with this, to raise the operational parameters of nuclear installations.

Extensive work is conducted all over the world on the creation of new brands of reactor graphite with improved properties. Since at present the theory allows predicting only approximately the change in properties due to radiative damage of various materials, the creation of new brands is topped by radiation tests not only of the material itself, but also of structural elements under conditions allowing to simulate the operation of structures of the graphite chosen. In this work an important place is occupied by investigations on the durability of brickwork of uranium-graphite reactors.

Research on the effect of radiation on the physical and mechanical properties of the materials employed in reactors has stimulated a systematical study of the nature of radiative disturbances. As a result graphite has become the first material in which the structure-physical change of properties under the influence of neutron radiation was detected. The study of radiative disturbances in graphite considerably widens the range of questions of materials science and solid state physics as well as on research and development of experimental methods determining the properties of materials in the process of radiation.

An extensive periodical literature and several monographs published abroad are devoted to the questions enumerated above. Generalization of the data on the radiation effect on reactor graphite is furthered considerably by various international conferences and symposia. However, the published results were obtained investigating graphite of foreign brands which differ from the domestic brands because of the peculiarities of the raw material used etc.

There are only a few publications in Russian devoted to the problem under consideration. The monographs by Nightingale (1962), Simmons (1965), Reynolds (1968), Mantel (1968) have not been translated into Russian.

In this country the first publications devoted to the problem of the graphite of nuclear reactors and the study of radiative damage in graphite were prepared on the recommendation of I.V. Kurchatov (Session of the USSR Academy of Sciences on Peaceful Use of Atomic Energy 1955, "Atomnaya Energiya" 1957 Vol 3, No 11).

In the book by S.E. Vyatkin, A.A. Deyev, V.G. Nagornyy, V.S. Ostrovskiy, A.M. Sigarev and G.A. Sokker "Yadernyy Grafit" ("Nuclear Graphite") (1967), which is the first Russian monograph on structural graphite for atomic engineering, its production methods are given, the crystalline and porous structure and the electronic, thermodynamic and mechanical properties are described as well as the interaction of graphite with some elements and compounds, and the behavior of reactor graphite of various foreign brands under radiation with comparatively small doses is elucidated.

In the book ("Atom Naya Energetika 20 Let" "Twenty Years of Atomic Engineering") (1974), written by leading Soviet scientists, data are given on the construction and operational experience of the AES's active in this country. Materials on the First AES as a school of domestic and foreign energetics are presented extensively.

In the "Spravochnik svoystv konstruktsionnykh materialov na osnove ugleroda" ("Reference Book on Carbon-based Construction Materials"), published in 1975, the production technology of domestic carbon materials and their properties are expounded in detail. As a supplement to the basic properties some data on neutron radiation of these materials are quoted.

The monograph by S.T. Konobiyevskiy "Deystviye oblucheniya na materialy" ("Effect of Radiation on Materials") (1965), devoted to problems of radiation materials science, considers atomic collisions under the action of radiation of various kinds and the structure defects of crystalline bodies arising in them and their connection with the properties of reactor materials. However, only a few pages are given to graphite. The book by B. Kelly "Radiation Damage in Solid Bodies" (1970), published later in Russian, expounds in detail the theory of a displacement cascade and considers the results of direct observations of radiation defects. However, problems related to the effect of radiation on materials are considered only with respect to the connection of radiation defects with the change of various properties of those materials.

The aim of the proposed book is systematization of the results of studies on the effect of radiation on the properties of graphite, description of the formation of properties of domestic graphite structural materials in the process of their production and of the interrelation of these properties with the behavior of graphite under radiation in a reactor. In order to detect these or other regularities, extensive use was made of model materials; the investigated properties were altered in them during the process of their production in a regular way. The published data on the construction and durability of graphite brickwork are generalized in this book. Together with this, various constructions of ampule devices are described as well as methods of graphite irradiation employed in investigations in this country.

In writing this book the authors, having generalized the results of both domestic and foreign research on graphite, have proposed methods to allow estimating by calculation the radiative changes of some properties of reactor graphite. Much attention has been given to the influence of porosity and degree of perfection of the crystal structure of the graphite materials (mainly of domestic production) on their physical and mechanical properties both in their original state and after radiation.

The list of the literature used in this work is not exhaustive because the authors did not consider it necessary to give a full review of all published work.

