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1. Introduction

Publication of the results of plasma and magnetic measurements made by the Soviet artificial satellites of Mars (Mars-2, 3, 5) [1-15] and of Venus (Venera-9,10) [16-23] has brought about a discussion, not finished yet, on the nature of obstacles creating near-planets bow shocks and on the intrinsic magnetic fields of these planets [24-31, 58-60].

In particular, in 1976-1978 Russell [24-28] revised the data of magnetic measurements near Venus and plasma and magnetic measurements near Mars, carried out by the Soviet spacecraft and contrary to the conclusions made by the authors of these experiments [1, 2, 8, 16], he stated that Venus' intrinsic magnetic field must be more intense than that of Mars (According to Russell [26-28], the magnetic moment of Venus is larger than estimated in [16] and the magnetic moment of Mars is smaller in [24, 25] than estimated in [1, 2] and [8]). In Russell's opinion the Soviet satellites of Mars never did enter the Martian magnetosphere.

Along with this, in those and more recent papers by Russell [24-29] and in the papers of the other authors published in 1979 (Intriligator [30], Cloutier and Daniel [31]) it is claimed that the mechanisms of solar wind interaction with Venus and Mars should be similar, and the magnetic field near both planets is generated by the currents induced in the ionospheres by

the solar

wism.

It might appear at first sight that there are some reasons for such a conclusion. However, the more detailed analysis of the data characterizing the regions of solar wind interaction with Venus and Mars shows that those regions differ in some substantial features which was either not mentioned or underestimated by the authors of the hypothesis about the similarity of the mechanisms of solar wind interaction with both planets.

Russell's papers [24-29] as well as some other papers dealing with the problem considered used only part of the experimental data obtained by Mars- and Venera-type Soviet spacecraft, even of the data published at the time of preparation of these papers.

Some papers [17, 20, 21, 32, 33] were published after the papers [24-28]; in 1979 the first results on the properties of the magnetic field, plasma, the characteristics of the atmosphere and of the ionosphere of Venus, obtained by the Pioneer-Venus mission were published [34-37].

The objectives of the present paper are:

1) to compare the typical features of the regions of solar wind interaction with Venus and with Mars taking into account the data not used in [24-29];

2) to consider arguments of the authors who deny the different nature of obstacles to the solar wind near Venus and Mars, with the use of the available experimental data (including the latest); and

3) to analyze the peculiarities of solar wind interaction with the Venus and Mars atmospheres.

II. Similar features of the regions of solar-wind interaction with Mars and Venus

As is known, bow shocks near Mars and Venus are located much closer to their surfaces than in the case of the Earth and the obstacles creating them have dimensions relatively close to each other. The upper atmospheres and the ionospheres of the planets have also a large degree of similarity.

In some cases the measurements onboard the Soviet artificial satellites in the vicinity of both planets showed that the peculiarities of the magnetic fields deep in the zone of the solar wind interaction with planet depend on the interplanetary magnetic field. This dependence observed in five measurement runs aboard the Mars satellites (Mars-3 on 21.1.72; Mars-5 on 14.2.74, 15.2.74, 20.2.74 and 24.2.74) led to the statement in [24] and [25] that the Soviet artificial satellites have never entered Mars' magnetosphere formed by its intrinsic magnetic field.

The very same data were used in [24] and [25] to get a lower estimate of the magnetic moment of Mars as compared with those in [2, 8] and an assumption was made about the ionospheric nature of the obstacle near Mars.

Let us discuss this question in more details.

Fig. 1 shows two magnetograms and ion spectra of February 13, 1974 (Fig. 1a) and of February 14, 1974 (Fig. 1b) from Mars-5 [8]. Note that the period of Mars-5 revolution around the planet is almost equal to that of the planet's rotation, hence the areocentric coordinates of the satellite in the same phase of revolution were practically similar for its neighbouring orbits. It implies that if Mars has an intrinsic magnetic field then the distribution of the magnetic field measured along the satellite orbit should remain the same for all the orbits if the effects due to the variations of the solar wind, flowing around the planet and of the interplanetary field can be neglected.

That is why the region 2-3 in Fig. 1a (for February 13, 1974) was defined as a magnetospheric region produced by the intrinsic dipole magnetic field of the planet since the field pattern in region 2-3 typical of the 13.2.74 session was observed at areographic latitudes of about -15 to 20^{o} in five out of nine passes of Mars-5 independently of the orientation of the interplanetary magnetic field.

The Martian dipole's exact inclination to the ecliptic plane is still an open question. Smirnov et al. [38] returned to the original assumption made by Dolginov et al. [2] about the low (-17^{o}) inclination of the Martian dipole and gave examples of the magnetic-field topology observed in three measurement runs, which resembles the low-latitude cusp in Mars' magnetosphere. with the dipole axis inclination -17°

Let us note, that in our opinion at present, it is only possible to say that the angle the dipole forms with the planet rotation axis is apparently more than 20^{o} and that the polarity of the dipole is opposite to the dipole field of the Earth (i.e. in the southern hemisphere the B_x-component is 'sunward', $B_x > 0$).

