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At the satellite Cosmos-378, launched November 17, 1970 into the orbit with the perigee of 240 km, the apogee of 1700 km and the inclination of 74° the measurements of charged particles in the broad energy range (in particular of fluxes of electrons with $E > 40$ kev and $E = 0.8$–$10$ kev) and of density and temperature of ionospheric electrons and ions were made. These measurements could be performed continiously along the whole orbit with the help of the memorizing device installed on the satellite. In the present paper only a part of the data obtained during the flight of the satellite over the south hemisphere at the local time near the noon is given.

The steady influx of solar wind thermalized plasma into the magnetosphere from the magnetosheath were first observed at the ionosphere altitudes from the satellite ISIS-1 by Heikkila and Winningham [1] . This influx occurs through the regions near the neutral lines of the dayside magnetosphere. Frank [2] with the help of the satellite IMP-5 first discovered and examined these influxes of solar wind plasma both at the magnetopause and at different altitudes in the magnetosphere. Magnetospheric zones through which solar wind plasma penetrates into the dayside magnetosphere were labelled dayside magnetospheric cusps [1] or polar cusps [2] . Indications of the polar cusp were observed by Frank and Ackerson [3,4] in the range of ionospheric altitudes from the satellite Injun-5 at the local time $10^h$. The published information about polar cusps [1-5] is mainly concerned to the observations over north hemisphere of the Earth (in [2] it is reported about "presumably existence" of the south polar cusp); the data on the south cusp are significantly more poor (only in the dissertation by Winningham [5] we have found the results of observations of the south dayside cusp from the satellite ISIS-I at $10^h$ LT). There are no data in this information on simultaneous measurements of local parameters of ionospheric plasma.

Therefore the Cosmos-378 results of observations of low energy electrons precipitating into the high-latitude ionosphere over the Earth's south hemisphere at the local time near the noon and simultaneous measurements of the ionospheric plasma density and the temperature seem to be interesting. An example of measurement results of electron fluxes with energies >40 kev, electron fluxes with energies <10 kev, the ionospheric ion density and the ionospheric electron temperature obtained during the flight of the satellite through the high-latitude ionosphere on November 27, 1970 near the apogee (1500-1750 km) are shown in Fig. 1. During 13 min of the flight (from $8^h12^m$ to $8^h25^m$UT) the orbit of the satellite lies in the range of altitudes from 1700 to 1750 km; at this time the invariant geomagnetic latitude $\Lambda$ of the satellite at first increased from $70^\circ$ to $79;5^\circ$ and then decreased to $75^\circ$. It corresponds to variations of the local time from $9^h$ to $16^h$.

Thus the part of the satellite orbit under consideration is related to the same local time and the values of $\Lambda$, at which the sharp enhancement of ionospheric electron fluxes with energies <1 kev is observed over the north hemisphere from ISIS-1 [1] and Injun-5 [3, 4] and is identified by the authors of these observations with the polar cusp.

The detailed description of the devices installed on Cosmos-378 will be published elsewhere. In the present paper we notice only that electrons with the energy >40 kev are detected with the help of properly screened gas-discharge counter [6] . Spectra of electrons with energies <10 kev were recorded once each 15 sec by means of two cylindrical multilayered electrostatic analyzers, which were the modification of the device, described in [7] , in energy ranges with $\Delta E/E \cong 0.4$ at following values of $E$ : 1 kev, 2 kev, 4 kev and 8 kev. Measurements of the density of ionospheric positive ions were made with the help of the spherical ion trap, the photography of which is shown in [8] . The measurements of the ionospheric plasma temperature were performed in two different ways: by means of spherical Langmuir probe and spherical high-frequency probe. The external grid of the ion trap, which is similar to described in [3] , was used as a spherical Langmuir probe.

The decrease of the counting rate of electrons with energies >40 kev is the indicator of the boundary of the trapped radiation zone, i.e. boundary of closed geomagnetic field lines and the low-latitude polar cusp boundary at the dayside magnetosphere. Frank and Akkerson [3, 4] well foundedly call the boundary of the trapped radiation "natural coordinate", when considering the phenomena related to the particle precipitation in the high-latitude ionosphere.

