SOVRAD

CONTENTS

informatics inc

Information Systems Company
6000 Executive Boulevard
Rockville, Maryland 20852
(301) 770-3000

REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS
BEFORE COMPLETING FORM

1. REPORT NUMBER	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
	and	

4. TITLE (and Subtitle)
SOVRaD - A Digest of Recent Soviet R&D Articles, Vol. 2, no. 6, 1976

Volume   Number

5. TYPE OF REPORT & PERIOD COVERED
Scientific . . . Interim rept.

6. PERFORMING ORG. REPORT NUMBER

7. AUTHOR(s)
Hibben, L. Boylan, J. Kourilo
Stuart G.

8. CONTRACT OR GRANT NUMBER(s)
0254
MDA-903-76C-0245

9. PERFORMING ORGANIZATION NAME AND ADDRESS
Informatics Inc.
6000 Executive Boulevard
Rockville, Maryland 20852

10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
DARPA Order No. 3097,
Amdt. 1. Program Code No.
6L10, Prog. El. Code 62711E

11. CONTROLLING OFFICE NAME AND ADDRESS
Defense Advance Research projects Agency/TAO
1400 Wilson Boulevard
Arlington, Virginia 22209

12. REPORT DATE
June 1976

13. NUMBER OF PAGES
15

14. MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office)
Defense Supply Service - Washington
Room 1D245, Pentagon
Washington, D.C. 20310

15. SECURITY CLASS. (of this report)
UNCLASSIFIED

15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; distribution unlimited.

(15) MDA903-76-C-0254, // DARPA Order - 3097

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

D D C
RECEIVED
AUG 25 1976
B

18. SUPPLEMENTARY NOTES

Scientific . . . Interim

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Hydrodynamics	Oceanography	Dolphin Swim Dynamics
Atmospheric Physics	Energy Conversion	Superconductivity
Optical Sensors	Laser Optics	E-Beam Discharge
Laser Isotope Separation	Fusion Technology	Turbulent Boundary Layer

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This is a collection of brief abstracts on miscellaneous topics from the current Soviet technical literature. The intent is to supply a quick look at items of possible interest, including topics not necessarily named in the DARPA interest profile, as a supplement to our reportage on specified topics.

It is intended to publish this collection on a monthly basis, to continue to provide prompt coverage of numerous aspects of Soviet R & D.

DD FORM 1473 EDITION OF 1 NOV 65 IS OBSOLETE
1 JAN 73

UNCLASSIFIED 387113

INTRODUCTION

This is a collection of brief abstracts on miscellaneous topics from the current Soviet technical literature. The intent is to supply a quick look at items of possible interest, including topics not necessarily named in the DARPA interest profile, as a supplement to our reportage on specified topics.

It is intended to publish this collection on a monthly basis, to continue to provide prompt coverage of numerous aspects of Soviet R & D. As an added feature, all recently acquired books will be listed as they are received. A list of source abbreviations is appended.

For further information the reader is invited to call Stuart Hibben or Lee Boylan at Informatics on (301)-770-3000.

Laser-Powered Rocket Model (abstract)

A miniature model of the laser-driven rocket predicted by Barchukov et al. (SOVRaD, 3/76, p. 4) is reported having been tested, according to a recent newspaper article. The model evidently was designed along the lines suggested, with a rear-mounted antenna to focus a ground-based laser beam, generating a repeated optical spark which delivers a forward thrust to the antenna and vehicle. A filmed launch sequence was shown of a three gram model, which accelerated at a rate requiring a film speed on the order of 1000 frames/sec to adequately observe the launch.

Commenting on the possibilities, V. I. Konov, one of the developers, notes that calculations show that with this method a rocket of several hundred kg could attain primary cosmic velocity in a few seconds, since it would not be burdened with fuel. The lack of laser power is the present obstacle, but Konov asserts that this is a matter of scaling up present laser technology. [Lomanov, G. "Exploding" air. Sotsialisticheskaya industriya, 18 July 1976, p. 4].

High-Power CO_2 Laser Radiation Effect in SF_6 (abstract)

More tests on laser separation of SF_6 isotopes are reported by Basov's group at FIAN. Measurements of pulsed $CO2$ laser energy absorbed in an isotopic mixture of $^{32}SF_6$ with 4% $^{34}SF_6$ revealed that, with high-powered (1.7 to 9×10^6 w/cm^2) incident radiation and pulse duration (3 μsec) much longer than v-t relaxation time, the resonance absorption peak frequency shifts toward a lower value in relation to the peak in $^{32}SF_6$ irradiated with low-power pulses.

The authors discuss the different absorption behavior for selected frequencies as well as for differing incident power levels, and present graphical results. They note a discrepancy between their finding on the optimum frequency for ^{32}S separation, and the value determined recently by Letokhov's group (ZhETF P, 23, 26, 1976). [Basov, N. G., V. T. Galochkin, A. N. Orayevskiy, and N. F. Starodubtsev. Characteristics of SF_6 absorption spectra under high-power IR radiation. ZhETF P, v. 23, no. 10, 1976, 569-574].