In the 4 passes of Mars-5 mentioned in the beginning of the section the pattern was observed similar to Fig. 1b (February 14, 1972): There the B_x-component in region 2-3 at the same areographic latitudes sometimes had a direction unusual for the expected dipole field ($B_x < 0$), it often changed its orientation, in some parts of region 2-3 its orientation coincided with that of the interplanetary magnetic field (i.e. with B_x orientation up to point 1 and after point 4).

Russell [24] also mentioned that on the dayside of the planet the time when the maximum field value was measured on Mars 5 (21.I.72) did not correspond to the minimum distance from the satellite to the planet, i.e. it did not coincide with the moment it passed the pericenter of its orbit, in his opinion, this could not also occur in the dipole field of the "intrinsic" magnetosphere of Mars.

Figs. 2 and 3 give some results of magnetic field and plasma measurements made on Venera-9 and -10 deep in the umbra part of the region of solar wind interaction with Venus.

As turned out, most measurements during different passes of Venera-9 and -10 gave the pattern similar to the one in Figs 2 and 3 [16, 17, 21], that is : the B_x-component of the magnetic field in region 2-3 of the tail often had a direction different from that expected for the dipole field [17, 21], changed its direction over some parts of orbits and its orientation deep in the region of solar wind - planet interaction often corresponded to that of the interplanetary magnetic field.

Let us take, for example, December 1, 1975 (Venera-10, Fig.2) or October 28, 1975 (Venera-9, Fig. 3); different symbols correspond to different directions of the B_x-component in the plane $Z_{SE}Y_{SE}$ measured along the trajectory when the vehicle emerged from the depths of the tail and entered the transition layer (point 3) and then the solar wind (point 4) [16]. In the southern hemisphere the B_x-component everywhere should have been directed to the Sun ⊙ ($B_x > 0$) in the dipole field which contradicts the observations: deep in the tail the B_x-component was antisunward ⊗ , then it changed the sign before entering the transition layer ⊙ , then in the solar wind it either preserved that direction (28.10.75) or again became 'anti-sunward' ⊗ (1.12.75)

The pattern of the B_x-component direction changes in those observation sessions is like that in Fig. 1b which is pattern for Mars' magnetosphere taken on 14.2.72.

Plasma characteristics measured when the vehicles entered the tails of Mars and Venus were also similar. Changes in the properties of the solar wind - planet interaction region when the vehicle crossed its characteristic boundaries were detected simultaneously in the plasma and magnetic field data, for example by a decrease of the magnetic field fluctuations and by a drastic decrease of ion fluxes when the vehicle passed from the transition region into the obstacle (see Figs 1 and 3, from region 1-2 and 3-4 into 2-3).

Note that Russell's statement [24, 25] that the satellites Mars-3 (on 21.1.72) and Mars 5 (on 15.2.74 and 20.2.74) did not enter the intrinsic Martian magnetosphere was based only on magnetic measurements data. Plasma spectra, however, obtained simultaneously with magnetic field data gave a pattern peculiar to the entering into the magnetosphere similar, for instance, to the pattern of Earth's magnetosphere boundary crossing [39] .

Thus, the similarity of the macrostructure of the magnetic field observed in the tails of the three planets, Mars, Venus and Earth as well as similar plasma formations made it more difficult to interpret the results and to determine the nature of an obstacle using only the data about the tail. The laboratory experiments by Dubinin et al. [40] clearly illustrate this conclusion.

Magnetic field properties in the near-Venus tail, detected by Venera-9 and Venera-10 were explained - and rather convincingly - by the induction effect produced by ionospheric currents that are created by the electric field $E = - \frac{1}{c}(V \times B_{inter})$ (where V - is the solar wind velocity, and $B_{interpl}$ is the interplanetary magnetic field) [17, 21]. The data of magnetic measurements on the Pioneer-Venus spacecraft obtained by Russell over the dayside [34] and nightside [36] of the planet confirmed, in fact, this conclusion based on the results of Venera-9 and -10. Hence it is obviously the ionosphere and the magnetic field created by currents induced by the solar wind in the ionosphere that act as an obstacle in the case of Venus

So, the apparent similarity of the results of magnetic and plasma measurements made during 4 passes of Mars-5 and of the data obtained in the most passes of Venus' soviet satellites gave grounds to assume a similar origin of obstacles near the two planets.

After the results of the Pioneer-Venus experiment were published Closier and Daniel [31], proceeding from their earlier calculations and models of a "magnetic barrier" and induced currents in the ionosphere of both planets, proposed identical models of ionosphere barriers to the solar wind near Mars and Venus, taking no account of the role of intrinsic magnetic fields of the planets in the interaction with the solar wind (Intrilligator [30] shares similar concepts). Mars has, according to the estimates by Clotier and Daniel [31], its intrinsic magnetic field which is too weak to decelerate the solar wind (25 γ on the surface of the planet) and the effect of that field can be observed only in the planet tail.

