INFORMATION REPORT INFORMATION REPORT

CENTRAL INTELLIGENCE AGENCY

S-E-C-R-E-T

[redacted] 25X1

COUNTRY	USSR	REPORT	[redacted]
SUBJECT	Soviet Paper on the Study of Cosmic Rays by Rockets and Earth Satellites	DATE DISTR.	16 January 1959
		NO. PAGES	1
		REFERENCES	RD
DATE OF INFO.	[redacted]		
PLACE & DATE ACQ.	[redacted]		25X1

25X1

SOURCE EVALUATIONS ARE DEFINITIVE. APPRAISAL OF CONTENT IS TENTATIVE.

[redacted]

[redacted] paper by S. N. Vernov and A. Ye. Chudakov entitled "Study of Cosmic Rays by Rocket and Sputniks in the USSR" [redacted]

25X1

[redacted] Comment: Chudakov and Vernov in conjunction with other authors have written on cosmic ray studies utilizing earth satellites, c.f. Uspekhi Fizicheskikh Nauk, volume LXIII No. 1b, September 1957. [redacted]

[redacted]

25X1

S-E-C-R-E-T

[redacted] 25X1

STATE	X	ARMY	X	NAVY	X	AIR	X	FBI		AEC					

(Note: Washington distribution indicated by "X"; Field distribution by "#".)

INFORMATION REPORT INFORMATION REPORT

S-E-C-R-E-T

[redacted]

25X1

S.N. Vernov
A.E. Chudakov

STUDY OF COSMIC RAYS BY ROCKETS AND SPUTNIKS IN THE USSR

In the USSR study of cosmic rays by rockets was started in 1947.

In the beginning, with the help of Geiger counters the number of charged particles was measured, and formation of the electron-photon component in the interaction of primary particles of cosmic rays with nuclei of light elements was investigated.

It was shown that in 1947, 1948, 1949, and 1951 the intensity of cosmic rays, at the altitudes up to 75 km, was the same and didn't change more than by 5%. In 1949 the data on the photon intensity outside the atmosphere were obtained. In order to measure the number of high energy photons, one of us (A.E. Chudakov) proposed the method permitting to carry out these measurements with a strong background of charged particles.

It was found with the help of this apparatus that at the altitudes exceeding 50 km, the flux of photons with the energy of the order of 10^7 ev and more is 0.25 $\frac{\text{photons}}{\text{cm}^2/\text{sec.}}$

The same apparatus was used for photons measuring in the stratosphere at various heights, and it was shown that at the heights of 20 km, a maximum intensity is 0.7 $\frac{\text{photons}}{\text{cm}^2/\text{sec}}$

Ionisation produced by cosmic rays up to the altitudes of 100 km was measured in 1951. Measurements were carried out under various thickness of absorbers 1 gr/ cm^2 of steel, 15 cm of aluminum, 1 cm of lead.

Surrounding of the ionization chamber by lead 1 cm thick leads to increase of ionization 2.-6 $\pm$ 0.003 times, by 15 cm of aluminium - 1.92 $\pm$0.02, and by 15 cm of aluminium + 1 cm of lead - 3.26 $\pm$ 0.03 times. Difference in the values of ionization during 3 rocket flights does not exceed 2 ÷ 3%.

Comparison of ionization and the number of particles in the stratosphere and above the atmosphere shows that an average specific ionization of cosmic ray particles considerably exceeds ionization of the relativistic particle. Relation of the average specific ionization to ionization of the relativistic particle is as follows:

20 km	-1.59 $\pm$ 0.06)	without
50 km	-2.16 $\pm$ 0.07)	absorber
50 km	-1.68 $\pm$ 0.06 -	under the layer of aluminium 15 cm thick

SECRET

[redacted]

25X1

[redacted]

The great value of the specific ionization in the stratosphere can be explained by existence of secondary heavy (sufficiently slow) particles.

Outside the atmosphere the number of such secondary particles is sufficiently small. As one can see from the above-mentioned data, when the ionization chamber is positioned under the layer of aluminium 15 cm thick, the average specific ionization approximately corresponds to the results expected on the basis of experiments at the height of 20 km. Large value /2.16/ of the average ionization of the primary cosmic particles is due to the alpha-particles and more heavy nuclei available in the primary radiation.

This conclusion about a large average specific ionization of primary cosmic particles was proved also by measuring bursts in the pulse-type ionization chambers on rockets.

These works on the cosmic ray study were carried out by one of us (A.E. Chudakov).

In the preparation of electronics and radio-emission system there took part P.V. Vakulov and B.A. Khvoless, in the measurements of the number of charged particles and bursts M.I. Fradkin, and in the photon measurements - V.I. Solovjova.

On the basis of the experiments on the cosmic rays carried out on the rockets, there were prepared new measurements, part of which was fulfilled during flights of the 2nd and 3rd Sputniks.

New possibilities realized due to these sputniks permit to find a new method to solve the following problems.

First of all it is possible to obtain cosmic ray distribution over the globe and consequently, to study the magnetic field of the Earth.

Due to a long duration of observations by the sputnik, one may hope to find new components of cosmic radiation.

In this connection a particular attention must be drawn to the search of photons in cosmic radiation.

If the photon component will be found in cosmic rays a new possibility to study the outer space arises.

An essential role plays also the study of the composition of primary cosmic rays and determination of nuclei of various elements among particles of this radiation.

Sufficiently long measurements on the sputniks permit to compare the changes in the intensity of these rays with those processes on the Earth and in the cosmos, which caused these variations.

