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Space TECHNICAL INFORMATION DIGEST

SPACE SYSTEMS INFORMATION BRANCH, GEORGE C. MARSHALL SPACE FLIGHT CENTER

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IN THIS ISSUE

IAS MONOGRAPH SERIES PROPOSED. The International Academy of Astronautics (IAS) proposes to sponsor a series of monographs in the field of astronautical sciences and engineering. The books will be published by Springer Verlag, of Vienna, the firm that prints Astronautica Acta for the IAS. Persons interested in publishing books in the series need not be members of the academy.

The following guidelines are offered by the Academy for prospective authors:

1. The manuscript must deal with a specific topic in the field of astronautical sciences and engineering. (This includes the life sciences but not space law.)

2. Textbooks, popular books, and lengthy papers more appropriate for professional journals will not be accepted. Monographs will have not less than 150 printed pages.

3. Manuscripts (or portions thereof) and a complete outline should be submitted to Springer Verlag, Molkerbastei 5, Vienna, Austria, for review.

NASA employees considering publication of material in this manner are reminded that they should first review Section 42, Personnel Management Manual, MSFC 17-1 (NASA Chapter 3-7-2), before entering into a contract with the publisher or submitting material for publication. (Source: Letter to MSFC from Dr. Theodore von Kármán, IAS)

NEW TUBE PERMITS PHOTOGRAPHY OF ULTRA-HIGH SPEED ACTIVITY WITH VERY SHORT EXPOSURES. Multiple-frame photography of ultra-high speed activity is now possible with exposures as short as 0.0002 sec. This can be achieved through the use of a new tube announced in late January, 1962, by the Radio Corporation of America.

Called an image-converter tube, the device was designed specifically as a high-speed light shutter for special electronic cameras now in use. The high resolution tube is less than 25 cm long and about 10 cm in diameter (10 in. long, 4 in. dia).

This new scientific implement is expected to be valuable in the field of magnetohydrodynamics, including applications for propulsion systems of space vehicles. (Magnetohydrodynamics refers to the investigation of extremely hot gases influenced by electric and magnetic fields.) The tube is useful in the study of lasers, exploding wires, gaseous discharges and other high-speed phenomena.

The new tube has electrostatic-focus, a gating (control) grid that functions as a shutter, and an electrostatic deflection system that can produce three images on one photographic frame within 100 nanoseconds.

The operating principles of the image converter tube are relatively simple. The event or action is focused on the tube's photocathode by means of a fast objective lens. Light striking the photocathode releases electrons that are attracted at high velocity toward the fluorescent screen at the opposite end of the tube. In their passage, the electrons first encounter the electron gating grid. This grid may be charged either to stop the electrons emerging from the cathode or to permit their travel toward the screen. This grid is also used to focus the electrons on the screen.

After the electrons pass the gating grid, they are directed through a small aperture to a set of deflecting electrodes. Design of these electrodes makes it possible for the beam to be deflected over a wide angle without serious distortion or loss of resolution.

The electron beam energy is converted by the phosphor screen into visible radiation. The screen is especially prepared with a fine-grain phosphor and is backed with aluminum to increase light output. Under normal operating conditions, the tube can provide a minimum increase in radiant energy emitted from the screen of as much as 50 times the radiant energy incident on the photocathode. (Source: Data supplied by Radio Corporation of America)

INTERGALACTIC COMMUNICATIONS "CODE" EXHIBITED. The Boston Chapter of the Professional Group on Aerospace and Navigational Electronics held a meeting on May 24, 1962, in Waltham, Massachusetts. Dr. H. I. Ewen talked about the efforts being made to find out whether intelligent beings in intergalactic space may be communicating with others by using the radio-astronomer's reference: the 21-cm line.

Evidence now indicates that the Earth is not the sole planet in the Universe supporting intelligent beings, but that there are probably large numbers of such planets. "Unless we pessimistically assume that scientific competence leads immediately to planetary suicide, the chances for successful communication seem favorable."

Dr. Frank Drake, of the National Radio Astronomy Observatory, Green Bank, West Virginia, has provided an example of the type of message that might be intercepted from another civilization in space. The example is given below, and consists of five hundred fifty-one 0's and 1's.

What does it tell us?