III. Differences between the solar wind-planet interaction regions near Mars and near Venus

Despite the above-mentioned similarities of the Mars and Venus obstacle properties there are essential differences in sizes and some properties of those obstacles that contradict the conclusion made in previous section.

1. The ionopause [21, 35], i.e. the upper boundary of the Venus ionosphere is the obstacle dayside boundary the ionopause was observed at 280 to 300 km as a drastic decrease of ionospheric electron density, which takes place on the altitude interval about 50 to 100 km [33].

If it is assumed according to Russell [24] and to Clotier and Daniel [31] that the Mars' obstacle (as well as the Venus' one) is its ionosphere, and the ionopause, detected at 280 to 300 km with direct VIKING-2 measurements of Ne(h)-profile is the obstacle boundary, then it is interesting to compare the obstacle properties by comparing the ionospheric properties of the two planets.

It should be expected in this case that the topside ionospheres of the both planets must be exposed to the solar wind, and their properties must differ from those of the ionosphere protected by the intrinsic magnetic field, in particular of the Earth's one.

Let us use for comparison statistically rich data on Ne(h)-profiles obtained by the same group of experimentalists on the Soviet satellites of Mars and Venus [33, 42-44] by the radio occultation techniques.

From comparison of Ne(h)-profiles in the Mars and Venus ionospheres (Fig. 4a, b) the following conclusions can be made:

a) a sharp upper ionospheric boundary-ionopause was distinctly observed near Venus but within the limits of errors of Ne(h)-measurements by the radio-occultation technique there was no distinct boundary near Mars which could be distinguished on the background of Ne-density fluctuations at the threshold of this technique.

b) the diurnal variations of radiooccultation Ne(h)-profiles at Mars show (Fig. 4a) that with an increase of the Sun zenith angle χ, i.e. with moving from the dayside regions to those near terminator, Mars' ionosphere became less extended and Ne variations were well described by a simple law typical of the Earth's ionosphere both in the ionization maximum, and in the topside ionosphere (photochemical equilibrium in the maximum region and the influence of diffusion at some height above the maximum [44, 45].

The experimental Ne(h)-profiles obtained from direct measurements made on Viking spacecraft in Mars' ionosphere were used by Clotier and Daniel to construct a model [31] implying at $h > 250$ km the ionospheric plasma convection in the field of a 'magnetic barrier' created by the magnetic field compressed above the ionopause.

Here the magnetic field of a 'barrier' at 250 km should be $\sim 60\gamma$ to preserve on the ionopause the pressure balance with the solar wind ram pressure $\rho V^2 \cos^2\chi \sim 1.6\ 10^{-8}$ dyn/cm^2. and $N_e k(T_e + T_i) \sim 0.5\ 10^{-9}$ dyn/(cm^{2}sec) [46, 47]. However, the magnetic field of the same order of magnitude at the ionopause height, can correspond to the intrinsic field of the planet if the field $\sim 30\gamma$ [16] measured in the Mars-2 orbit pericenter at $h = 1000$ km with $\chi = 35-45^{\circ}$ is extrapolated to these heights. In this case the convection in the Clotier and

Daniel model [31] can correspond to the plasma convection in the Mars magnetosphere created by intrinsic magnetic field, and Mars' ionopause can be a boundary similar to the Earth's plasmapause. As it has been mentioned above the properties of the martian dayside ionosphere were consistent with those of the ionosphere of the planet protected by the intrinsic magnetic field from direct exposure to the solar wind. Along with this 'Mars-2' recorded drastic changes in the properties of plasma and magnetic field of the transition layer typical of the entry the dayside magnetosphere for $\chi = 34$ to 37° at 1000 to 1500 km. This boundary was considered as a boundary of an obstacle, i.e. of Mars' "intrinsic" magnetosphere.

The situation in the Venus ionosphere is somewhat different.

Radio-occultation data show that unlike Mars' ionosphere the extent of the Venus' dayside ionosphere increased with the zenith angle growth; the ionopause height h_u increased, and $h_u(\chi)$ up to $\chi \sim 60^{\circ}$-70° almost corresponded to $1/\cos^2\chi$ [33] determined by the ionopause balance with the solar wind dynamic pressure $\rho V^2 \cos^2\chi$ [21]. Topside ionosphere of Venus (in particular 'ionolayer' forming there) cannot be described by purely ionospheric mechanisms without consideration of the solar wind direct influence upon the ionosphere [21, 48].

Thus the Mars and Venus topside ionosphere properties are different; At the Venus an immediate contact of the solar wind plasma with ionosphere is obvious, i.e. the ionopause is really a boundary between thermal ionospheric plasma and solar wind.

It should be emphasized that the Ne(h) profile calculation technique used by Clotier and Daniel [31] for Mars' ionosphere which took into account the convection and 'magnetic barrier' turned out to be less successful than in the case of Venus' ionosphere.