SECRET

[redacted]

In order to measure cosmic rays two identical instruments were placed on the 2nd sputnik. Both instruments were absolutely independent from each other. Therefore coincidence of results of these instruments permits to be sure about normal behaviour of the apparatus during the flight.

Every instrument consisted of a counter of charged particles with a length of 100 mm and diameter of 18 mm. The counters were surrounded on the average by 10 grams per cm^2 of matter. The operating voltage of the counter (400 v) was provided with the help of semi-conducting transformer supplied by the battery of 6.5 v.

Both instruments included semi-conducting scalers. Each of these instruments required a power of 0.1 watt. The total power supply was 0.15 watt. The power storage was sufficient for a continuous work for 200 hours.

Weight of one instrument including the batteries was 2.5 kg. The scheme of the instrument was discribed in the paper published in Usp.Fiz. Nauk /1/.

During the sputnik flight the records of the both instruments coincided with each other within the statistical accuracy nearly in the every case.

When the sputnik flied over the USSR by "direct path" (motion from south to north), altitude of its flight was nearly constant. At the motion on "opposite path" the altitude continuously increased approximately from 350 to 700 km. Relation of the intensity of cosmic rays on "opposite paths" to the intensity on "direct paths" in the same geographic points gives a relative increase of intensity due to the difference in altitudes.

This dependence of cosmic ray intensity on altitudes must be caused, in any case, by the following effects.

1. Increases of intensity due to decrease of the Earth screening.
2. Increase of intensity due to decrease of the Earth magnetic field that leads to decrease of a threshold energy of particles which are able to penetrate through the Earth magnetic field.

The altitude dependence found can be explained by taking into account only these two effects.

The measurements of cosmic ray intensity during the sputnik flying on many "direct paths" permit to plot the lines of equal intensity of this radiation /"isocosms"/.

Isocosms for three values of the counting rate 18; 27 and 36 particles per sec were obtaind.

SECRET

[redacted]

SECRET

[redacted]

25X1

The best [redacted] gives the isocosms which coincide with geographic parallels. In the equatorial region, Symposon/2/ discovered that the line of minimum intensity of cosmic rays ("cosmic equator") does not coincide with the geomagnetic equator. In this connection, it is of a great interest to obtain the data on distribution of cosmic ray intensity over the globe.

Spread of points relative to the approxpriate isocosms 2-3 times exceeds that to be expected basing on the statistical errors only. Apparently, this phenomenon is connected with variations of cosmic ray intensity. Analysis of the data obtained shows that, in some cases, considerable increases of cosmic ray intensity were observed.

Thus, on the 7th November, 1957, in the time interval from 4.36 a.m. to 4.49 a.m., Moscow time, in the latitudes above 58°, increase of cosmic radiation approximately by 50% was recorded. This increase was simultaneously fixed by two instruments. The both instruments gave identical dependence on time.

The fact being of interest is that large fluctuations of intensity are observable during the "burst".

This "burst" was not recorded at the sea level. At present it is difficult to determine the source of this increase of intensity. It is not excluded that this phenomena is caused by increase of density of the electron flux with a relatively small energy - of the order of hundreds of kev, which can be recorded with a rather small efficiency by Geiger counter due to the bramsstrahlung. (But not by increase of intensity of primary cosmic rays).

Possibility of such interpretation is grounded on the analysis of data of the 3rd sputnik. A scintillation counter having a high efficiency for photon recording was mounted on this sputnik. In this case, a rather large intensity of photons was observed. An in the region of those latitudes where this burst was observed, intensity of photons increased and had strong fluctuations.

It is possible to explain the origin of these photons by the bremsstrahlung radiation of electrons with the energy of 10^5ev. Thus, variations of cosmic ray intensity observed on the 2nd sputnik differ from the variations observed at sea level and in the stratosphere (at the altitudes of 20-30 km).

Apparently, two types of variations are available. A part of variations is caused by cosmic rays, and therefore it must correspond to change of the number of primary cosmic rays. Another part of variations does not deal with cosmic rays. Apparently, a new radiation and variation of the intensity of charged particles and photons caused by this radiation were recorded on the sputniks with the help of apparatus constructed for the study of cosmic rays. These variations are caused by the radiation which can be called as the "Earth radiation", i.e.the particles of high energy originating near the Earth and rotating around the Earth.

SECRET

[redacted]

25X1

SECRET

[redacted] 25X1

A.I. Lebedinskij and one of us (S.N. Vernov) considered the possibility of storing a large numbr of secondary particles near the Earth. These particles are able to move quasi-periodically from one hemisphere to another. In the first approximation motion of the particle in the magnetic field must take place in such a way that the magnetic moment of the particle will be constant. Therefore, a charged particle in "closed" in the region of a relatively weak magnetic field. This particle is able to do a great number of oscillations and their intensity must be very large. One of the sources of particles is the decay products of neutrons emitted by the Earth under the action of cosmic rays. On the other hand, particles of corpuscular streams emitted by the Sun can be such a source.

This phenomenon of "halo" of substance and high energy electrons can exist around the other planets having magnetic field.

REFERENCES

1. Vernov S.N., Logatche Ju.I., Chudakov A.E., Schaffer Ju.T. Usp. Fiz. Nauk, v.XIII, N1, 149-162 (1957).

2. Sympson and others. Phys. Rev. (1955), and the report at the Varenna conference.

SECRET

[redacted] 25X1