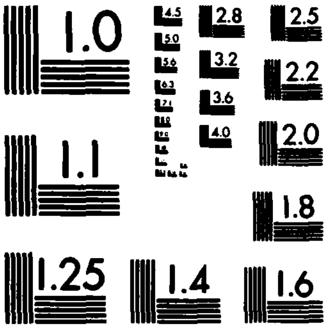
AD-A133 792 CONCERNING THE POSSIBILITY OF EMPLOYING SUPERCONDUCTING 1/1
SYSTEMS FOR ANALY..(U) FOREIGN TECHNOLOGY DIV
WRIGHT-PATTERSON AFB OH O P ANASHKIN ET AL. 27 SEP 83
UNCLASSIFIED FTD-ID(RS)T-1010-83 F/G 4/1 NL



MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

②

FTD-ID(RS)T-1010-83

AD-A133 292

FOREIGN TECHNOLOGY DIVISION

CONCERNING THE POSSIBILITY OF EMPLOYING SUPERCONDUCTING SYSTEMS FOR ANALYZING THE COMPOSITION OF COSMIC RAYS

by

O.P. Anashkin, B.M. Belitskiy, et al

83 10 19 126

EDITED TRANSLATION

FTD-ID(RS)T-1010-83 27 September 1983

MICROFICHE NR: FTD-83-C-001181L

CONCERNING THE POSSIBILITY OF EMPLOYING SUPERCONDUCTING SYSTEMS FOR ANALYZING THE COMPOSITION OF COSMIC RAYS

By: O.P. Anashkin, B.M. Belitskiy, et al

English pages: 5

Source: Kosmicheskiye Luchi, Sbornik Statey,
Nr. 13, Publishing House "Nauka",
Moscow, 1972, pp. 166-168

Country of origin: USSR
Translated by: Joseph E. Pearson
Requester: FTD/TQTD
Approved for publi release; distribution unlimited.

THIS TRANSLATION IS A RENDITION OF THE ORIGINAL FOREIGN TEXT WITHOUT ANY ANALYTICAL OR EDITORIAL COMMENT. STATEMENTS OR THEORIES ADVOCATED OR IMPLIED ARE THOSE OF THE SOURCE AND DO NOT NECESSARILY REFLECT THE POSITION OR OPINION OF THE FOREIGN TECHNOLOGY DIVISION.	PREPARED BY: TRANSLATION DIVISION FOREIGN TECHNOLOGY DIVISION WP-AFB, OHIO.

U. S. BOARD ON GEOGRAPHIC NAMES TRANSLITERATION SYSTEM

Block	Italic	Transliteration	Block	Italic	Transliteration
А а	*А а*	A, a	Р р	*Р р*	R, r
Б б	*Б б*	B, b	С с	*С с*	S, s
В в	*В в*	V, v	Т т	*Т т*	T, t
Г г	*Г г*	G, g	У у	*У у*	U, u
Д д	*Д д*	D, d	Ф ф	*Ф ф*	F, f
Е е	*Е е*	Ye, ye; E, e*	Х х	*Х х*	Kh, kh
Ж ж	*Ж ж*	Zh, zh	Ц ц	*Ц ц*	Ts, ts
З з	*З з*	Z, z	Ч ч	*Ч ч*	Ch, ch
И и	*И и*	I, i	Ш ш	*Ш ш*	Sh, sh
Й й	*Й й*	Y, y	Щ щ	*Щ щ*	Shch, shch
К к	*К к*	K, k	Ъ ъ	*Ъ ъ*	"
Л л	*Л л*	L, l	Ы ы	*Ы ы*	Y, y
М м	*М м*	M, m	Ь ь	*Ь ь*	'
Н н	*Н н*	N, n	Э э	*Э э*	E, e
О о	*О о*	O, o	Ю ю	*Ю ю*	Yu, yu
П п	*П п*	P, p	Я я	*Я я*	Ya, ya

*ye initially, after vowels, and after ъ, ь; e elsewhere.
When written as ё in Russian, transliterate as yё or ё.

RUSSIAN AND ENGLISH TRIGONOMETRIC FUNCTIONS

Russian	English	Russian	English	Russian	English
sin	sin	sh	sinh	arc sh	$\sinh^{-1}$
cos	cos	ch	cosh	arc ch	$\cosh^{-1}$
tg	tan	th	tanh	arc th	$\tanh^{-1}$
ctg	cot	cth	coth	arc cth	$\coth^{-1}$
sec	sec	sch	sech	arc sch	sech^{-1}
cosec	csc	csch	csch	arc csch	csch^{-1}

Russian	English
rot	curl
lg	log

GRAPHICS DISCLAIMER

All figures, graphics, tables, equations, etc. merged into this translation were extracted from the best quality copy available.