The authors explain it by great mobility of the Venus ionosphere upper boundary due to influence of the solar wind, in fact admitting the difference between the upper ionosphere properties of the two planets.

Thus, if the obstacle upper boundary on the dayside of the planet had an altitude ∼1000 km ('Mars-2' data [6]) then in the given case the obstacle size near Mars in the noon region 3 times exceeded those of Venus

Mars obviously has larger cross sizes compared to Venus near the terminator an obstacle altitude near Mars is 2000 km (Vaisberg et al. [14, 15], Dolginov, Gringauz et al. [16], and ∼1000 km near Venus (Verigin et al., [20]). The authors [38] who assumed the existence of the low-latitude cusp in Mars magnetosphere, noted that ". . . the Mars intrinsic field is obviously sufficient to increase the magnetospheric cross-section near terminator and in the tail compared to atmospheric interaction characteristic of Venus".

As is known the bow shock near Mars is farther removed from the planet than that near Venus. It is an essential difference between the Martian and Venusian solar wind-planet interaction regions.

Table 1

Planet	h_{max} km	$h_{ionopause}$ km	N_e max, cm^{-3}	T_e °K	$n[CO_2]$, cm^{-3}	T_n, °K	B_0, γ	ω_i sec^{-1}	ω_{e} sec^{-1}	ν_{en} sec^{-1}	ν_{in} sec^{-1}	σ_1 Mo/m	σ_2 Mo/m
Mars	135		$1.7 \cdot 10^5$	300°	$8 \cdot 10^9$	180°	a) 60 [49]	0.15	$8.8 \cdot 10^3$	23	4.6	0.02	0.55
	[42]		[42]		[45]	[53]	b) 5 [25]	0.015	$8.8 \cdot 10^2$	23	4.6	0.02	5.5
Venus	140	300-500	$5 \cdot 10^5$	400°	$4 \cdot 10^{10}$	$285^\circ \pm$ $\pm 10^\circ$	10	0.03	$1.76 \cdot 10^3$	132	23	0.6	8
	[33]	[33]	[33]		[48]	[54]	[16]						

Russell [24, 25] and Vaisberg et al. [13, 14] believe that the averaged position of the Mars bow shock was nearer to the planet than the authors of the 'intrinsic Mars' magnetosphere concept (Dolginov et al., [49, 50], Gringauz et al. [34] has evaluated, i.e. nearer than it could be if Mars has an intrinsic magnetic field with the value consistent with the estimates made by Dolginov et al. [49, 50].

The mean bow shock position does not characterize the obstacle nature since the obstacle model must be consistent with all bow shock positions observed (including the farthest from the planet). The fact that Vaisberg et al. [13, 14] and Russell [24, 25] used the averaged bow shock position to analyze the obstacle nature was repeatedly criticized by Gringauz [7], Gringauz et al., [51], Dolginov [32], Breus [21]). However, even a comparison of the averaged positions of both bow shocks shows that the bow shock near Venus is much nearer to the planet than that of Mars. Fig. 5 shows the mean position of the front near Mars (Vaisberg et al., [13]) that is nearer to the planet than according to measurements made by Gringauz et al. [52] and the mean front position of Venus, according to the data of the 32 bow shock crossings by Venera-9 and Venera-10 (Verigin et al. [20]). The bow shock near Venus is obviously closer to the planet than the Mars bow shock. It is quite consistent with the above-mentioned lower size of the obstacle near Venus as compared to Mars.

3. Following the hypothesis on the ionospheric nature of an obstacle of both planets Russell assumed however that an obstacle near Mars might have larger sizes than that near Venus due to a higher conductivity of the Mars ionosphere as compared to the Venus one [28].

Comparison between the atmosphere and ionosphere properties of the two planets is not in favour of such a conclusion.

Table 1 gives the characteristics of the planetary ionospheres and neutral atmospheres, the magnetic field values according to Russell [25] and Dolginov et al. [16, 49] as well as the Larmor frequencies ω_e and ω_i which can be used to estimate the conductivity and the collision frequencies ν_{en} and ν_{in} of electrons and ions. To calculate ν_{en} and ν_{in} the data of most recent atmospheric models were used based on experimental data (obtained in particular from Viking's data) which imply that the atmospheres of both planets in the region of the main ionization maximum completely consist of CO_2, and the ionospheres of O_2^+ [45, 48]. In addition to CO_2 the Venus atmosphere contains atomic oxygen at $h \approx 160$ km $n[O] \sim 50\%$ $n[CO_2]$ [48], [55]; considerable concentrations of O in the Venus atmosphere that were ignored here can only increase an estimate of the conductivity of the Venus' atmosphere.

Two final columns of Table 1 give the estimates of Pedersen σ_1 and Hall σ_2 ionospheric conductivities in the main maximum of ionization for various estimates of planetary magnetic fields. To compare the estimates we can obviously restrict ourselves to the values of σ_1 conductivities in the maximum, since the upper atmospheres have sufficiently close extent and properties for such a comparison (Fig. 4a, b).

