Bulgarian Academy of Sciences. Space Research Institute.
Aerospace Research in Bulgaria. 18. 2003. Sofia

PHOTOELECTRIC CURRENT FROM THE SURFACE OF THE "INTERKOSMOS BULGARIA 1300" SATELLITE

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Abstract

Based on the information obtained from measurement of electron and ion density onboard the satellite, cases of evidently increasing electron density during the transition from shadow to sunlight are observed. Compared to the almost identical electron and ion density in the other parts of the satellites orbit this increase of electron current is interpreted as a photo current.

1. Introduction

An investigation carried out during the first scientific rocket experiments [1, 2] shows that the photoemission-generated photo current amounts approximately to 10^{-8}-10^{-9} A/cm^2. Similar values are obtained from theoretical calculations [3], producing an approximate photo current of $2{,}5.10^{-9}$ A/cm^2 with surface potential near 0 V.

The study is based on the probe measurements made onboard the "Interkosmos Bulgaria 1300" satellite.

2. Equipment description

This study is based on data for electron temperature and density from the device P7, and ion density from the device P6, as well as the probe-satellite potential difference measured by the device IESP. The value of the probe-satellite potential difference is calculated based on data obtained from the Langmuir probe (device P7) in the way described in [5].

Ion density is estimated based of the data from the three-electrode spherical ion trap (device P6), whose external grid is under "floating potential".

One of the sensors of the device IESP that measured electrical field is used as a base: the potential difference between the probe and the satellite body is measured continuously.

Below are shown the results from the measurements of a couple of selected satellite orbits.

3. Measurement results:

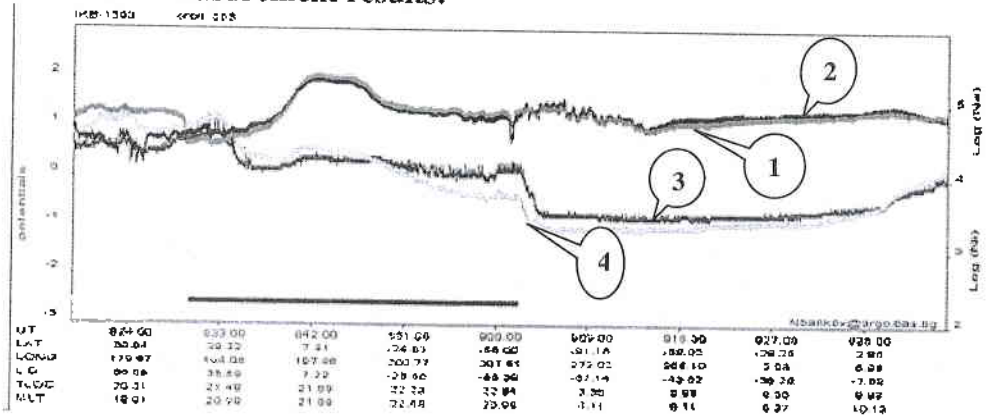

Fig.1

In Fig.1 are presented the results from the measurement of the following parameters along orbit No.583:

1- Ion density; 2-electron density; 3- potential difference between the probe and the satellite body, calculated from the volt-ampere characteristics (device P7); 4- potential difference between the probe and the satellite body, measured directly (device IESP).

The dark line in the lower part of Fig.1 corresponds to "shadow" i.e. the orbit is partially in shadow. The shapes of the two densities are identical except for the points of transition from "sun" to "shadow" and vice versa. This is true almost whenever the condition of electro neutrality of satellite-surrounding plasma is fulfilled.

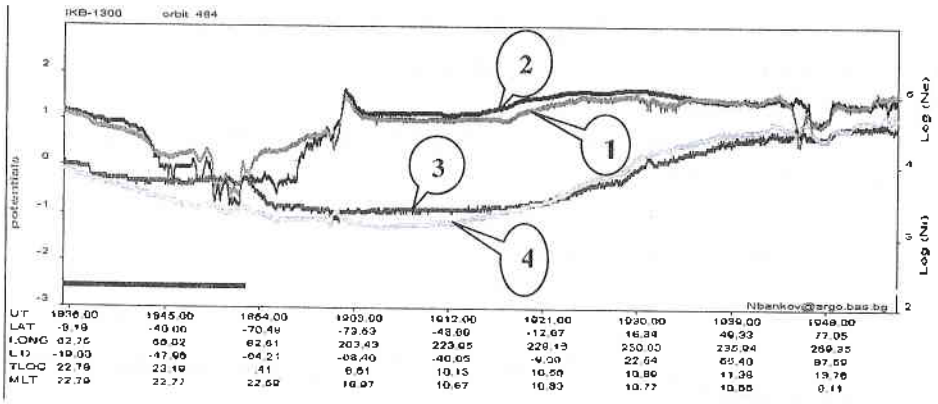

Fig.2

In Fig.2 are shown the same parameters. The difference is that (No.484) in this case, the satellite is completely in the "sun". It may be seen that, in this case, the curves of both concentrations match. With transition from "shadow" to "sun" significant increase in electron density is observed.

