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In 1976 Gringauz et al. (1976a, b) analyzing the Venera-9 and -10 plasma measurements noticed that from these satellites electron fluxes always and reliably had been recorded deep in the Venus optical umbra and that the detected fluxes of electrons could ionize the neutral atmosphere of the planet and create its night ionosphere. The calculations of an ionization by electrons of the Venus atmosphere published later (Gringauz et al., 1976c, 1977a) and made under assumption of isotropic scattering of electrons in elastic and inelastic collisions had shown the sufficiency of the measured electron fluxes for the creation of the night ionosphere of the planet.

In 1977 at the IAGA Session in Seattle the calculations of collisional ionization by electrons of the Venus atmosphere were reported that had been made under the other extreme assumption: the direction of a moving electron experienced a collision does not change (Gringauz et al., 1977b). These calculations published later in the J.G.R. (Gringauz et al., 1979b) were carried out using the results of the measurements of the electron flux spectra in those 9 cases when from the Venera-9 and -10 spacecraft the electron density profiles $n_e(h)$ for the night ionosphere of Venus were simultaneously measured by means of the radio-occultation technique. The correlation has been revealed between the fluxes of electrons in the Venus optical umbra and the electron density in the radio-occultation profile maximum n_{em} and therefore the conclusion has been made that it is the fluxes of electrons with energies of several tens of electronvolt detected by the Venera-9 and -10 which are responsible for forming the main upper maximum of ionization (Gringauz et al., 1977b, 1979).

It should be noted that the above mentioned calculations were made with the parameters of the night neutral atmosphere of Venus not well known enough. The direct measurements of the content and the density of neutral particles n_n in the vicinity of the ionization maximum were not available; and n_n-value for the upper atmosphere models existed was too high at these heights and did not allow ionizing electrons to reach the maximum ionization height. So, for example, in Marov and Ryabov's model of the Venus atmosphere accepted by COSPAR (Varna, 1975) and in Dickinson and Ridley's model, (1977), the n_n-value $\approx 6x10^{10}$ cm^{-3} at 140 km was given (CO_2-content was $\approx$95% and $\approx$60%, respectively). The dotted curve in Fig. 1 shows the dependence $n_n(h)$ according to Marov and Ryabov's model of the neutral atmosphere (1974) and the chain-dotted line shows that according to Dickinson and Ridley's model (1977) (for the solar zenith angle $\chi = 150^0$).

Since the authors of the Venera-9 and -10 electron measurements were convinced that the correlation between the electron fluxes measured at $\approx$1500 km and n_{em} testified that electrons with energies of several tens of electronvolt reach the height of about 140 km and are the main source of ionization they made a conclusion that the proper value of n_n at this height is $\approx$30 times less than the value given by the models and is $\approx 2x10^9$ cm^{-3} (Gringauz et al., 1977b, 1979). The dependence $n_n(h)$ given in (1977b, 1979) is presented in

Fig. 1 as the dotted-curve with a circle (height scale H_h $\approx$ 5 km).

Among the results of the Pioneer-Venus measurements in the Venus vicinity there are the data on the neutral and ionized components of the Venus upper night atmosphere and on the electron fluxes obtained at heights of the night ionosphere. These data allow us to check the conclusions made by the authors in their previous publications (Gringauz et al. 1976c, 1977a,b, 1979).

The data of the Pioneer-Venus quadrupole mass-spectrometer measurements proved that at height of $\approx$140 km ($\chi \approx 150^o$) $n_n \approx 5\times10^9$ cm^{-3} (CO_2 ($\approx$60%) and O($\approx$30%)are the main components (Nieman et al., 1979) . The solid line in Fig. 1 shows the dependence $n_n(h)$ plotted based on these data. As seen, the results of the direct measurements of n_n much better agree with this dependence given in (Gringauz et al., 1977b, 1979) than with the data of the neutral atmosphere models available in 1977-78. Hence, the corrections made for n_n in the Venus neutral atmosphere model made in our publications mentioned above turned out justified. The significant amount of atomic oxygen at ionospheric heights, that results in O_2^+ being the main ion at the n_e-maximum altitude must not lead to the changes in the conclusions of these papers since the coefficients of dissociative recombination of ions O_2^+ and CO_2^+ are very similar (Gringauz et al., 1979). However, now, when the results of direct measurements of the density and of the chemical content of the Venus night upper atmosphere are available is of interest to repeat the previously made calculations of the ionizing effects of the electron fluxes using the parameters of the real Venus atmosphere experimentally obtained by

Nieman et al. (1979).