Concerning the Possibility of Employing Superconducting Systems For Analyzing the Composition of Cosmic Rays

O. P. Anashkin, B. M. Belitskiy, V. B. Brodskiy,
L. V. Kurnosova, N. N. Mikhaylov, L. A. Razorenov,
T. M. Sidyakina, M. I. Fradkin.

There is a whole series of problems, for the solution of which it is necessary to create rather powerful fields on board satellites and space rockets. In particular, the magnetic fields are needed for analyzing charged particles for charge sign and energy. The employment of normal permanent magnets is complicated due to their large weight, and of electromagnets - due to their high energy consumption. These difficulties are eliminated to a considerable extent in the case of the employment of superconducting solenoids for the creation of powerful magnetic fields. In this case the weight is mainly determined by the weight of the superconducting wire and the cryostat, and energy consumption is practically absent.

At the present time the creation of superconducting solenoids for different purposes under laboratory conditions has been perfected to a rather high state, however experience in lifting such devices on rockets and satellites has been completely absent. Moreover, the employment of superconducting devices in space flight can meet with a number of difficulties. First of all, it is necessary to ensure the helium, cooling the solenoid, both in the powered flight phase, as well as in the subsequent phase, under conditions of weightlessness. Then, in the case of introducing current into the solenoid on Earth before the launch of the satellite it is necessary to ensure the preservation of superconductivity in the powered flight phase. Usually, liquid helium is employed for the cooling of solenoids. There is a two-phase system in the cryostat: liquid helium in its lower part and gas in the upper part and in the neck. Under conditions of weightlessness the liquid helium can flow along the walls and fall into the neck. In this case very intensive vaporization and the ejection of helium from the cryostat should occur. As a result, if no protective measures are taken, all the helium will rapidly vaporize.

It is more expedient to employ helium at a pressure, somewhat higher than the critical pressure. In this case helium is a homogeneous mass and the problem of the flowing (spreading) of the liquid phase under conditions of weightlessness falls off. It is possible to show, that the "supply of cold" in the case of working with helium in the supercritical state differs little from the "reserve of cold", existing in a vessel with liquid helium. The temperature close to the critical point (5.2° K) differs little from the temperature of liquid helium (4.2° K) and is suitable for maintaining the solenoid in the superconducting state.

It was necessary in an experiment to check the operation of superconducting solenoids cooled by helium in the supercritical state onboard a satellite, under the condition of introducing current into the solenoid on the Earth before the launching of the satellite. This type of methodical experiment was conducted on-board the "Kosmos-140" satellite. A special cryostat, the general view of which is shown in Fig. 1, was designed for conducting the methodical experiment. For maintaining a constant pressure of 2.4 atm(abs.) in the cryostat, somewhat exceeding the critical pressure (P=2.26 atm(abs.), a system of regulating valves was specified in the instrument. A pneumatic relay was employed for controlling the valve. Two small solenoids of superconducting wire made from 65-BT alloy were placed in the cryostat. Wire temperature sensing elements were employed at several points of the cryostat for measuring the temperatures.

The vessel went into the flight at a temperature of 5.2-5.3° K and at a pressure of 2.4 atm(abs.), i. e., with the helium in the critical state. Current was introduced into the solenoids on the ground and the solenoids were closed with the aid of key devices. In one of the solenoids the field was 9.5 thous. Oe, and in the other somewhat more 13 thous. Oe. Information was obtained about the operation of the temperature sensors, the field sensors, and the pressure sensor during the course of the flight.

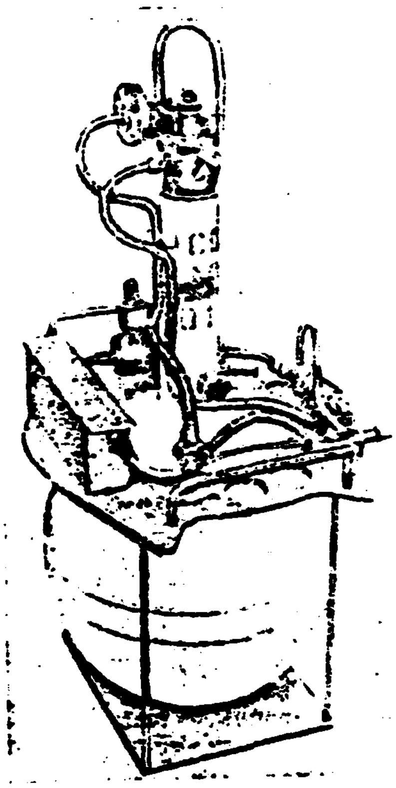


Fig. 1. General view of the cryostat.