Tests With 9-Beam Laser Fusion Systems (abstract)

Continued tests with the "Kal'mar" nine-beam laser system at FIAN are described. The object was to observe the heating and compression dynamics of various evacuated microspheres, including SiO_2, Al_2O_3 and polystyrene specimens with 50-200 microns radii and wall thickness from 1.5 to 7 microns. The usual Nd glass system was used, but with a YAG control laser, resulting in a generated line-width on the order of 10A. Relatively long pulses, on the order of nanoseconds, were used at incident energies up to 100j and power densities to 10^{13} w/cm^2.

The test consisted principally of recording x-radiation from the exposed target surface, which revealed the effects of non-sphericity and nonuniform pellet wall thickness. In addition, a densitometry technique was used which registered a bright center as well as a bright outer shell or halo around the exposed microsphere. The authors note that in contrast to the results using picosecond pulses, in this case the outer bright shell was larger than the initial microsphere diameter; the same was observed for filled microspheres. [Basov, N. G., A. A. Kologrivov et al. <u>Observing the compression of hollow microspheres under laser irradiation.</u> ZhETF P, v. 23, no. 8, 1976, 474-477].

Focusing Optics For Laser Fusion (abstract)

A highly precise technique is described for focusing multiple laser beams on a fusion target. The system uses planar or spherical simulated targets for adjusting the optical elements, and an auto-collimator for visual monitoring. The theoretical focusing precision of this system is given as 0.88 micron; tests show the actual value to be about 2 microns. Two variants of the arrangement are shown schematically and are cited for their adjustment accuracy and stability. [Mak, A. A., A. D. Starikov, and V. G. Tuzov. <u>Direction and focusing of powerful optical beams on the surface of small targets.</u> OMP, no. 1, 1976, 42-44].

Ion Beams Proposed For Fusion (abstract)

An argument is offered for using high-power ion beams as the energy transfer mechanism for achieving thermonuclear fusion. The authors note that in theory the ion beam technique should combine the advantages of the laser (short relaxation interval, possibility of superdense compression) with those of the e-beam (higher efficiency in beam generation and in target heating). The problem is attacked with the general requirement of delivering on the order of 10^8 joules to a target of less than 1 cm^3 in the order of a nanosecond.

The main obstacle is admittedly the lack of a powerful enough ion beam; however densities up to 10^3 a/cm^2 at energies of 1-10 Mev are foreseeable, which by implication should be adequate.

The authors develop a theoretical model for an ion beam system which would deliver 10^8j to a 1 cm dia D-T target in 5 nsec. This presumes a spherical surrounding shell of needle-form field emitters, with the target at the shell's center. Calculations show that for a shell radius of 500 cm and using potassium ions, a current density of 30 a/cm^2 should prove sufficient. While many operational details are omitted, the authors nevertheless conclude that rapid developments in ion beam technology make the proposed method increasingly attractive for CTR. [Ivanov, B. I., A. A. Kalmykov, and O. A. Lavrent'yev. <u>On the feasibility of initiating a pulsed thermonuclear reaction by heavy-current ion beams.</u> ZhTF P, v. 2, no. 3, 1976, 129-133].

High-Luminance Far-Ultraviolet Source (abstract)

The use of quasistationary hypersonic fluxes of radiant plasma is proposed for generating vacuum far-ultraviolet radiation. Theoretically, shielding of short-wave radiation, e.g., by cold plasma or metal vapors, cannot occur in such a source as hypersonic plasma flow, even in a quasistationary operational mode. The erosion-type magnetized plasma compressor [accelerator], described by Rozlov et al. elsewhere (ZhTF, v. 43, no. 4, 1973, 740) is offered as an efficient and readily controllable source of high-power hypersonic fluxes of dense plasma.

Experiments with an erosion plasma compressor were designed to determine the effect of vacuum UV radiation shielding by the plasma. The test data indicate that a high utilization factor of the working medium (teflon, Cd vapors), avoiding the shielding effect, was obtained by optimizing either the geometry of the discharge gap or the technique of plasma-forming material feed. The efficiency of the erosion-type plasma compressor was thus demonstrated in generating unshielded high-power vacuum UV radiation with 3 to 8 eV luminance temperature in the 12 to 10 eV range of quantum energy. Such radiation could be used for photoionization of inner shell electrons with population inversion, gas ionization in photoionization lasers, etc. [Kamrukov, A. S., G. N. Kashnikov, N. P. Kozlov, V. A. Malashchenko, V. K. Orlov and Yu. S. Protasov. Possible development of high-luminance source of far-ultraviolet radiation, based on hypersonic dense plasma fluxes. ZhTF P, v. 2, no. 10, 1976, 447-450].