Let us consider the results of measurements, shown in Fig. 1. From the top part of this figure it is seen, that the trapped radiation boundary ($\Lambda \sim 75^{o}$) was crossed by the satellite at $\sim 11^{h}$ MLT; fluxes of electrons with energies 0.8 - 10 kev did not exceed $4.10^{6} cm^{-2} sec^{-1} kev^{-1} ster^{-1}$ inside the radiation belt (values of fluxes indicated in this figure are maximum values, recorded in each energy range). In this region the fluxes are regular enough. Immediately after the crossing the mentioned boundary the flux of electrons with $E$ = 800-1200 ev sharply increases and sometimes exceeds $3 \cdot 10^{7} cm^{-2} sec^{-1} kev^{-1} ster^{-1}$. A certain increase of the electron fluxes are also observed in the energy range 1600-2400 ev. Fluxes of electrons with higher energy increase essentially less and their values never exceed $6 \cdot 10^{6} cm^{-2} sec^{-1} kev^{-1} ster^{-1}$ (broken line). It should be noted that in this region outside the trapped radiation boundary fluxes of low-energy electrons are greatly variable with characteristic times apparently less than the measurement time constant (0.2 sec). Values of fluxes in this region are also probably underestimated because of a certain influence of ultraviolet solar radiation and those values are distorted to some extent owing to interferences which seem to be connected with rapid variations of the satellite potential. However this does not change the general character of the behaviour of electron fluxes. Curves $\alpha$ shown in the figure give the angle between the magnetic field direction and the axis of analyzers.

At the decreasing of the satellite invariant latitude $\Lambda$ again to 75° at ~$15^{h}$LT the counting rate of electrons with $E$ >40 kev sharply increases, the satellite is returned into the trapped radiation zone and the fluxes of electrons with $E$=800-1200 ev decrease sharply, reaching the value $<10^{5} cm^{-2} sec^{-1} kev^{-1} ster^{-1}$ at $\Lambda \sim 70°$. The enhancement of the density of ionospheric positive ions from $3 \cdot 10^{h} cm^{-3}$ to $5 \cdot 10^{4} cm^{-3}$ at the altitude 1700-1754 km shown in Fig. 1 is observed in the zone of existence of intense fluxes of electrons with energies 0.8-10 kev. At last, the results of the measurements of ionospheric electron temperature $T_e$ are also shown in Fig. 1; the solid curve corresponds to averaged values obtained by means of high-frequency probe and triangles-by means of the spherical Langmuir probe with the period of time from 1 to 5 minutes. Both probes showed the significant growth of $T_e$ (from $3000^oK$ to $6000 \div 7000^oK$) during the transition from the trapped radiation zone to the precipitation zone of electrons with energies 800–1200 ev.

It is necessary to note that the data of the Langmuir probe gave us the opportunity to make some conclusions about the distribution function of ionospheric electrons. Besides the recording of the probe curve it was analysed by the modulation method similar to that used by Bowen et al. [9] . The analysis of the results showed that after the exit of the satellite out of the zone with closed geomagnetic field lines (after the fall of the counting rate of electrons with $E > 40$ kev), the velocity distribution of ionospheric electrons was often non-Maxwellian. This appeared to be caused by thermal plasma disturbances by fluxes of more energetic particles. So values of $T_e$ in the region of $\Lambda > 75^o$ are the measure of a certain "effective temperature", which represents the intensity of the disturbance of thermal ionospheric plasma in the region under consideration.