To take into account the effect of atomic oxygen on the height variation of the distribution function f of the ionizing electrons we introduced 4 terms to the right-hand side of Eq. (2) from Gringauz et al.'s papers (1977b, 1979) proportional to n_o and similar to the terms of Eq. (2). The ionization rates $q_{CO_2^+}$ and q_{O^+} were calculated after the determination of f using the equations analogous to (5) (Gringauz et al., 1977b, 1979). The ionization and excitation cross-sections of Eqs. (2) and (5) for CO_2 and O were calculated according to the data of Jackman et al.'s paper (1977). The ionospheric electron density was determined from the following expression:

$$n_e(h) = \sqrt{(q_{CO_2^+} + q_{O^+})/\alpha_{O_2^+}}$$

where $\alpha_{O_2^+} \approx 2.2 \times 10^{-7}$ cm^{-3} sec^{-1} (Bardsley, Biondy, 1970) is the coefficient of dissociative recombination of O_2^+-ions with electrons with $T_e \approx 300^\circ$K.

The smooth line in Fig. 2 shows $n_e(h)$-profile calculated using the data of the Venera-9 electron flux measurements on October 28, 1975 ($h \approx 1700$ km; $\chi = 142^\circ$). The broken line in this figure gives the results of $n_e(h)$-determination using the data obtained during the satellite radio-occultation ($\chi \approx 150^\circ$) being ≈ 11 minutes later (Aleksandrov et al., 1976). As seen, $n_e(h)$-profile calculated from the electron flux measurement data with taking into account the parameters of the Venusian real night atmosphere (but not their model values) agrees well with the radio-occultation profile in terms of the height of n_e-maximum, value of $n_{e\,max}$ and the width of the layer at $n_{em}/2$-level. So, the results of direct measurements confirm the idea about the electron source of ionization of the Venus night ionosphere.

From 1978 the electron source of ionization in the Venus night atmosphere was the subject of discussion and was admitted as possible (Chen and Nagy, Gravens et al., 1978; Kliore et al., Brace et al., Intrilligator et al., Jonson and Hanson 1979). The transfer of O^+-ions from the day ionosphere, their following diffusion downwards and the ion-moleoular reaction with CO_2 was considered as a competing mechanism of ionization (Taylor et al., Kliore et al., Brace et al., Jonson and Hansen, 1979). However, those source of ionization results in forming $n_e(h)$-profile 2-3 times wider at $n_{em}/2$-level as compared with the profile formed due to ionization by electrons (see Fig. 4 of Brace et al.'s paper (1979)). The wider diffusion profile $n_e(h)$ has the maximum at a height h_m determined from the condition when the characteristic time of diffusion of O^+-ions and the characteristic time of reaction $O^+ + CO_2 \rightarrow O^+ + CO_2$ are equal, i.e. $\tau_D = H_h^2 / D = \tau_{ch} = (k[CO_2])^{-1}$, $K = 1.2 \times 10^9$ cm^3 sec^{-1}. With the diffusion coefficient $D \approx 10^{19}/n_h$ cm^2.sec (Bauer, 1976) this condition leads to $h_m \approx 155$ km ($n_h(h_m) \approx 3 \times 10^8$ cm^{-3}). So, the contribution of O^+-ions transferred from the day ionosphere can be probably essential for the part of the $n_e(h)$-profile being over the maximum of the Venus night ionosphere ionization.