Possible Mechanism of Coherent X-ray Emission (abstract)

The possibility is predicted of coherent x-ray emission from charged particle penetration through a single crystal. This possibility arises from consideration of the quasi-Cerenkov radiation caused by periodic nonuniformity of the index of refraction in a crystal. Analysis of the semi-classical field equation in a medium leads to the conclusion that it is always possible to achieve emission at an angle $\theta = 0$ deg. and a frequency ω corresponding to the characteristic susceptibility line by selecting an adequate orientation of the crystal. The authors show that intensity of the characteristic quasi-Cerenkov radiation may be increased by an estimated minimum of two orders of magnitude, by combining the particle channeling effect with the effect of anomalous transmission of x-rays. The characteristic quasi-Cerenkov radiation is excited by self-pumping, i.e., exitation of the atoms closest to a transiting particle and simultaneous quasi-Cerenkov radiation from excited atoms. [Akhmanov, S. A. and B. A. Grishanin. Coherent radiation of characteristic lines during charged particle penetration through a single crystal. ZhETF P, v. 23, no. 10, 1976, 562-565].

Optical Information Recorder (abstract)

An optical imager is introduced, consisting of a bismuth silicate ($Bi_{12}SiO_{20}$) crystal-based multilayer system with dielectric mirror coating. The dichroic mirror permits image recording and readout from different crystal faces. The mirror reflects 99.5 % of the readout beam (at $\lambda = 0.63\,\mu$) and transmits the recording beam (at $\lambda = 0.44\,\mu$) from a mercury lamp. The device is excited with 10 μsec to 1 sec. voltage pulses. The readout beam is oriented perpendicularly to a crystal surface, thus minimizing image distortion. Typical recorded images are shown.

The maximum visible spatial frequency of the object is on the order of 15 to 20 lines/mm. At higher frequencies the image contrast is insufficient, mainly because of photo-induced birefringence at the readout wavelength. The frequency-contrast characteristic of the device could be enhanced, if a $Bi_{12}SiO_{20}$ crystal with highly selective photosensitivity can be obtained, or the quality of dielectric layer is improved, i.e., its resistance increased or the current-voltage characteristic made linear in a strong electric field. [Berezhnoy, A. A., V. Z. Gurevich, S. V. Morozov and Yu. V. Popov. Optical information recording on bismuth silicate crystal. ZhTF P, no. 5, 1976, 198-200].

Measuring Multielectronic Scintillations in an Image Converter (abstract)

Photoelectric recording of the number and brightness of multielectronic scintillations, the characteristics of an image converter, requires measurement of a single-electron spectral distribution. This measurement, however, is impractical for many converters, or requires the use of complex instrumentation. Hence the method of comparative measurement of the converter characteristics is introduced, which bypasses measurement of single-electronic distribution of scintillations.

The proposed method consists of 1) measuring amplitude spectra of multielectronic scintillations from dark and background-illuminated photocathodes of an image converter; 2) evaluating scintillation amplitude in terms of the number of electrons emitted from the input photocathode; and 3) evaluating the average single-electron distribution of scintillations from recordings of the number of scintillations with arbitrary amplitude. Discrepancy between the single-electron distribution value determined by the cited simplified procedure, and that determined from photo flash was $\pm 15\%$. [Melamid, A. Ye., T. A. Arkhipova, G. Z. Kuptsova and A. M. Potapov. Method and instrumentation for measuring number and brightness of multielectronic scintillations in an image converter. PTE, no. 6, 1975, 191-196].

Award for Explosive Emission Research (abstract)

Ten years after th theoretical basis of explosive field emission was advanced by Soviet scientists, the USSR has formally

credited a Soviet research team with discovery of the phenomenon. The long delay is ascribed in part to the fact that more refined imaging and current monitoring techniques had to be simultaneously developed in order to observe the explosive emission action in sufficient detail.

A recent newspaper interview with two members of the team describes the collaborative effort among Leningrad State University, Tomsk Institute of Atmospheric Optics and other facilities in advancing this research. The Soviets claim the effects involved are unique enough to justify a new name, for which they suggest "heavy current electronics." In a brief description of the physical effects, it is noted that repeated pulses on the order of megamperes can be pulled off a needle cathode before it is depleted; liquid metals or semiconductors could also serve as cathodes.

Present uses of explosive emission include thermonuclear research, electron accelerators, high power gas lasers and other applications. The researchers foresee further application in a wide range, including communications, metal processing, defectoscopy and medicine. [Kushtapin, M. Explosion generates electrons. Leningradskaya pravda, 11 July 1976, p. 2].