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PUBLICATIONS

ELECTRO- AND MAGNETOOPTICS OF LIQUID CRYSTALS

Moscow ELEKTRO- I MAGNITOOPTIKA ZHIDKIKH KRISTALLOV in Russian 1978 signed to press 30 Jan 78 pp 1-4, 7-11

[Annotation, table of contents, preface and introduction from book by L. M. Blinov, Izdatel'stvo "Nauka", 4,000 copies, 384 pp]

[Text] This book is a thorough general treatment of practically all known phenomena occurring in liquid crystals under the influence of electric and magnetic fields. The first part of the book (Chapters 1-3) is an introduction to the physics of liquid crystals. In the second part (Chapters 4-8) is a detailed discussion of orientational and electrohydrodynamic effects in the nematic phases and structural transformations and instability in cholesteric and smectic crystals. The main stress has been laid upon giving the qualitative picture and laying bare the physical significance of the phenomena. Prospects for practical application of electrooptical effects are also discussed.

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Foreword

The number of publications dealing with investigation of liquid crystals is increasing rapidly. According to figures from the LOCUS publishing house, which produces the special journal LIQUID CRYSTAL ABSTRACTS, in 1968 about 180 works were published, while in 1975 abstracts of 800 articles and patents appeared in the same journal. The number of publications dealing with electro- and magnetooptical properties of liquid crystals is increasing proportionately or even somewhat faster (the total number as of 1976 was about 500). But to date there have been no books on the subject either in the USSR or abroad, although individual chapters of the books by A. P. Kapustin and I. G. Chistyakov have dealt with some electro- and magnetooptical phenomena. The need for such a book is currently making itself rather strongly felt, since electrooptical effects in liquid crystals have begun to find extensive application in engineering, and the number of scientists and engineers engaged in electronics who have become interested in the subject has increased sharply.

This book is intended to be a significantly expanded version of a previously published survey and is based on a course of lectures on electrical and optical properties of liquid crystals given by the author in 1975 to members of the Scientific Research Institute of Organic Intermediates and Dyes. Although there is a view that "a book presents" and "a textbook explains," in this book an attempt has been made to provide a clear description of the phenomena along with an explanation of their physical essence. In addition the author has striven to keep in view the quantitative aspect of the subject, basing himself of the theoretical approach of de Gennes' book. Thus the book's purpose is to systematize experimental and theoretical data on electro- and magnetooptical phenomena in liquid crystals and to elucidate these phenomena from a unified physical viewpoint.

The book consists of two parts. In the first (introductory) part, the physical bases of the molecular-statistical and continuum theory of liquid crystals, which have been dealt with very scantily in this country's literature, are described without the use of mathematical formulations. The second part deals with the electro- and magnetooptical effects themselves. Their interpretation makes use of the theoretical outline given in the introductory part. The author has tried to give a relatively full bibliography only in the second part of the book; in the first part he has noted only the most fundamental works which will aid in gaining an understanding of the physical importance of the phenomena. This book is intended for a wide range of scientific personnel: experimental physicists, electronics engineers and chemical physicists. University instructors and students specializing in the physics of dielectrics and crystals may also find sections of it useful. Some information on liquid crystal substances of a reference nature may be of interest to theoretical physicists as well.

Virtually all the material in the book relates to thermotropic liquid crystals, since electro- and magnetooptical lyotropic mesophases have not yet been treated as a self-standing subject. The description of nematic and cholesteric substances goes into considerable detail, since heretofore smectic liquid crystals have not formed part of the author's field of interest. This is, of course, a shortcoming in the book, and assuredly not the only one. The author will be extremely grateful for critical observations, which will unquestionably be of use in his further work.

The author expresses his deep gratitude to his colleagues working in the electrooptical of liquid crystals: M. I. Barnik, Ye. I. Balabanov, S. V. Belyayev, M. F. Grebenkin, I. N. Kompanets, V. G. Rumyantsev, S. A. Pikin, V. G. Chirinov and V. M. Popin, Ye. I. Kovshev and V. V. Titov, in discussions with whom he has been able to delve into many physical and chemical questions, and also to V. A. Kizel' for valuable advice.

Introduction

Liquid crystals are liquids in which there occurs a certain orderly disposition of molecules resulting in an anisotropy of mechanical, electric, magnetic and optical properties. Even though liquid crystals (mesophases) unite the properties of the solid phase and isotropic liquids, the electro- and magnetooptical phenomena in them are largely unique, having as a rule no parallels in the solid or isotropic phases.

On one hand, all effects typical of dielectric liquids occur in liquid crystals (e.g. the Kerr effect, electrohydrodynamic instability and so on). At the same time, a number of effects typical of the solid state are not observable in liquid crystals. This is particularly true of effects resulting from the injection and movement of charge carriers, the presence of unpaired electrons, special types of symmetry (e.g. the Pockels effect) and the like. Liquid crystals are diamegnetic and accordingly all currently-known magnetooptical phenomena in them have their corresponding electrooptical analogs. In general terms, electrooptics of liquid crystals is more extensive than their magnetooptics, for two reasons. First, the molecules have permanent electric dipoles but lack magnetic dipoles, and accordingly also lack the possibility of investions of dielectric anisotropy resulting from changes in the proportion of orientational polarization and other effects resulting from dipoles, e.g. the flexoelectric effect, the segnetoelectric effect and so on. Secondly, a number of electrooptical effects result from the passage of current (electrohydrodynamic instability), and these phenomena lack magnetic analogs. Nonetheless, we have not wished in our title to refer exclusively to electrooptics, since many experimental and theoretical results have been obtained for the action of a magnetic field on mesophases (although hereafter we will sometimes speak of electrooptics alone for the sake of brevity, while noting the existence of magnetic analogs).