The critical attitude to the electron source of the Venus night atmosphere ionization was based on the absence of the night atmosphere glow registration (Krasnopolsky, 1978; Jonson and Hansen, 1979) and the lack of experimental data from the Pioneer-Venus satellite on ionizing e'^ctron fluxes existing in the ionosphere being available du> the preparation of

Kliore et al., Brace et al.'s (1978) papers . However, as it has been shown in Breus (1978) and Cravens et al. (1978)'s papers the estimates of glowing at 5577Å made by Krasnopolsky (1978) are not reliable enough. Stewart et al. (1979) who at first attributed all glowing ≈6 kR in the vicinity of 2060Å to the Cameron band (O, O) CO (based on which the flux of energy of electrons precipitating into the night atmosphere (≈ 0.1 erg cm^{-2} sec^{-1}) was estimated) changed afterwards their viewpoint (Steward and Barth, 1979) but the upper level of the CO radiation intensity in the Cameron bands held true in their paper ($\lesssim 4$ kR) is still high enough and does not evidently contradict the assumption about the electron source of ionization. (To make a more reliable conclusion it should be waited when the UV-spectroscopic results of the Pioneer-Venus measurements within 2800-3400Å are published).

The measurements of the electron fluxes made by Intrilligator et al. (1979) directly in the Venus night ionosphere, have shown that energetic electrons reach really ionospheric heights. It is, from our viewpoint, the decisive argument in favour of the fact that the ionosphere near the upper maximum of n_e is formed due to the collision ionization. According to the data of Intrilligator et al. the flux of electrons with energies 50÷500 ev in the night ionosphere is quite enough for its formation. If these measurements are reliable (the value of the fluxes is not given) the idea about low-energetic electrons proposed by Gringauz et al. (1976a, b, c, 1977a, b, 1979) as a source of ionization in the night ionosphere should be considered as proved.

In conclusion let us briefly comment a source of electrons producing the night ionosphere. The source of energy they contribute into the night atmosphere is undoubtedly the origin of the solar wind, however, the way of its transfer may be rather long and not quite clear yet. As is known, there is the plasma-magnetic tail behind Venus revealed by the measurements of the electron componen of the plasma and the magnetic field (Verigin et al., Dolginov et al., 1977) . It possesses many properties of the Earth's magnetic tail. The magnetic field in the Venus plasma-magnetic tail is characterized by the presence of two bundles of field lines separated by the layer where the magnetic field energy density is minimum. In the vicinity of this layer there are detected the fluxes of energetic ions - the plasmasheet - where ions with energies 2÷4 kev were recorded (Verigin et al., 1977, 1978) . The physical processes resulting in heating ions in the plasmasheet of the Venus plasma-magnetic tail effect also on electrons increasing their energy. In this respect electrons precipitating into the night atmosphere from the Venus plasma-magnetic tail may be are not electrons of the solar wind.

Energetic ions of the plasmasheet invading into the Venus atmosphere will also cause its ionization. This source of ionization (Verigin, 1978) has the necessary property of the variability, it is more effective at lower heights than the electron fluxes and can be proposed as one of sources responsible for the formati[illegible] of the sporadic second (lower) maximum of n_e. The Venera-9 and -10 did not measure the fluxes of the plasmasheet ions directed to Venus. The ion fluxes directed from Venus are 0.5÷5% of the flux of ions in the solar wind (see e.g. Figs 8 and 9 in Verigin et al.'s paper (1977, 1978)) and if the fluxes of ions in the plasmasheet are mainly isotropic it should be expected (according to the estimates of ionization caused by protons in the Venus atmosphere made by McElroy, Strobel (1969) and Bauer (1976)) that the ionization, these fluxes produce, can turn out to be comparable with the ionization observed in the lower maximum of the Venus night ionosphere.