High-Conductivity Pyrolytic Film Coatings (abstract)

Thermally stable mirror-like film coatings with a high electric conductivity (0.003 to 0.07 ohm x cm) were deposited on a quartz or metallic substrate, using vacuum pyrolysis at 800 to 900°C of a series of conjugated polymers including poly[naphthoylene-bis(benzimidazole)], polyphenylene, and poly(azophenylene). The 0.5 to 2.2 nm thick films were stable at 1000°C in vacuum and up to 500°C in air blowing at 300 m/sec. Thickness and ρ(in the -196 to +100° range) of the films deposited under stated conditions are only weakly dependent on temperature. The films deposited at a lower temperature (400 to 500°C) from conjugated oligomers, e. g., poly(phenylacetylene), poly(ethynylpyridine) vapors exhibited semiconducting characteristics. The films are shown to be highly-ordered polycrystalline structures composed of condensed aromatic ring systems with 93 to 99% C. [Liogon'kiy, B. I., G. M. Shamrayev, A. A. Dulov and A. A. Berlin. Obtaining electrically-conductive film coatings by vacuum pyrolysis of conjugated polymers. VS, Kr. Soob., no. 1, 1976, 58-62].

Boundary Layer Control by Suction (abstract)

The feasibility of laminarization of a turbulent boundary layer by distributed suction of water was studied experimentally on a towed body of revolution of streamline shape. Water from the boundary layer was sucked through a porous surface on the central cylindrical part of the body. The experimental setup and procedures are described.

The turbulence vs. towing speed plots indicate that transition from laminar to turbulent flow with suction occurs at a towing

speed about 5 to 18 . . . s higher that without suction, depending on the water discharge coe..._..ent (0.6×10^{-4} to 3×10^{-3}). Suction of even a small water quantity is shown to significantly decrease (by 10 to 30 db) the spectral levels of turbulent fluctuation velocity over a 6 to 500 Hz frequency range. [Kozlov, L. F. and A. I. Tsyganyuk. <u>Fluctuating velocity and its spectral levels in a boundary layer with suction</u>. IN: Sb. Gidromekhanika, no. 31, 1975, 21-25].

Approximate Method for Determining Flow Velocity and Friction in a Boundary Layer (abstract)

Approximate analytical expressions are obtained for the profiles of turbulent friction and turbulent velocity in a boundary layer, without taking into account the viscous sublayer. The theoretical profiles are plotted for different x values (not identified), together with the experimental data of Schubauer and Klebanoff (NASA Rep. 1030, 1951). The comparison made for the sections between the pre-separation and gradientless region confirms the validity of the derived theoretical expressions for solving the problem of a turbulent boundary layer. [Movchan, V. T., <u>Approximate calculation of the friction and velocity profiles in turbulent flow with positive pressure gradient</u>. IN: Sb. Gidromekhanika, no. 31, 1975, 25-28].

Deformation Theory of Artificial Muscles (abstract)

A dynamic theory for deformation of contractile polymers, or so-called pH artificial muscles, is advanced as a step toward development of a dynamic muscular prosthesis. Only polymers which are capable of directly converting chemical to mechanical energy via osmosis are considered. The conversion occurs under isothermal conditions.

The osmosis process is described for a flat cell model formed by two semi-permeable membranes and immersed in a solvent. The cell volume is assumed to remain unchanged under deformation, and the membranes to be permeable to smaller polymer molecules only. Using Fick's equation and the nonequilibrium thermodynamic equation, the author derives the equation for osmotic pressure π as a function of the polymer molecule concentrations in the cell and of concentration of the membrane-penetrating molecules in the ambient liquid. This equation is modified for an electrolyte to take into account the polarity of the membrane-penetrating ions.

Using the modified π equation and the Voigt-Kelvin model of a viscoelastic medium, the author describes longitudinal deformation of a pH thin film or fiber under the idling condition, i.e., in the absence of an applied mechanical force. This is done by an equation which takes into account changes in cell volume and solvent filtration into the cell. This equation shows that deformation rate depends on the osmotic and rheological time constants. The former can be decreased by decreasing film thickness; the latter cannot. Hence, polymer viscosity and solvent filtration viscosity are the factors limiting the deformation rate of thin pH structures, whereas only the osmotic constant is the limiting factor for thick rod-type structures.

It is emphasized that such pH artificial structures do not have all the characteristics of live tissue, although they are the closest models of the live prototype. Also, they are not expected to compete with thermal energy converters in regard to specific power. [Belyakov, R. V. Linear deformation theory for elastic-osmotic polymer structures (artificial muscles). Bionika, no. 9, 1975, 12-20].

Dolphin Swimming Stereophotogrammetry (abstract)

Stereophotograms of successive phases of dolphin body motion in a ring basin were obtained, and were used to compute kinematic characteristics of dolphin swimming. The experimental procedure is described in detail. The high accuracy and completeness of the characteristics determination are cited as the main advantages of stereofotogrammetry over cinematographic techniques.