The preponderance of electro- and magnetooptical effects typical of liquid crystals involve reorientation of the director (the primary axis of orientation of the molecules) of a macroscopic quantity of the substance under a field or in liquid flow. The root cause of this reorientation is the anisotropy of the electric and magnetic properties of the substance (dielectric and diamagnetic susceptibility, electrical conductivity), but the course of the process depends also on anisotropy of viscoelastic properties and the initial orientation of the molecules of the mesophase relative to the field. The result of the reorientation is a change in the optical properties of the substance, still as a result of its optical anisotropy. This process of reorientation of the director (localized or throughout the sample) may be traced in literally all electro- and magnetooptical effects. Examples are: the Frederiks transition; dynamic scattering, where the local reorientation of the director results from turbulent motion of the liquid; and cholesteric-nematic phase change in a magnetic field, where the director is reoriented during uncoiling of the cholesteric spiral; wave instabilities of an A-type smectic with space-periodic changes in the director in a layer of the substance, and so on. The basic process of reorientation of the director on the one hand occasions all the unusual behavior of liquid crystals in external fields, and on the other clearly justifies a continuum approach to the theoretical discussion of the phenomena in question.

The study of magneto- and electrooptical liquid crystals has a long history, in which two stages of unequal length can be traced. Starting with work performed by Bjornstahl in 1918, and continuing until 1968-1970, there was a slow process of collection of experimental data, although in the course of it most of the effects known today were discovered (reorientation in a magnetic field; scattering of light, accordingly described as "dynamic"; formation of domain structures; the effect of a field on the smectic and cholesteric mesophases and the like). During this stage a great contribution was made by the Soviet school of scientists: V. K. Frederiks, V. N. Tsvetkov and A. P. Kapustin.

During the 70's, the prospect of extensive practical employment of liquid crystals in information display devices led to the synthesis of a number of new classes of substances with mesophase intervals at room temperature. The same period also saw heightened interest in liquid crystals on the part of theoretical physicists who had perviously been concerned with the solid state. Thanks to the work of P. de Gennes, V. Helfrich, S. A. Pikin and others, a profound understanding of the mechanism of a large number of electrooptical effects has been achieved. The experimental work in this period typically entails precise fixing of experimental conditions such as the type of external influence, strict determination of molecule orientation of liquid monocrystals, independent structural determination and measurement of the basic physical parameters of the substances that determine their electrooptical behavior and so on. As a result, we may state that the physics of most electro- and magnetooptical phenomena in nematic and cholesteric liquid crystals has been rather fully worked out (although this cannot yet be said of various smectic mesophases). Moreover, electro- and magnetooptical experiments have formed the basis of a number of precision methods for determination of physical parameters of matter such as the coefficients of elasticity and viscosity, optical anisotropy, the piezooptic coefficient and the like. All of these achievements have made the electro- and magnetooptics of liquid crystals an independent, extremely interesting and practically useful area of the physics of the condensed state of matter.

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PUBLICATIONS

UDC: 621.385.6+621.375.8(075.8)

ELECTRONIC MICROWAVE AND QUANTUM INSTRUMENTS

Moscow ELEKTRONNYYE PRIBORY SVCH I KVANTOVYYE PRIBORY in Russian 1979 signed to press 28 Nov 78, pp 2, 283-285

[Annotation and table of contents from the book by N. D. Fedorov, Atomizdat, 9,300 copies, 285 pages]

[Text] Annotation

This book presents the physical principles of electronic microwave instruments and quantum microwave and optical devices. The principles of operation, basic characteristics and parameters of flight path and reflecting drift and reflex klystrons, traveling and back wave tubes, magnetron-type devices, semiconductor microwave devices, quantum paramagnetic amplifiers (masers), quantum frequency standards and lasers are analyzed.

The textbook is designed for university-level electrical engineering students.

Figures 200; Tables 12; References 27.

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6508
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PUBLICATIONS

UDC 621.383.4

PHOTORESISTORS AND THEIR APPLICATION

Leningrad FOTOREZISTORY I IKH PRIMENENIYE in Russian 1978, signed to press 6 May 78 pp 2, 144

[Annotation and Table of Contents from the book by E.O. Bogdanov, Energiya Publishers, 15,000 copies, 144 pages]

[Text] The physics of the photoconductivity process in photoresistors is briefly presented in the book, and their basic characteristics are treated. Methods of designing electrical circuits are presented, many of which have not been considered previously in technical literature. Circuits and designs of devices which are both in service and described in the literature for the first time are widely represented.