According to the PIONEER-VENUS data the ionosphere magnetic field value must be lower than $B = 10\gamma$ measured by VENERA-4 at height of 200 km [49]. The use of the lower values of B will increase the estimated conductivities of the Venus ionosphere as well as taking into account other components (in addition to CO_2) of the atmosphere.

Table 1 shows that according to the magnetic field values for both planets (Dolginov et al.) the conductivity of the Venus ionosphere exceeds by an order that of the Mars ionosphere. For $B_0 \sim 5\gamma$ near Mars (Russell [25]) the conductivities are about the same. It should be also mentioned that the electric field $E = -\frac{1}{c}[V \times B_{interpl.}]$ inducing currents $j = \sigma E$ (where V is the solar wind bulk velocity, $B_{interpl.}$ is the interplanetary magnetic field) in the Venus ionosphere should exceed the electric field inducing currents in the Mars' ionosphere because of the $B_{interpl.}$ decrease by about of factor of 2 to 3 with the increase of the heliocentric distance between Venus to Mars.

Thus, the idea about more intense induced magnetic field near Mars which increases the size of an obstacle more than 3 times against that of Venus due to a higher conductivity of the Mars' upper atmosphere is unconvincing.

The above-given considerations on the bow shock position and the obstacle sizes near Venus and Mars confirm a viewpoint of the "intrinsic" magnetosphere of the Mars.

4. Different variations of Mars' and Venus' bow shock positions are essential for finding out the obstacle nature (Gringauz [7]).

Fig. 5 distinctly shows a stable position of the bow shock near Venus and a large amplitude of variations of bow shock position near Mars. According to the data of Bogdanov and Vaisberg [12] a change of the subsolar point of the bow shock near Mars was up to 1R.

A large amplitude of bow shock variations, by the order of magnitude corresponding to the magnetosphere sizes in the front region ($\frac{\Delta R\ \mathrm{magnetosphere}}{R\ \mathrm{magnetosphere}}$) is known to be observed on the planets with the intrinsic magnetic field, such as Earth and Jupiter. In [12, 38] is assumed that such an amplitude of variations could be related to a change of orientation of greatly inclined magnetic dipole while rotating. The authors [12, 38], however, could not reveal this dependence.

According to the data of Ne(h)-profile observations from the Soviet Mars satellites and the Mariner Mars vehicles considerable variations of the Martian ionosphere extension and the upper boundary height were not detected. Along with this the Venus ionopause altitude varied from 280 - 300 km to more than 1000 km with a relatively stable bow shock position (Pioneer-Venus data).

Thus, the removed crossings of the Mars bow shock and a large amplitude of its variations cannot be explained in the framework of the concept on Martian obstacle of ionospheric nature.

5) The bow shock of Mars(like the Earth's one) has a trend to move farther from the planet when the solar wind ram pressure ρV^2 decreases (and vice versa).

As to Venus the cases were observed when the front position had an unusual dependence on ρV^2 (Verigin et al. [20]). Thus, in Fig. 5, points (a), (b) the bow shock position corresponded to dynamic pressures 4.10^{-8} and $4.2.10^{-8}$ $\frac{dyn}{cm^2}$ and in the point (c) ρV^2 sufficiently increased (8.410^{-8} $\frac{dyn}{cm^2}$) the bow shock, however, removed from the planet.

Such a difference in the behavior of bow shock near the Venus and near the Mars can be explained by the contribution of the induced field B_{ind} to the pressure balance at the obstacle boundary near Venus (Breus [21]).

Since the field $\mathcal{B}_{ind}$ is produced by the currents generated by the electric field $E = -\frac{1}{c}\left[V \times B_{interpl}\right]$, then with an increase of solar wind velocity and ρV^2, respectively, B_{ind} must also increase and the pressure balance can sustain if the bodunary position is the same. So, the behaviour of obstacle boundary created by the induced magnetic field can be different than the behavior of the magnetopause of the magnetosphere created by the intrinsic magnetic field. The Mars intrinsic magnetosphere, however, has relatively small sizes.

It has been earlier mentioned (Dolginov, Gringauz et al. [16]) that the magnetosphere boundary because of relatively small size of the magnetosphere when the dynamical pressure of the solar wind was high could approach the surface at rather short distances and in such a case the transition layer plasma might immediately interact with the ionosphere. In such cases intense currents might be induced in the ionosphere and the magnetic field of these currents could be more distinct in the structure of solar wind-planet interaction region, changing the dipole field pattern near Mars. Thus during the Mars-5 pass on 20.2.74 the B_x-component sign changed in region 2-3, that is typical of the induction effect. In fact, the solar wind dynamic pressure was maximum that day in comparison to the other satellite passes (Dolginov, Gringauz et al. [16]) and the induction effect could be distinct in the Martian 'intrinsic' magnetosphere.

