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ESTIMATES OF THE UPPER LIMIT OF ION TEMPERATURE IN THE 7000-30000 KM ALTITUDE RANGE ACCORDING TO MEASUREMENTS ABOARD AES "ELEKTRON-2"

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SUMMARY

Estimates of the upper limit of ion temperature in the 7000-30000 km. altitude range are made with the aid of an earlier described method, using the data of collector current variations of the charged particle trap, having a zero potential in the outer grid because of spacecraft spinning.

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This method was described in reference [1]. It allowed the measurement of ion temperature provided the device's orientation relative to spacecraft's velocity vector is known, and the observations are conducted uninterruptedly.

If these conditions are not fullfilled as is the case, for example, in the experiments on "Elektron-2", only the upper limit of ion temperature can be estimated by the maximum difference for the given region in the values of the collector current, modulated by satellite spinning.

The results of estimates made by the above method aboard "Elektron-2" in January I964 are as follows:

R	2,1	3,5	4,2	4,3	5,3
T_i,eV	0,65	0,85	1,1	1,1	1,1

where R is the geocentrical distance in Earth's radii R_E.

The only results of measurements of elektron (T_e) and ion (T_i) temperatures at such substantial distances from the Earth (through$\sim$I4 R_E) among the published ones were obtained with the aid of a charged particle trap on AES "IMP-2" [2,3] (refer to Fig.1).

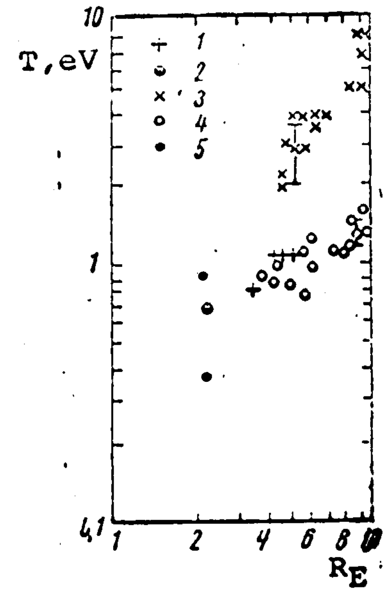

Fig.1.

Results of measurements on "Elektron-2" and "IMP-2". "Elektron-2": 1) T_i; 2) T_e in perturbed conditions; "IMP-2": 3) T_i; 4) T_e; 5) T_e in perturbed conditions.

Measurements on IMP-2 and Elektron-2 were conducted in the same year and pretty close in season. During the comparison the geomagnetic environment was taken into account.

It may be seen from the figure that the upper limits of ion temperature obtained from Elektron-2 at various distances from the Earth agree well with the results of measurements of electron temperature on IMP-2, but are substantially lower than the ion temperatures measured on the latter.

It follows from the experimental data related to the region of heights $< 2R_E$ that the ratio T_i/T_e is everywhere and nearly always less than the unity (with the exception of rare cases in the equator in nighttime) [4-6].

The theoretical calculations [7-9] related to the same region of heights and also the calculations describing the distribution of charged particles in the protonosphere [7] are evidence that in the absence of local selective sources of heating the ion temperature must not exceed the electron temperature at great distances from the Earth [9].

When comparing our own estimates of ion temperature's upper limit with the electron's temperature T_e according to measurements on "IMP-2", there is a good agreement with the above concept. Unfortunately it is impossible to judge about the form of altitude dependence of the ratio T_i/T_e from the data on the upper limit of T_i.

In order to explain the excess of ion temperatures over the electron ones and the rise of the ratio T_i/T_e with the altitude increase at distances from $5R_E$ to $10R_E$, the authors of [2,3] assume the existence of a selective heating source acting upon the ions near the boundary of the magnetosphere and of the thermalized interplanetary plasma [3].

The existence of sources of heating, bounded by interplanetary plasma and acting near the magnetosphere boundary appears to be quite realistic. However, the condition of existence of electrostatic ionic oscillations, by whose action on the magnetospheric plasma it is possible, according to authors' [3] opinion, to explain their results, is precisely $T_i/T_e \gg 1$.

This is why the explanation given in [3] does not appear to be quite successful. The question as to what causes the discrepancy of the results of our estimates with the data on T_i in the works [2,3] in the same altitude region, where measurements on "IMP-2" overlap with the estimates of the upper limit of T_i according to data of "Elektron-2" [see Fig.1], still remains obscure.

We may point to one of the possibilities of explaining these discrepancies, namely the difficulty of processing the volt-ampere characteristics of the type shown in Fig.2 of work [2] and Fig.3, 4 of the work [3] linked with the necessity of determining the inclinations of volt-ampere characteristics by very scarce point obtained with one volt variation intervals of the values of potential.

* * * THE END * * *

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Translated by

Dr. Andre L. Brichant

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