In experiments with trained bottle-nosed dolphins and a common porpoise, space coordinates of the dolphins' trajectory points, their speed and angular characteristics were determined with ± 2 mm, ± 1 to 2% and ± 0.25 to 0.5 degree r.m.s. errors, respectively. Typical experimental plots of the speed and acceleration components vs. time are shown for the common porpoise in an accelerating motion. The data show the potential usefulness of stereophotography for kinematic study of swimming of sea mammals. [Dubravin, A. P. and L. F. Kozlov. Application of stereophotography to the study of swimming kinematics of dolphins. Bionika, no. 9, 1975, 33-36].

Stable Spark Gap for High-Power Pulsers (abstract)

Development is described of gas-filled spark gaps with a high breakdown resistance during charging, for use in high-power ($I_{max} > 10^4$A) pulse dischargers. Various electrode (steel, VNM and VNZh tungsten alloys, graphite, tantalum) and frame (lucite, "kaprolon") materials as well as air, technical grade and high-purity N_2, and CO_2 ambients were tested for their effect on breakdown voltage and its standard deviation. Testing was done in an L-C circuit at 100 kV capacitor voltage and in a two-stage pulser with tantalum electrodes.

At a slow ($\sim$1kV/sec) charge rate, the most stable breakdown without conditioning was obtained with Ta and VNZh electrodes in CO_2. A sharp deterioration in the breakdown stability was observed in the two-stage pulser, when an overvoltage pulse was applied across the gap. A significant increase in gap reliability was obtained by increasing the diameter of the discharge chamber. Instability in breakdown of the gas-filled gap is explained by thermal erosion of the electrodes and deposits of chemical reaction products, e.g., TaN, on active electrode surfaces. [Zolotarev, E. I., V. D. Mukhin, L. Ye. Polyanskiy and V. N. Trapeznikov. Breakdown voltage stability in gas-filled spark gaps designed for use in voltage pulse generators. ZhTF, no. 3, 1976, 595-600].

High-Sensitivity Magnetometer With a Superconducting Shield (abstract)

A SQUID-type device combining measurement of absolute magnetic field value H_O with a high-sensitivity is described. The magnetometer is designed to study shielding by a superconducting shell, based on the magnetic field effect upon Zeeman sublevels of the Cs^{133} atom in the ground state. A Cs vapor-filled cell is enclosed in a superconducting thermal jacket composed of three lead envelopes with a hemispherical bottom. Sequential transition of the envelopes to the superconducting state is effected by a cooling system. An ultra-weak static field H_O is in resonance with the amplitude of the signal S from the atomic system, which is recorded by a photodetector. Thus, S is proportional to H_O, if the frequency $\alpha_O = \gamma H_O$ is less than half-width of the resonance line.

A sensitivity of 10^{-8} oe was attained in experiments. Absolute accuracy of measurement was of the same order. Using this equipment, the authors measured remanent magnetization along the superconducting shield axis down to 10cm distance from the bottom, versus only 33cm from the bottom, measured with a saturated-core magnetometer. [Andrianov, B. A., I. Ye. Grin'ko, A. F. Lukoshin, L. V. Sidorkina and V. I. Sheremet. Cesium quantum magnetometer with a superconducting shield. PTE, no. 1, 1976, 178-180].

Pulsed Excitation of the Ionosphere (abstract)

Early in 1975, scientists at IZMIRAN together with other cooperating activities began a series of tests on pulsed r-f excitation of the ionosphere and magnetosphere, under the code name Juliana Program. A preliminary report briefly describes some initial findings, and shows that a measurable excitation was in fact being induced. The transmitter frequency was 12.5 kHz, with bursts from 0.5 to 15 sec. generated, and with several seconds interval between pulses. Optical sensors to detect change in electron activity by sky brightness variation, as well as a specially designed magnetometer, were set up 200 km distant from the transmitter.

The tests, which were done at high geomagnetic latitude (60°), show a clear correlation of change in night sky luminance with transmitter pulses, as well as a pulsed variation in geomagnetic field peaking at about 16 mγ. Graphical results show non-random responses well outside the r.m.s. error of the measuring apparatus. Thus the test confirms the results of Fraser-Smith and Cole, who first reported enhancement of Pc-1 pulsation activity by ground excitation in 1975. The authors suggest further tests will be run to refine the present technique. [Chmyrev, V. M., V. K. Roldugin, et al. Artificial injection of VLF waves into the ionosphere and magnetosphere. ZhETF P, v. 23, no. 8, 1976, 452-455].

Review of Electromagnetic Fields in the Sea (abstract)

Soviet and Western research on electromagnetic

phenomena in water is reviewed. Characteristics of ocean waters which
may affect e-m fields are given, and methods for calculating fields
in water are described. Data on fields generated in electrically conducting
seawater in the presence of the terrestrial magnetic field are presented.
Various r-f systems based on e m fields in sea waters are described.