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11110000101001000011001000000010000010100
10000011001011001111000001100001101000000
00100000100001000010001010100001000000000
00000000001000100000000001011000000000000
00000010001110110101101010000000000000000
00001001000011101010101000000000101010101
00000000011101010101110101100000001000000
00000000000100000000000010001001111111000
00111010000010110000011100000001000000000
10000000010000000111110000001011000101110
10000000110010111110101111110001001111100 1
00000000000111110000010110001111111100000
10000011000001100001000011000000011000101
00100011111001011 11
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This will be decoded and interpreted in a later issue of STID. (Source: IRE Transactions on Aerospace and Navigational Electronics, September, 1962.

GENERATING ULTRA-HIGH MAGNETIC FIELDS. Within the last few years, interest in producing powerful magnetic fields has arisen for a number of reasons. Solid-state physics, for example, utilizes very high magnetic fields in the study of light absorption in materials for use in optical masers. Nuclear physics finds an application of power fields in the study of high-energy particles.

The subject of generating powerful magnetic fields has a history of at least several decades. The French scientists, Deslandres and Perot, showed in 1914 that steady magnetic fields of about 4.0×10^6 amp/m (50×10^3 oersted) could be generated with heavy electric currents passed through a small, cylindrical, water-cooled solenoid; about 570 kw of power was used. This early pioneering effort has brought about modern "orthodox" attempts to produce very high, steady magnetic fields. Modern achievements in the highest steady fields have reached 1.264×10^7 amp/m.

It has been discovered in the last 2 yr that certain alloys and metallic compounds lose all their resistance and become superconducting at very low temperatures. That is, once the currents are established, they can maintain a high steady magnetic field without dissipating power. Superconducting coils have been built that can generate fields of 4800 to 8400 amp/m; prospects of building coils of much higher capability are indicated.

The use of iron-cored magnets is ignored for "power fields," defined by Dr. David Parkinson as fields "in excess of 100 kilo-oersted" (7.96×10^6 amp/m). Three choices are outlined:

1. The orthodox approach: A coil operating near room temperature and using several Mw of power.
2. A coil using less power, but requiring large quantities of cryogenic coolant (e.g. nitrogen or hydrogen).
3. The use of coils made of superconducting alloys.

Of the three choices, superconducting coils appear the most likely to have the potential of generating fields up to about 2.4×10^7 amp/m. This is a special case of the class of low-temperature coils (choice 2 above).

Many metals, called <u>superconductors</u>, lose all trace of electrical resistance below some critical temperature, T_c. If one of these metals is formed in a closed ring, and cooled below T_c, a "super-current" can be caused to circulate in the ring. This current will continue to flow indefinitely, without power dissipation, unless destroyed by raising the temperature above T_c.

The magnetic fields that can be generated by using superconductors have other limiting factors. A critical magnetic field (H_c) can destroy the "super-current," although this value is usually less than 2×10^5 amp/m. Superconductivity can also be destroyed by increasing the super-current itself beyond a critical value.

In a magnetic field, super-currents are thought to be carried by very thin superconducting filaments that run through the material. Alloys such as niobium-zirconium show strong evidence of filaments that are created by mechanical strain and damage to crystal structure, but in compounds such as niobium tin the filaments may be an intrinsic property of the material.

Whether the superconducting technique or the conventional technique is used, material strength will govern as fields exceed 2.4×10^7 amp/m. The first attempts at getting steady fields in this range may be made with a large superconducting solenoid around a small, high-powered conventional coil. Thus the two apparently competing approaches may eventually complement each other. (Source: New Scientist, November 22, 1962)

NEW ALUMINUM LUBRICANTS ANNOUNCED. Achievement of a vacuum approaching the "nothingness" of outer space has helped General Electric scientists overcome aluminum's resistance to lubrication.

In laboratory measurements of surface friction (Fig. 1), the new aluminum lubricants have demonstrated coefficients of friction only about one-fifth those observed with conventional lubricating oils. The same chemical compositions are expected to have important applications in a variety of processes for aluminum fabrication.

Investigations into the chemistry of "fresh" metal surfaces in ultra-high vacuum (approaching that encountered by Project Mercury spacecraft at their apogees) have revealed "important new information about the fundamental processes of friction, wear, and lubrication," a company spokesman reported.