Samples of measurement results of electron fluxes with $E > 40$ kev and $E = 800$–$1200$ ev shown in Fig. 1, which correspond to the dayside high-latitude ionosphere over Earth's south hemisphere are similar to results of measurements carried out in the dayside ionosphere from the satellites ISIS-1 [5] , Injun-5 [3, 4] . Measurements from ISIS-1 showed, that in the range of $\Lambda$ from $74^o$ to $79^o$ the sharp growth of fluxes of electrons with energies of an order of hundreds of ev was observed (approximately by an order of value from $10^8$ to $10^9 cm^{-2} sec^{-1} ster^{-1}$)

and the highest energies (up to 1 kev) were observed near $\Lambda = 77^{\circ}$. Since the electrostatic analyzer on Cosmos-378 could record only the most energetic part of the electrons, recorded at $\Lambda \sim 74-79^{\circ}$ by means of ISIS-1, one can consider that values of electron fluxes recorded in the same range of $\Lambda$ from Cosmos-378 do not contradict to the data by Heikkila and Winningham [1] . Similarly to the observations by Frank and Ackerson, the sharp growth of fluxes of electrons with the energy of an order of hundreds ev from the results of Cosmos-378 takes place immediately outside the boundary of the trapped radiation zone.

Taking into account these points and that the range of local time included the noon, one can interpret the results of measurements of electron fluxes shown in Fig. 1 as the results related to the observations of the south dayside polar cusp and therefore as the additional experimental confirmation of the direct penetration of thermalized solar plasma from the magnetosheath into the ionosphere through the neutral band of the south dayside magnetopause.

It is seen from Fig. 1 that in the dayside polar cusp at altitudes $\sim$ 1700 km the density of ionospheric charged particles and the temperature of ionospheric electrons significantly increase. Local enhancements of charged particle density at different altitudes including 2000-3000 km in the high-latitude ionosphere have been observed by many authors [10-12] . Morse et al. [12] on the ground of the analysis of the data on simultaneous observations of the precipitation of electrons with $E = 2.5$ kev and the data of the ion trap from the satellite OVI-15 concluded that local enhancements of the charged particle density caused by electrons with the energy of the order of 1 kev and less penetrating into the ionosphere, can arise both beneath the maximum of $F$-region and above it. The experimental data, cited in [12] are, however, obtained only at nighttime. As for dayside polar cusps, the systematical enhancements of $F$-region critical frequencies in the region of the geomagnetic pole near the magnetic noon studied by Besposvannaya and Udovich [13] can serve as the indirect evidence of its influence n the ionosphere.

Present results of simultaneous local measurements of electron fluxes penetrating into the ionosphere from the dayside magnetosphere cusp and the enhancements of the ion density and the electron temperature are indicative of the ionizing effect of solar plasma electrons on the upper atmosphere. Apparently the ionisation and the heating of the ionosphere takes place at lower altitudes beneath the $F$-region maximum (according to [14] the altitude of maximum ionizing effect of electrons with $E \sim 1$ kev is $\sim 160$ km and with $E \sim 0.5$ kev $- \sim 240$ km) and positive ions detected by Cosmos-378 reached the altitude $\sim 1700$ km as the result of vertical diffusion.

In conclusion it should be noted once more the significant peculiarity of the orbit of Cosmos-378: this satellite covered the range of local time $\sim 5$ hours during one 10 min real time flight across the dayside cusp. Owing to this point the results of measurements from Cosmos-378 give the most convincing confirmation of the magnetospheric model by Winningham [5] and Heikkila [15], constructed on the ground of the data of many flights of the satellite ISIS-1 across the dayside cusp; according to this model the dayside cusp extends from the noon meridian for several hours local time in both sides.

## Figure caption

Fig. 1 Fluxes of electrons with $E < 10$ kev and $E > 40$ kev. Positive ion density ( $n_i$ ), electron temperature ( $T_e$ ).

MLT - magnetic local time,

LT - local time,

UT - universal time,

$\alpha_{N_e} < 10$ kev - the angle between the magnetic vector and the normal to the aperture of the electrostatic analyzer,

$\alpha_{N_e} > 40$ kev - the angle between the magnetic vector and the normal to the aperture of the gas-discharge counter.