The book is designed for a wide circle of engineering and technical workers, engaged in the design and use of various devices, in which photoresistors are employed, and it can be useful to instructors, and graduate and undergraduate students of the higher educational institutes.

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PUBLICATIONS

UDC 621.382(075)

MICROELECTRONICS: DESIGN, TYPES OF MICROCIRCUITS, NEW DIRECTIONS

Moscow MIKROELEKTRONIKA. PROYEKTIROVANIYE, VIDY MIKROSKHEM, NOVYYE NAPRAVLENIYA in Russian 1978, signed to press 3 Jul 78 pp 3, 311-312

[Annotation and Table of Contents from the book by I.Ye. Yefimov, Yu.I. Gorbunov and I.Ya. Kozyr', Vysshaya Shkola Publishers, 25,000 copies, 312 pages]

[Text] The handbook is the second part of the book "Mikroelektronika (Fizicheskiye I Tekhnologiskiye Osnovy, Nadezhnost')" ["Microelectronics (Physical and Technological Fundamentals, Reliability)"], published by "Vysshaya Shkola" Publishers in 1977. Questions of the design of bipolar and MOS integrated circuits, hybrid integrated circuits and large-scale integrated circuits, as well as the basic types of integrated circuits and new developmental trends in microelectronics are treated in it.

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PUBLICATIONS

UDC 621.049.73.75:001.2(024)

METHODS OF PARTITIONING RADIOELECTRONIC EQUIPMENT CIRCUITS INTO STRUCTURALLY COMPLETE SECTIONS

Moscow METODY RAZBIYENIYA SKHEM REA NA KONSTRUKTIVNO ZAKONCHENNYE CHASTI in Russian 1978, signed to press 20 Feb pp 2, 134

[Annotation and Table of Contents from the book edited by K.K. Morozov, Sovetskoye Radio Publishers, 11,500 copies. 136 pages]

[Text] Three groups of methods of partitioning the electrical circuitry of radioelectronic equipment are treated in this work, where the mathematical modle of the equipment circuit is represented as a graph. Belonging to the first group are sequential methods, in the utilization of which each structurally complete section is formed by means of sequentially selecting acceptable lower level components. Iteration methods are combined in the second group. All the sections are formed simultaneously, while optimization is assured through the rearrangement of the components. The random designation procedure belongs in this group. The method of branches and bounds is the basis for the third group of methods. It is demonstrated that this method permits a precise solution of the problem of partitioning the electrical circuitry of radioelectronic equipment into structural sections.

The book is intended for radio design engineers and specialists engaged in problems of radioelectronic equipment design using computers. It can be useful to students in the advanced courses of radio engineering specialists.

Some 7 tables, 56 figures, and 41 bibliographic citations.

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LIST OF SOVIET ARTICLES DEALING WITH COMPOSITE MATERIALS NO 1, 1979

Moscow GOSUDARSTVENNYY KOMITET SOVETA MINISTROV SSSR PO NAUKE I TEKHNIKE. AKADEMIYA NAUK SSSR. SIGNAL'NAYA INFORMATSIYA. KOMPOZITSIONNYYE MATERIALY in Russian Vol 4, No 1, 1979 pp 1-7

[Following is a list of the Soviet entries from SIGNAL'NAYA INFORMATSIYA. KOMPOZITSIONNYYE MATERIALY (SIGNAL INFORMATION. COMPOSITE MATERIALS), a bibliographic publication of VINITI. This listing is from Vol 4, No 1, 1979]

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CSO: 1870

PUBLICATIONS

LIST OF SOVIET ARTICLES DEALING WITH COMPOSITE MATERIALS NO 2, 1979

Moscow GOSUDARSTVENNYY KOMITET SOVETA MINISTROV SSSR PO NAUKE I TEKHNIKE. AKADEMIYA NAUK SSSR. SIGNAL'NAYA INFORMATSIYA. KOMPOZITSIONNYYE MATERIALY in Russian, Vol 4, No 2, 1979, pp 1-11

[Following is a list of the Soviet entries from SIGNAL'NAYA INFORMATSIYA. KOMPOZITSIONNYYE MATERIALY (SIGNAL INFORMATION. COMPOSITE MATERIALS), a bibliographic publication of VINITI. This listing is from Vol 4, No 1, 1979]

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[Following is a listing of the Soviet entries from SIGNAL'NAYA INFORMATSIYA. KOMPOZITSIONNYYE MATERIALY (SIGNAL INFORMATION. COMPOSITE MATERIALS), a bibliographic publication of VINITI. This catalog is from Vol 4, No 3, 1979]

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