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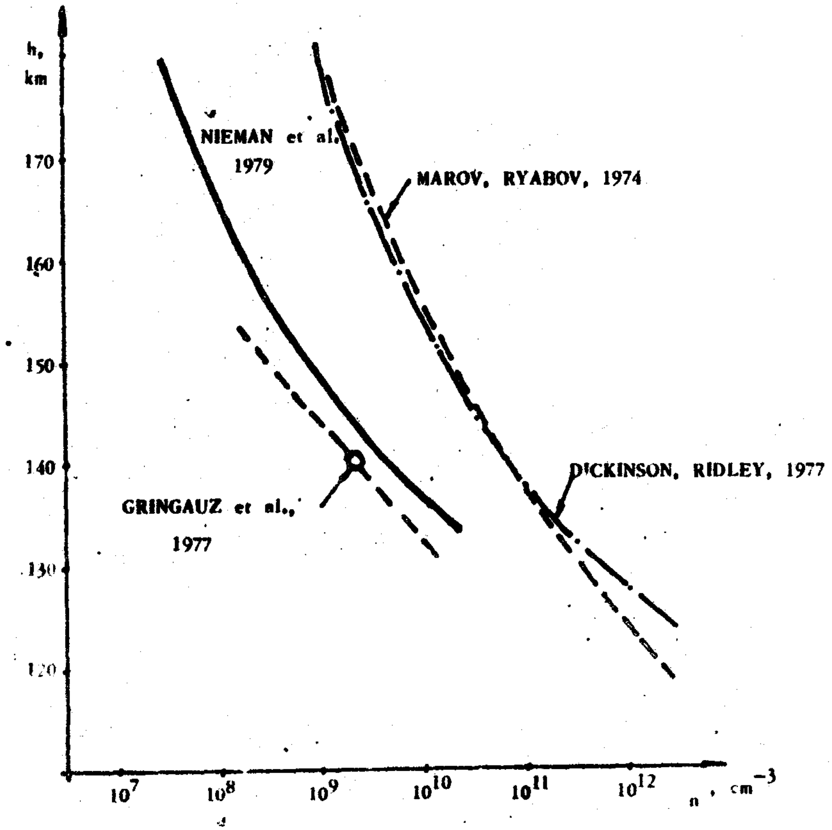

h, km
170
160
150
140
130
120
NIEMAN et al. 1979
MAROV, RYABOV, 1974
DICKINSON, RIDLEY, 1977
GRINGAUZ et al., 1977
10^7
10^8
10^9
10^10
10^11
10^12
n, cm^-3

Fig 1

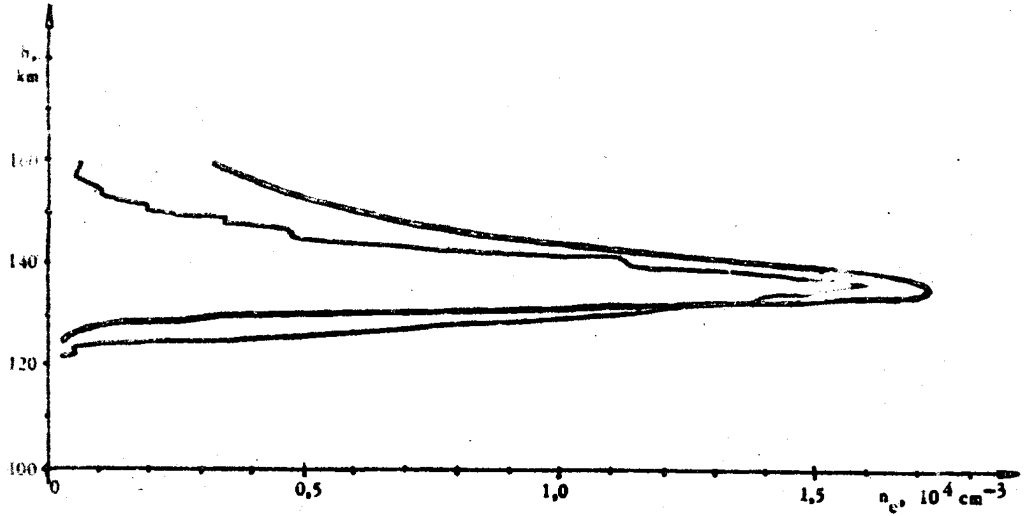

Fig 2