Chapter headings of the report are as follows:

I. Propagation of electromagnetic waves in seawater

    1. Brief description of water properties
    2. Propagation of harmonic e-m waves in water
       a. Homogeneous conductive medium
       b. Stratified medium
       c. Electromagnetic waves diffraction from
          conductive objects in water
       d. Magnetohydrodynamic waves in seawater

II. Noise from field recording in water and in under-
water electromagnetic systems

    1. Random e-m fields in seawater
       a. Noise of tropospheric and magnetospheric
          origin in seawater
       b. Hydrodynamic noise
       c. Electrical noise from a towed electric antenna
       d. Fields of galvanic type in water
       e. Industrial noises
    2. Electromagnetic systems in water
       a. Communication systems with underwater
          instruments
       b. Submarine navigation
       c. Underwater electrical exploration
       d. Underwater antennas

There are 265 references cited. [Akindinov, V. V., V. I. Naryshkin
and A. M. Ryazantsev. Electromagnetic fields in seawater (Review).
RiE, no. 5, 1976, 913-944].

Resume of Soviet Tokamak Program (abstract)

A useful review of recent results in the Soviet Tokamak program
is given in a recent issue of Fizika plazmy (Plasma Physics), together with
a schedule covering the next five years. The program is divided into five
general steps as follows:

       1. Scaling up of plasma parameters in existing con-
          figurations (T - 4, T - 10 and T - 20 designs).

2. Search for new configurations requiring lower input to the plasma (small T - 8 and T - 9 designs with non-circular plasma cross-section).

3. Limitation of impurity effects (T - 12, TO - 2, TM - 4, TB - 0).

4. Auxiliary heating and stabilization (TM - 3, Tuman - 2, T - 11, TF - 1, TM - 1 - VCh, TO - 1, Tuman - 3).

5. New magnetic systems design (T - 7).

Of the tokamaks cited, seven are presently in operation; these are the T-4, TM-3, T-9, TO-1, TF-1, Tm-1-VCh and Tuman-2. The rest are in various stages of design and development. Brief reviews of the operating machines are included.

The article cites the T-7 as the first to have superconducting windings, which will comprise 48 coils on an NbTi core. However the Soviets announced elsewhere this year that the present T-10 is to be redesigned with superconducting coils, and will be designated as T-10M.

[Mirnov, S. V., V.S. Mukhovatov, V. S. Strelkov and V. D. Shafranov. Review of the present tokamak program in the USSR. Fizika plazmy. no. 2, 1976, 348-360.]

First Measurements of Tokamak 10 Plasma (abstract)

Measurements of the fundamental plasma parameters are reported in the Tokamak T-10 device with major and minor torus radii of 150 and 39cm, respectively. The measurements were carried out after the startup in mid-1975 with a 35 koe pinch field intensity and discharge current up to 400 kA during a 1 sec maximum. The measurement techniques are given; both H and D plasmas were tested. The ion temperature at the plasma column axis was calculated to be lower than theoretical owing to the small difference between T_i and electron temperature T_e at a plasma density N above $4 \times 10^{\pm 3}$ cm^{-3}. In some experiments, plasma heating was supplemented by neutral beam injection. Plasma T_e = 1kev, plasma T_i = 0.7 kev and a neutron yield of 3×10^9 per discharge were achieved at a plasma density of 6×10^{13} cm^{-3}. Confinement time was evaluated to be about 80 msec, assuming a parabolic distribution of T_e, T_i and N_e.
[Berlizov, A.B., N.L. Vasin, V.P. Vinogradov, et al. First measurements of plasma parameters in the tokamak - 10 device. ZhETFP, v. 23, no. 9, 1976, 502-505.]

Electrochemical Power Generation (verbatim)

Three possible systems of hydrogen energy utilization are discussed: the so-called general "ecoenergy"; decomposition of hydrogen-containing products, including natural gas; and direct oxidation of hydrogen-containing products. Cost estimates indicate a definite advantage of electrochemical generator systems over the other cited power sources. It is anticipated that in the next 20 to 30 years, "ecoenergy" systems using hydrogen energy will be developed to satisfy engineering standards, and their cost will be substantially lowered. Thus a wide range of national economy problems will be solved. [Lidorenko, N. S. and G. F Muchnik. Electrochemistry and new methods of electric power generation. IN: Sb. XI Mendeleyevskiy s'yezd po obshchey i prikladnoy khimii. Moskva, no. 3, 1975, 327-330. (RZhKh 19L, 5/76, no. 5L293)].

Superconductivity in Power Generation (abstract)

A popular review of superconducting applications to power engineering summarizes some problems and trends in present Soviet studies. Emphasis is on superconducting power transmission, particularly in view of the vast distances between the generating regions in the west and consuming areas in the eastern USSR. The key factor is stated as refrigerant cost, which is a main impetus behind the search for high temperature superconducting materials. Thus the bulk of present superconductors require liquid helium; with new compounds having critical temperatures over 21K, one can shift to liquid hydrogen at great savings. The next quantum jump would be to superconductivity at 77K, at which point liquid nitrogen could be substituted, again giving an economy plus being safer to handle. Polymers and metal-dielectric sandwich structures are suggested among the promising candidates for high-temperature superconductivity.