6. According to Russell the fact that the magnetic field maximum value was observed not at the shortest distance of the satellite orbit from the planet (the 'Mars-3' measurements on 21.1.72) is one more argument against Mars "intrinsic" magneto-

sphere. It should be emphasized, however, that if the planet has a dipole magnetic field and the magnetosphere has dayside cusps whose position and sizes depend on dipole inclination and the distance from the magnetopause to the planet, the satellite orbit pericenter can occur in the dayside cusp region (magnetic field depression zone). In that case the maximum magnetic field will not be in the orbit pericenter. Since a pericenter of Mars-3 orbit during the pass on 21.1.72 was at the areographic latitude-40° on the planet dayside [32] the effect noted by Russell could be associated with the Mars' magnetosphere dayside cusp.

7. Finally, to strengthen the viewpoint of a non-magnetospheric nature of a Mars' obstacle Russell uses the Vaisberg's et al. communication on heavy ion fluxes at the obstacle boundary layer and in the transition region behind the bow shock front [56].

Additional analysis of the experimental data [13,56] made by Bezrukikh et al. [57] showed that the peculiarities of data used by Vaisberg et al. for the conclusion on the detection of heavy ions can be explained without an assumption of heavy ions present in the plasma recorded.

It should be mentioned that there surely is a principal possibility of charge-exchange between the solar wind flow and the upper atmosphere and heavy ions in the solar wind-planet interaction region probably do exist both near Venus and near Mars irrespective of a character of their obstacles because of the direct contact of the solar wind ions with Venus' atmosphere and ionosphere and with the Mars' atmosphere and ionosphere in the dayside cusp regions. This effect is obviously present in the Earth's cusp regions also.

IV. Conclusion

It has been mentioned above that in addition to considerable similarity there are essential differences between the region of solar wind-planet interaction near Venus and near Mars. Among them are, in particular, lesser sizes of a Venus obstacle compared to Mars' one, respectively, the bow shock near Venus is closer to the planet; there are different dependences of the dayside ionesphere properties on the Sun's zenith angle.

Analysis of the total experimental data makes it possible to draw a conclusion that Venus' ionosphere and respectively induced magnetic field are decisive for formation of the bow shock and of the picture of solar wind flow around the planet. As to Mars, it is the intrinsic field of this planet that is essential in forming an obstacle decelerating the solar wind.

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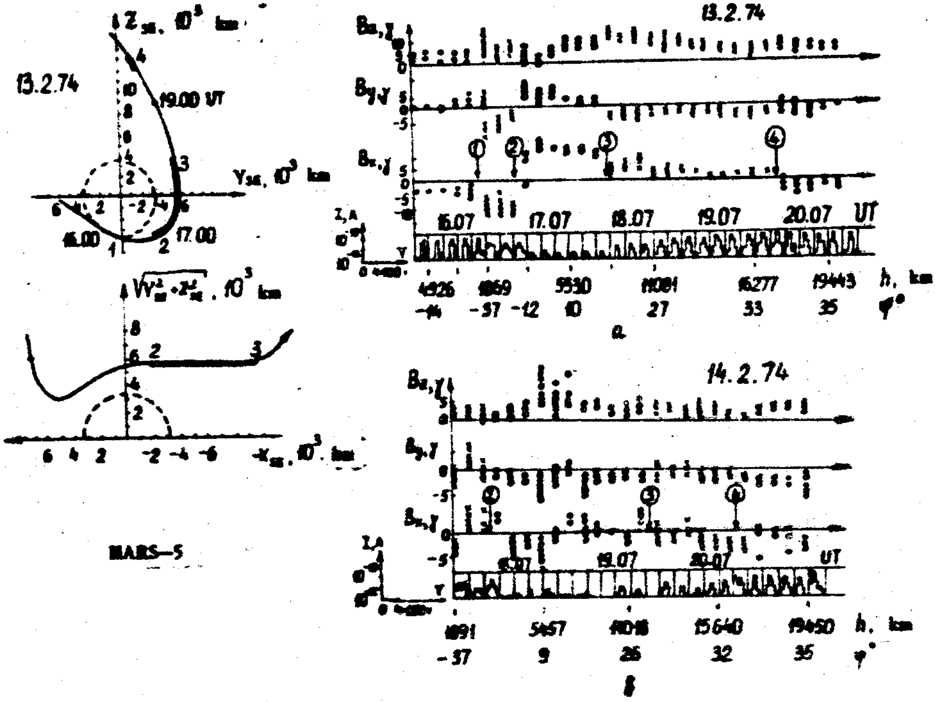

13.2.74
$Z_{se}, 10^3$ km
19.00 UT
17.00
16.00
$Y_{se}, 10^3$ km
$\sqrt{Y_{se}^2+Z_{se}^2}, 10^3$ km
$-X_{se}, 10^3$ km
MARS–5
13.2.74
B_{z}, γ
B_{y}, γ
B_{x}, γ
15.07
17.07
18.07
19.07
20.07
UT
4926
1869
5530
11081
16277
19443
h, km
-44
-37
-12
10
27
33
35
φ°
a
14.2.74
1891
5457
11018
15640
19450
-37
9
26
32
35
б