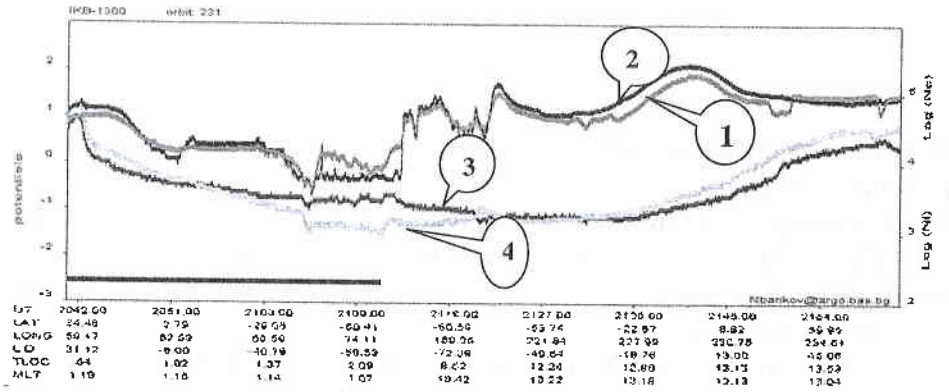

Fig.3

On Fig.3 is sown case of transition of the satellite from dark to sun part of the orbit No.231. It is visible that at a transition between two areas, electron density visible accrues in comparison with ion density, and in the rest part of the orbit both densities are with the same order.

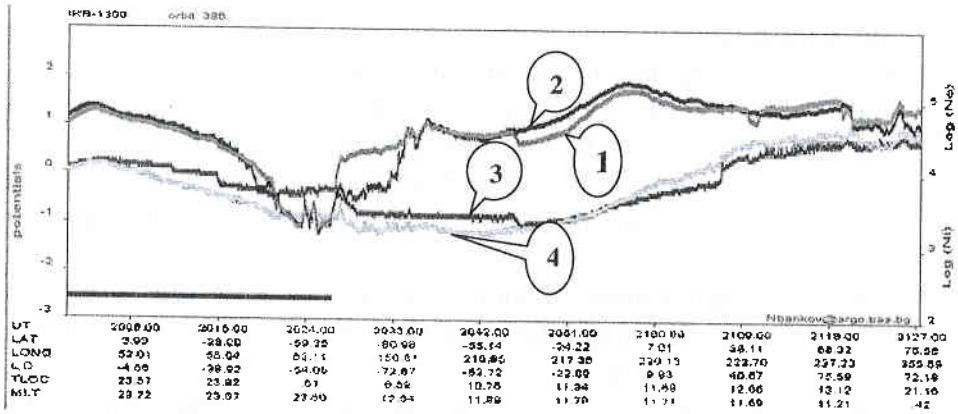

Fig.4

In Fig.4 are shown the same parameters for orbit No.386. In this case the transition from "shadow" to "sun" results in a jump in electron density compared to ion currents. The value of these parameters for (Fig.1 and Fig.2) is about $0,5.10^3$ cm $^{-3}$ for both cases.

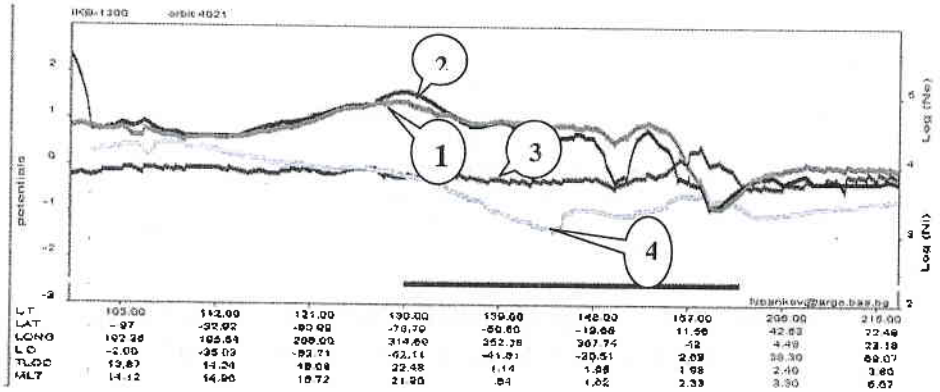

Fig.5

In Fig.5 are shown the values of these parameters for orbit No.4021.

Electron and ion density have almost the same value independently from the two transitions from shadow to sun and vice versa.

In contrast to the cases from Fig.3 and Fig.4, the curves indicating the behavior of the potential difference between the satellite body and the sensor, have value about 0 volts.

4. Conclusions

The analysis of the presented observations shows that:

- It is observed increasing (with jump) of the electron density in the order of $0{,}5.10^3$ cm^{-3} when the potential difference sensor-body is positive through the satellite's transition from dark to sun along the orbit. This phenomenon is attributed to photocurrent.
- The phenomenon "photocurrent is not observed when the potential difference between the sensor and the body of the satellite is negative.
- The equalization of the electron and ion density after the "jump" defined as a photocurrent is probably caused by the next rise in ion density. As was explained above, the outer grid of the three - electrode ion trap (device P6) is isolate from the body and did not influence on the photoelectrons.

References

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ФОТОТОК ОТ ПОВЪРХНОСТТА НА СПЪТНИК "ИНТЕРКОСМОС БЪЛГАРИЯ – 1300"

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Резюме

На базата на информация от измерители на електронната и йонна концентрация, работили на борда на спътника са установени случаи на видимо повишаване на електронната концентрация при прехода на обекта от неосветената към осветена част на орбитата. На фона на почти съвпадащи си йонна и електронна концентрации в останалата част на посочените орбити това повишаване на електронния ток е интерпретирано като фототок.