A brief mention is made here of a superconducting d-c generator designed by a factory collective in Leningrad, which is claimed to achieve close to 100% efficiency. [Makovskiy, V. Horizons of superconductivity. Sovetskaya Rossiya, 14 July 1976, p. 2]

Millimeter Wave Receiver with Josephson Detector (abstract)

A theory is presented on an r-f receiver in which the response of the Josephson detector, operating in a self-selection mode, is taken at the intermediate frequency. The calculated form of the response to a monochromatic signal is close to that observed by the authors experimentally, as well as to the measurements of Fife et al. (J. Appl. Phys, 1972, 2391). Experiments were made with an 8mm band receiver using an IF if 25 MHz and Nb-Nb point contacts operating at 4.2K.

Results show that the cited receiver with proper selection of parameters will introduce practically no additional noise in signal processing, and could obtain a power threshold only two orders worse than the theoretical limit set by Likharev et al. (RiE, 1973, 2390, 2595) of 10^{-17} w/Hz$^{1/2}$. The experimentally achieved threshold of 10^{-13} w/Hz$^{1/2}$ at an input bandpass of 1 GHz could readily be improved by two orders. [Kulikov, V. A. and K. K. Likharev. R - f receiver with Josephson detector in a self-selection mode. IVUZ Radiofiz, no. 4, 1976, 543-556]

11

E-beam to Radio Wave Converter (abstract)

A converter identified as the ubitron is described, in which a curvilinear relativistic electron beam focused by a periodic magnetic field is used to generate high-power electromagnetic oscillations with a wavelength in the 3cm range. A heavy-current accelerator, described elsewhere, was used to produce a 700kV beam. A pulsed solenoid with a system of copper semi-rings generated a periodic magnetic field up to 2.5 koe. The wavelength of generated oscillations varies with the period of the focusing field according to the theoretical resonance condition, and independently of the field intensity.

The experimental output power P was a function of the periodic component $H_\perp$ of the magnetic field. The maximum P was 30 Mw which corresponds to 5% efficiency of the device. Thus the beam energy conversion factor was found to be higher than in some other devices based on induced bremsstrahlung of curvilinear e-beams, but is still lower than the theoretically predicted factor of several tens of percent. [Krementsov, S.I., M.D. Rayzer and A.V. Smorgonskiy. An ubitron generator using a relativistic electron beam. ZhTF P, v. 2, no. 10, 1976, 453-457].

E-Beam Discharge in Air (abstract)

Tests are described of heavy-current discharges in an air ambient, in which the radial distribution of temperature in the discharge plasma was monitored. It was observed that at currents on the order of 400 ka, with a rise time of 2×10^{11} a/sec, a nonequilibrium radial temperature distribution occurs, and the temperature profile undergoes a significant change with elapsed time. It is shown that when shock wave velocity reaches 2 to 3 km/sec and plasma temperature is within the range of $40\text{--}70 \times 10^3$ K, flow self-similarity is destroyed. In the region of maximum current, where the pinch effect is strongest, temperature at the discharge channel axis reaches 72,000K; the greatest temperature gradient in this case is observed near the half-radius point. A schematic of the discharge system is included. [Andreyev, S.I., S.N. Leonov, and R.A. Liukonen. Temperature distribution in a pulsed high-current discharge path in air. ZhTF, no. 5, 1976, 981-986]

Recent Publications

Akustika i ul'trazvukovaya tekhnika (Acoustics and ultrasonic technology).
No. 11. Kiyev, Izd-vo Tekhnika, 1976.

Demidov, V. P. Radioelektronika v voyennom dele (Electronics in
warfare). Moskva, Izd-vo DOSAAF, 1975, 141 p. (KL, 18/76, #14669)

Dubonosov, S. P. et. al. Lazernyye kanaly v kosmicheskoy svyazi
(Laser channels in space communication). Moskva, Znaniye, 1975, 64 p.
(KL, 6/76, #4543)

Fizika plazmy. Sbornik (Plasma physics. Collection of articles).
Metsniyereba, 1975, 196 p. (KL, 11/76, #8778)

Geomagnitnyye issledovaniya. Sbornik (Geomagnetic research. Collection
of articles). Moskva, Nauka, 1975, 186 p. (KL, 6/76, #4421)

Gorshkov, S. G. Morskaya moshch' gosudarstva (The state's naval
power). Moskva, Voyenizdat, 1976, 463 p. (RBL, 5-6/76, #1269)