Fig. 1

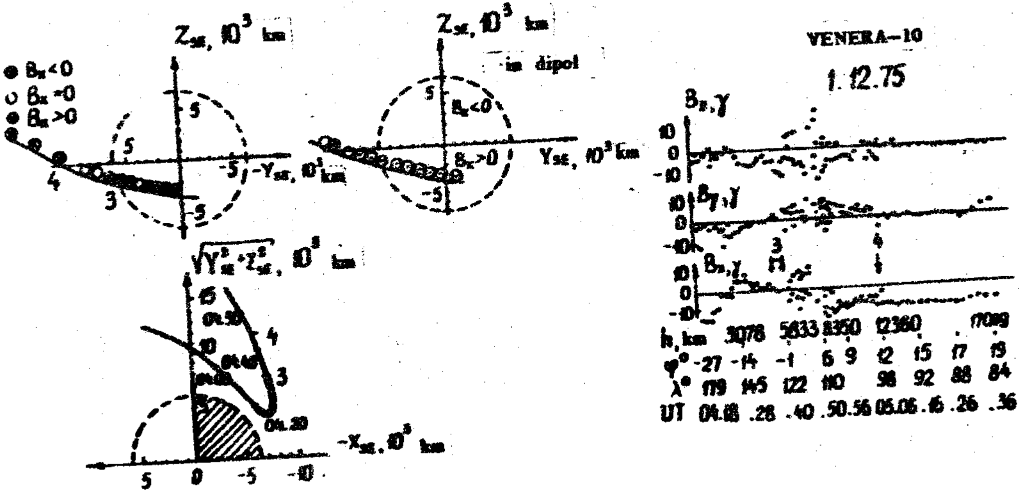
VENERA–10
1.12.75
● $B_x<0$
○ $B_x=0$
● $B_x>0$
Z_{SE}, 10^3 km
$-Y_{SE}$, 10^3 km
Y_{SE}, 10^3 km
in dipol
$B_x<0$
$B_x>0$
$\sqrt{Y_{SE}^2+Z_{SE}^2}$, 10^3 km
$-X_{SE}$, 10^3 km
04.50
04.40
04.30
04.20
B_x, γ
B_y, γ
B_z, γ
h, km 3078 5833 8350 12360 17089
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Fig.2

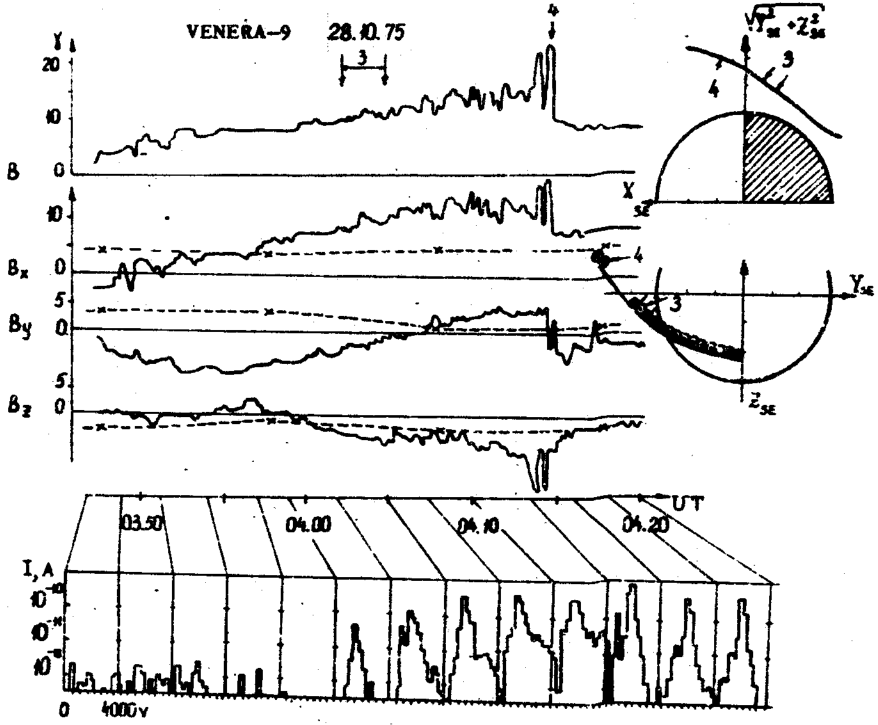
VENERA-9
28.10.75
3
4
γ
20
10
0
B
Bx
By
Bz
5
X_{SE}
Y_{SE}
Z_{SE}
$\sqrt{Y_{SE}^2+Z_{SE}^2}$
03.50
04.00
04.10
04.20
UT
I, A
0
4000v