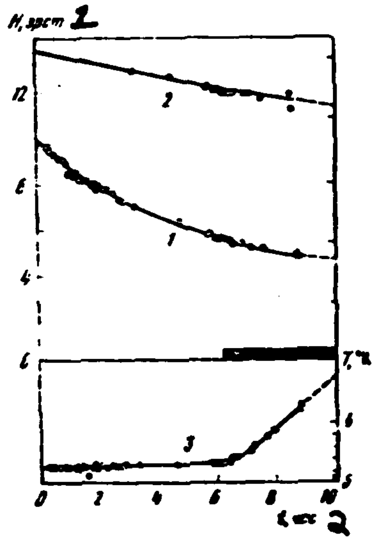


Fig. 2. Variation in the intensity of a magnetic field in the solenoids and the increase in the temperature within the cryostat during the flight.

For arbitrary designations see the text.

KEY: 1 - S, Oe; 2 - t, h.

The main results of the measurements are the following.

1. The instrument withstood the powered flight phase satisfactorily; during this phase the temperature in the cryostat and the field strength in each of the solenoids paractically did not change.

2. In the course of the forst 6 h of the orbital flight the temperature in the cryostat, in accordance with the data of all the sen-

sors, changed extremely slowly and did not increase more than about 0.1° K.

3. The pressure in the cryostat remained constant during the duration of the entire flight.

4. Within 6 h after the beginning of the flight the satellite twisted in such a manner, that there was a centrifugal force of 10^{-3} g, directed in the direction of the neck of the cryostat, i. e., in the direction, opposite to the effect of gravity under terrestrial conditions. After this a noticeable increase in temperature began in the cryostat. The heating of the system after the introduction of artificial "gravity", directed towards the neck, can be explained by the appearance of directed convection in the vessel, and the cold gas began to "descend" into the neck, and the warm gas to accumulate in the working part of the dewar. This should lead to the discharge primarily of the cold gas through the valve and, consequently, to the more rapid heating of the system.

Fig. 2 shows the dependence of the change in the field in each of the solenoids on time under terrestrial conditions (solid curves 1 and 2). The evident damping of the field is due to the iimperfection of the employed contacts and can readily be eliminated. It is important, that the damping of the field in flight occurred exactly as under terrestrial conditions (the points are flight data). Curve 3 shows the dependence of temperature on time in accordance with the data of one of the sensors. It is evident, that the increase in tem½erature began at the moment of the appearance of the "artificial gravity" (the black boldface band). When the temperature reached the value, at which the magnitude of current in the solenoids was critical, the collapse of the field occurred.

On the basis of the obtained data it is possible to draw the following conclusions.

1. Helium under a pressure higher than the critical pressure can be employed as a cooling agent under the conditions of space flight.

2. The high static and vibrational overloads in the powered flight phase do not disturb the superconducting state of the wire of the solenoid windings.

3. The presence of even small forces, simulating gravity, can greatly affect the operation of the system. In designing superconducting devices, intended for operation in space, it is necessary to take the possible rotations of the satellite into account.

4. The conducted methodical experiment shows the real possibility of creating on satellites devices with powerful magnetic fields, in particular magnetic particle analyzers, without the expenditure of large weights and without high energy consumption.

Abstract

The experimental results on the use of superconductive systems on board the spaceships are described. To ensure low temperatures in the cryostat under weightlessness helium was used at a pressure above the critical one (a pressure of 2.4 atm and initial temperature of 5.2°). In flight, the temperature was controlled at six points while the pressure and intensity of magnetic field were controlled in the solenoids.

The methodical test proved it possible to mount special installations, on satellites, with extensive magnetic fields based on superconductive alloys and particularly, low weights and low power consumption magnetic analyzers.

DISTRIBUTION LIST

DISTRIBUTION DIRECT TO RECIPIENT

ORGANIZATION	MICROFICHE
A205 DMAHTC	1
A210 DMAAC	1
B344 DIA/RTS-2C	9
C043 USAMIIA	1
C500 TRADOC	1
C509 BALLISTIC RES LAB	1
C510 R&T LABS/AVRADCOM	1
C513 ARRADCOM	1
C535 AVRADCOM/TSARCOM	1
C539 TRASANA	1
C591 FSTC	4
C619 MIA REDSTONE	1
D008 NISC	1
E053 HQ USAF/INET	1
E403 AFSC/INA	1
E404 AEDC/DOF	1
E408 AFWL	1
E410 AD/IND	1
E429 SD/IND	1
P005 DOE/ISA/DDI	1
P050 CIA/OCR/ADD/SD	2
AFIT/LDE	1
FTD	
CCN	1
NIA/PHS	1
NIIS	2
LLNL/Code L-389	1
NASA/NST-44	1
NSA/1213/TDL	2

END

FILMED

11-83

DTIC