Ivanov, A. P. Fizicheskiye osnovy gidrooptiki (Physical fundamentals
of hydrooptics). Minsk, Nauka i tekhnika, 1975, 503 p. (KL, 10/76,
7823)

Motulevich, V. P.,ed. Techeniye nizkotemperaturnoy plazmy i yeye
vzaimodeystviye so stenkami kanala; Sbornik (Low-temperature plasma
flow and its interaction with channel walls. Collection of articles).
Moskov. Energeticheskiy inst., Sbornik trudov, no. 26, 1974, 94 p.
(KL, 11/76, #9491)

Niculescu, D., I. Bradea, M. Popa, O. Ivanciu, and Ye. Cruceanu.
(Observing an increased T_c in a Re-Ga system). Phys. Letter, v. A55,
no. 4, 1975, 233-234 p. (RZh Metal, 6/76, #61251)

Registriruyushchiye sredy dlya golografii (Recording media for
holography). Leningrad, Nauka, 1975, 175 p. (RBL, 5-6/76, #917)

Ryabov, V. R. Primeneniye bimetallicheskikh i armirovannykh stale-
alyuminiyevykh soyedineniy (Application of bimetallic and fiber-reinforced
aluminum-steel compounds). 2nd ed. Moskva, Metallurgiya, 1975, 215 p.

Simpozium po fizike akustiko-gidrodinamicheskikh yavleniy. Sbornik
(Symposium on physics of acoustico-hydrodynamic phenomena. Collection
of articles). Sukhumi, 1975. Moskva, Nauka, 1975, 307 p. (KL, 8/76,
#6093)

Stolyarov, A. M. Sistemy i sredstva otobrazheniya informatsii (Methods and systems for information display). Ryazan, 1975. (KL, 6/76, #4568)

Sverkhprovodniki i ikh ispol'zovaniye v uskoritel'noy tekhnike. Sbornik. (Superconductors and their use in acceleration technology. Collection of articles). Moskva, Atomizdat, 1975, 93 p. (KL, 18/76, #14721)

Tsyplakov, O. G. Nauchnyye osnovy tekhnologii kompositsionno-volokhnistykh materialov (Technology of fiber-composite materials). Part 2, Perm', Kn. izd-vo, 1975, 276 p. (KL, 18/76, #14920)

Venikov, G. V. Opticheskiye vychislitel'nyye sistemy (Optical computing systems). Novoye v zhizni, nauke, tekhnike; seriya Tekhniki no. 1, 1976, 64 p. (KL, 11/76, #8874)

Vetlitskiy, I. A. et. al. Sverkhprovodyashchiy magnit dlya formirovaniya puchkov chastits s malym vremenem zhizni (Superconducting magnet for forming particle beams with short lifetimes). Moskva, ITEF, 1975, 35 p. (KL, 11/76, #8773)

Vliyaniye vneshuykh vozdeystviy na sverkhprovodyashchiye svoystva metallov. Sbornik. (Effect of external disturbances on superconducting properties of metals. Collection of articles). Kishinev, Shtiintsa, 1975, 57 p. (KL, 18/76, #14703)

Volkov, Yu. M., R. V. Dogadayev et. al. Vliyaniye prielektrodnykh protsessov na kharakteristiki impul'snykh MGD-generatorov (Effect of electrode region processes on characteristics of pulsed MHD generators). Moskva, IAE im. Kurchatova, 1975, 23 p. (KL, 18/76, #14853)

Voprosy dozimetrii i zashchity ot izlucheniya (Problems of dosimetry and radiation shielding). No. 14, Moskva, Atomizdat, 1975, (RZhGeofiz, 6/76, #6 B152)

Voprosy issledovaniya nizhney ionosfery i geomagnetizma. Sbornik (Studies of the lower ionosphere and geomagnetism. Collection of articles). SO AN SSSR Novosibirsk, 1975, 175 p. (KL, 18/76, #14745)

SOURCE IDENTIFICATION

IVUZ Radiofiz   –   Izvestiya vysshikh uchebnykh zavedeniy. Radiofizika

KL   –   Knizhnaya letopis'

KLDV   –   Knizhnaya letopis'. Dopolnitel'nyy vypusk

OMP   –   Opt o-mekhanicheskaya promyshlennost'

PTE   –   Pribory i tekhnika eksperimenta

RBL   –   Russian Book List

RiE   –   Radiotekhnika i elektronika

RZhGeofiz   –   Referativnyy zhurnal. Geofizika

RZhKh   –   Referativnyy zhurnal. Khimiya

VS Kr. soobsh.   –   Vysokomolekulyarnyee soyedineniya. Kratkiye soobshcheniya

ZhETF P   –   Pis'ma v Zhurnal eksperimental'noy i teoreticheskoy fiziki

ZhTF   –   Zhurnal tekhnicheskoy fiziki

ZhTF P   –   Pis'ma v Zhurnal tekhnicheskoy fiziki