Fig.3

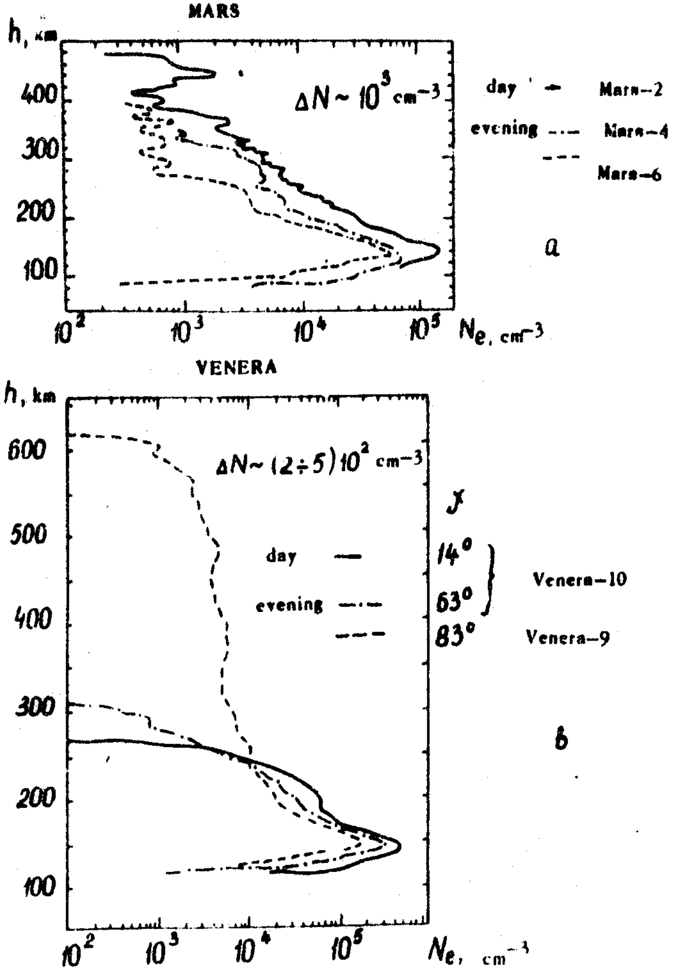
MARS
h, km
400
300
200
100
ΔN ~ 10^3 cm^-3
day — Mars-2
evening -·- Mars-4
--- Mars-6
a
10^2
10^3
10^4
10^5
Ne, cm^-3
VENERA
h, km
600
500
400
300
200
100
ΔN ~ (2÷5) 10^2 cm^-3
χ
day — 14°
evening -·- 63°
Venera-10
--- 83°
Venera-9
b
10^2
10^3
10^4
10^5
Ne, cm^-3

Fig.4

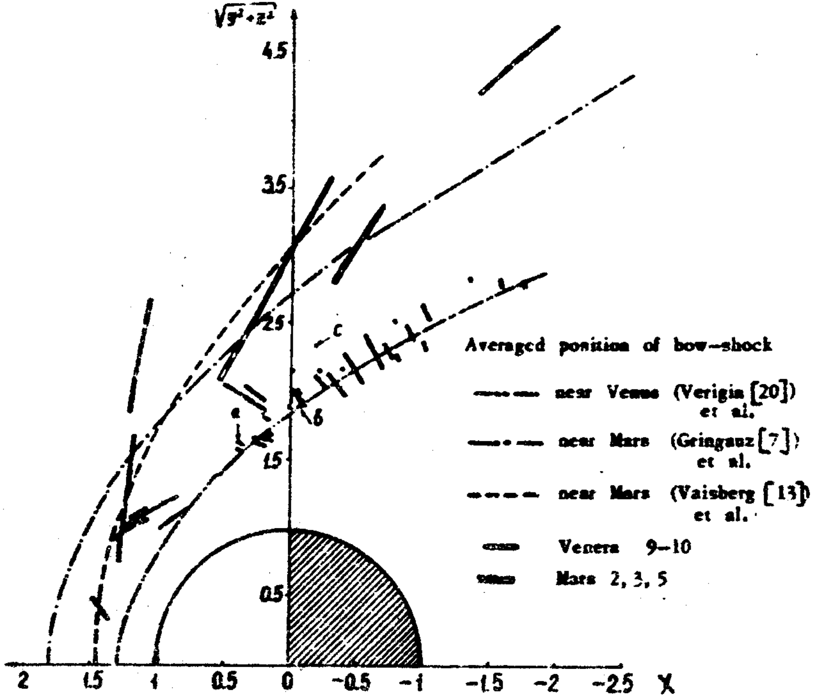
$\sqrt{y^2+z^2}$
4.5
3.5
2.5
1.5
0.5
2
1.5
1
0.5
0
-0.5
-1
-1.5
-2
-2.5
X
a
б
c
Averaged position of bow-shock
near Venus (Verigin [20] et al.)
near Mars (Gringauz [7] et al.)
near Mars (Vaisberg [13] et al.)
Venera 9-10
Mars 2, 3, 5

Fig. 5