$\Lambda$ - the invariant latitude,

$h$ - the altitude of the satellite over the Earth's surface.

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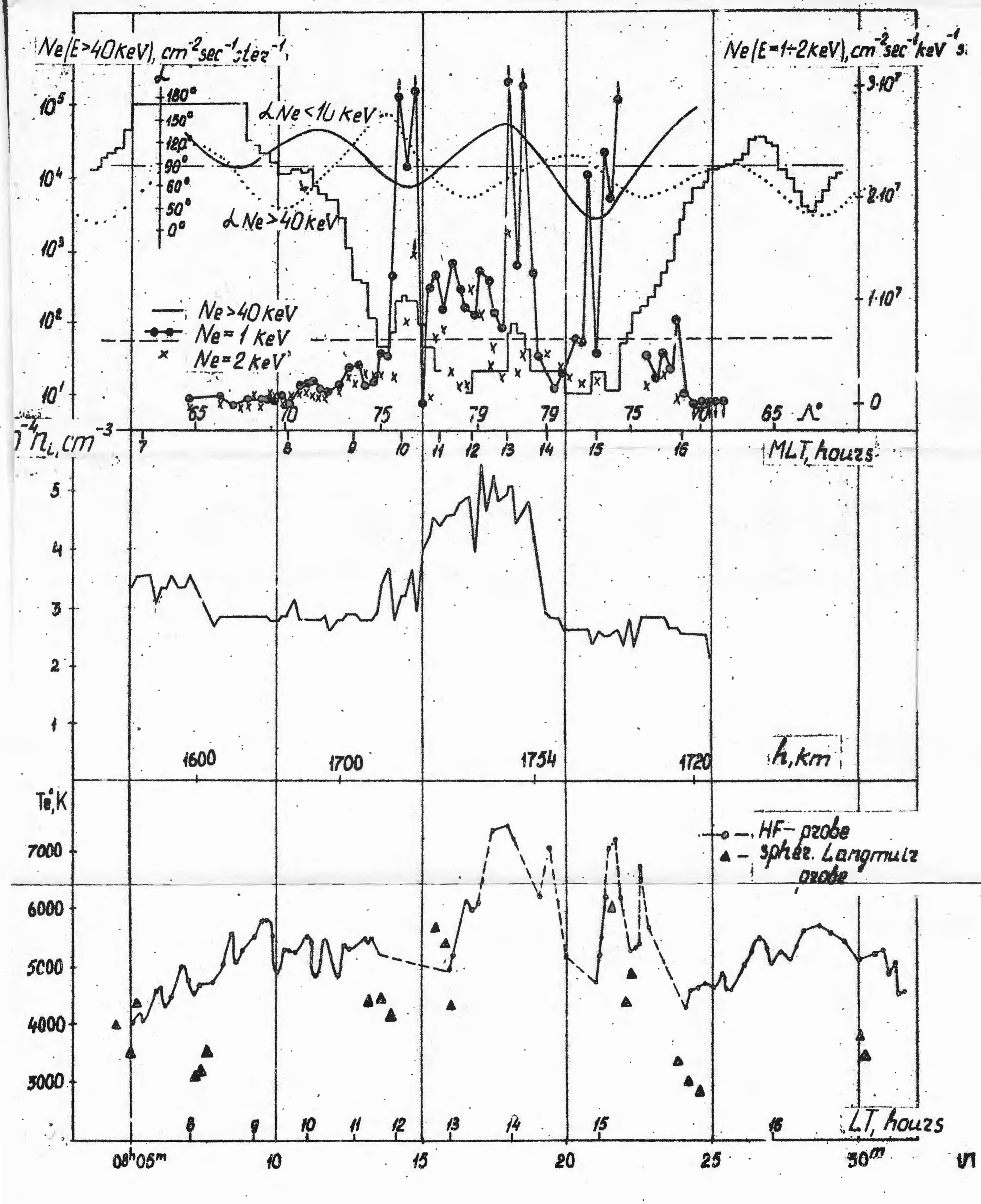

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