Chemical reactions that occur in a billionth of a second in ordinary atmosphere can be observed in "slow motion" over a period of many hours by using the new ultra-high-vacuum research technique. This has led to the identification of a class of compounds that form a chemical attachment to aluminum surfaces, form a wear-resistant film, and provide a coating for the tiny wear particles that can damage the sliding surfaces.

Several classes of organic chemical compounds have been identified that have the required properties, and they may be employed either in pure form or as compounded additives. The company research director did not identify the precise chemical compounds employed.

Broad applications are anticipated in bearing lubrication, and in aluminum fabrication methods such as die forming, roll forming, rolling, machining, extruding, wire drawing, polishing, spinning, and die casting. An example was cited in the case of aluminum extruded with the new lubricant. Early studies have indicated that the family of chemical materials effective for aluminum lubrication also has significant lubricating potential for other metals and alloys, both ferrous and nonferrous. (Source: Data supplied by General Electric)

LASER RADAR MAY HELP PRECISION SURVEYING OF DISTANT OBJECTS. Development work on a laser radar that may accurately measure the length and width of a target even at ranges of thousands of kilometers has been disclosed.

FIG. 1

Writing in Sperry's quarterly Engineering Review, published January 16, 1963, Robert D. Kroeger described a technique to bend the laser's light beam back and forth millions of times per second. Small targets in its path would be scanned, and precise length and width measurements would be returned to the radar receiver. This technique will present target details hundreds of times sharper than conventional microwave radars that ordinarily show targets as "blips" on a scope.

"Even in our early experiments we expect to get dimensions accurate to within inches at ranges of a mile or more," the author explained. The new technique could eventually be useful for precise mapping of other planets. On Earth, it could be used to discriminate between suspected targets and "clutter" of very similar dimensions.

The beam deflector, presently in development, will have a series of 1.27-cm (0.5-in.) long optical prisms mounted at the output of the laser inside the radar. The first prisms have been made as wedge-shaped sections of potassium dihydrogen phosphate, placed together to form solid rectangles.

When driven by a varying voltage, the prisms will deflect the light beam from the laser radar. The degree of deflection will depend on the characteristics of the prisms, the amount of voltage applied, and the number of prisms arrayed in the path of the laser beam.

Applied during the 500-μsec pulse of the laser, the voltage on the deflector will sweep the beam across a small horizontal arc to obtain angular target width, or across a vertical arc to obtain angular target length. On the following pulse the beam is deflected and swept in the alternate plane. The angular presentations are then multiplied by the target range to obtain a precise numerical readout of width and length. (Source: Data supplied by Sperry Rand Corp.)

TECHNICAL REPORTS AVAILABLE. The following listed technical reports can be requested through the NASA library, M-MS-IPL, Bldg. 4481.

NOTE: Those reports with an AD number may be on file in the local ASTIA branch in Bldg. 4484. Readers can save time by calling 876-6088 and inquiring if such reports are available before ordering them through NASA.

1. FIBER REINFORCED METALS AND ALLOYS. AD 276 620
2. ENGINEERED PERFORMANCE STANDARDS. SHEETMETAL, STRUCTURAL IRON AND WELDING FORMULAS. PB 181 130-1
3. SPALL STUDIES IN COPPER, R. A. Plauson, J. Grimsley and A. D. Solem. AD 276 057
4. VIBRATIONS OF ELASTIC SYSTEMS TAKING ACCOUNT OF ENERGY DISSIPATION IN THE MATERIAL. Original text by G. S. Pisarenko. AD 274 743

5. OPTIMUM STRUCTURAL REPRESENTATION IN AEROELASTIC ANALYSES, R. G. Schwendler and R. H. MacNeal. AD 277 468
6. SOME PROCEDURES IN DESIGN FOR MAINTAINABILITY, J. W. Altman. AD 278 804
7. RADIOLOGICAL PROTECTIVE CONSTRUCTION, W. L. Owen. AD 275 990
8. THE THEORY AND DESIGN OF FM RECEIVERS, Donald Hess. AD 282 110
9. WEAPONS AND WEAPONS EFFECTS - THE SIXTH NAVY SCIENCE SYMPOSIUM - VOL. 1. PB 181 358