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OBSERVATIONS OF THE AURORA IN THE FAR ULTRAVIOLET FROM "COSMOS-900"

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ABSTRACT

The results from observations of auroral emissions within the wavelength band 115 - 135 nm are presented. The experiment was carried out on board the satellite "Cosmos-900", launched on March 30, 1977, to an almost circular polar orbit. We assume that the precipitating fluxes of protons and electrons were the sources of excitation, according to the theory.

INTRODUCTION

The extreme ultraviolet region of auroral emission spectrum ($\leq$ 135 nm) has remained relatively unexplored because of the inaccessibility to ground-based observations, the experimental difficulties of such measurements, and the limited number of rocket and satellite experiments. In this paper results from observations of auroral emissions within the wavelength band 115 - 135 nm are presented. The experiment was carried out on board the satellite "Cosmos-900", launched on March 30, 1977, to an almost circular polar orbit ($h \sim 500$ km, inclination $\sim 83^{\circ}$).

In order to record the auroral emissions the ionization chamber was installed so that its entrance window was always directed towards the Earth. The ionization chamber consisted of coaxial electrodes and a MgF_2 entrance window [1] . Nitrogen oxide NO was used as a gas filling. It is possible to determine the chamber quantum efficiency within the wavelength band up to $\sim$ 50 % [2] . The ionization chamber spectral sensitivity determined by the potential of the photoionization filling NO and the threshold of radiation absorption by the entrance window of MgF_2 is within the wavelength range 115 - 135 nm. A special collimator consisting of an aluminium tube with a diaphragm system was installed to protect from scattered radiation. Absolute sensitivity characteristics of the ionization chamber is known from pre-flight laboratory calibrations. Table 1 gives basic parameters of the ionization chamber.

TABLE 1

Spectral sensitivity	115 - 135 nm
Effective area	31 mm^2
Field of view	22^o
Geometric factor	3,6 mm^2 sr
Quantum efficiency	0.5

The telemetry data indicating a normal working of the instrument were received up to late April, 1978. It was possible to observe continuously both the day-side and night-side glows of the atmosphere in the ultraviolet wavelength region by a fixed three-axis orientation of the spacecraft which directed the field of view of the ionization chamber to the Earth with an accuracy of several degrees. Taking into account the results of measurements by other authors [3-9] it is evident that the ionization chamber must record auroral emissions at the following wavelengths: atomic oxygen 130.6, 130.5, 130.2 nm, Lyman-alpha 121.56 nm, atomic nitrogen 120 nm, and molecular nitrogen band emissions.

RESULTS OF OBSERVATIONS AND DISCUSSION

The results described refer to September, 20-22, 1977. Figures 1 and 2 give the data for two orbits of the spacecraft during each of which it crossed the auroral latitudes twice. It should be noted that during the flight the level of the scattered radiation background was practically constant. On the illuminated and the dark parts of the orbit in most cases its value was close to that of the noise level. It can be assumed that such a low level of scattered radiation was reached due to the use of an entrance collimator, contrary to the experiments by Chubb and Hicks [4, 5] . As seen from Figs. 1 and 2 the ionization chamber signals exceeded the background only at the auroral oval latitudes along the orbit including the polar cup regions. Spatial characteristics of the emissions extending from 1.5^o to 5^o in invariant latitudes are rather complicated. It is possible to separate two different structures: large-scale structure with regions of higher intensity extending from $\sim$ 100 km to $\sim$ 500 km, and fine-scale structure with multi-peaks pointing to substantial time and spatial variations with intensities changing rapidly within several fractions of a second. Fig. 3 gives an example of the structure of emissions in the northern hemisphere at the invariant latitudes $\Lambda_0 = 84^o - 88^o$ at night MLT, with a rate of telemetry data transmission of 5 msec. Two regions of higher intensity are distinguished, recorded during a time interval of 30 sec. The intensity growth from minimum to maximum being rather sharp.

The emissions recorded by the ionization chamber could be caused by Lyman-alpha emission, the nitrogen line at 120 nm, the triplet of oxygen emissions at 130.4 nm, and molecular nitrogen band emissions. The sharp intensity increase is evidence of a discrete character of these auroral arcs. Besides, the display of the

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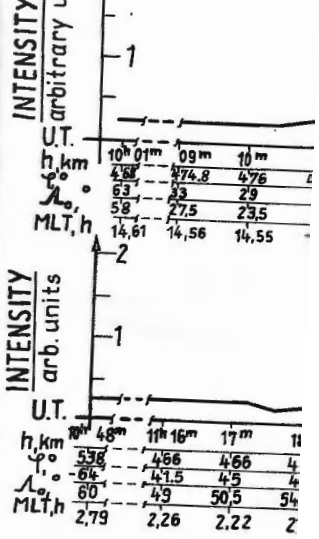

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large-scale structure with the distinct maxima of intensity is evidence of not only one but at least two sources of excitation which can differ by the type of particles and by their energy [4,10]. Considering these regions one can observe some variation in their intensities and extension. It allows us to assume that the precipitating fluxes of protons and electrons were the sources of excitation, according to the theory of Taylor et al. and Eather [11, 12].

We hope that after a more compre_hensive investigation of the data we shall be able to distinguish the electron and proton sources of excitations, analyzing the amplitudes of the intensity maxima of these auroral arcs and their relative behaviour.

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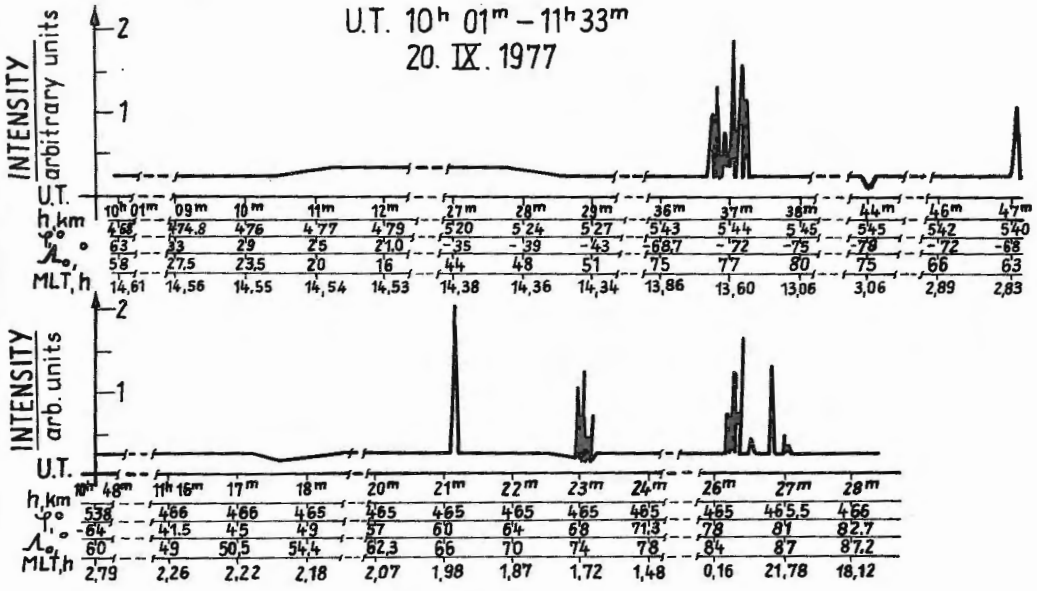

Fig. 1 Observations of aurora within the wavelength band 115 - 135 nm on September 20, 1977

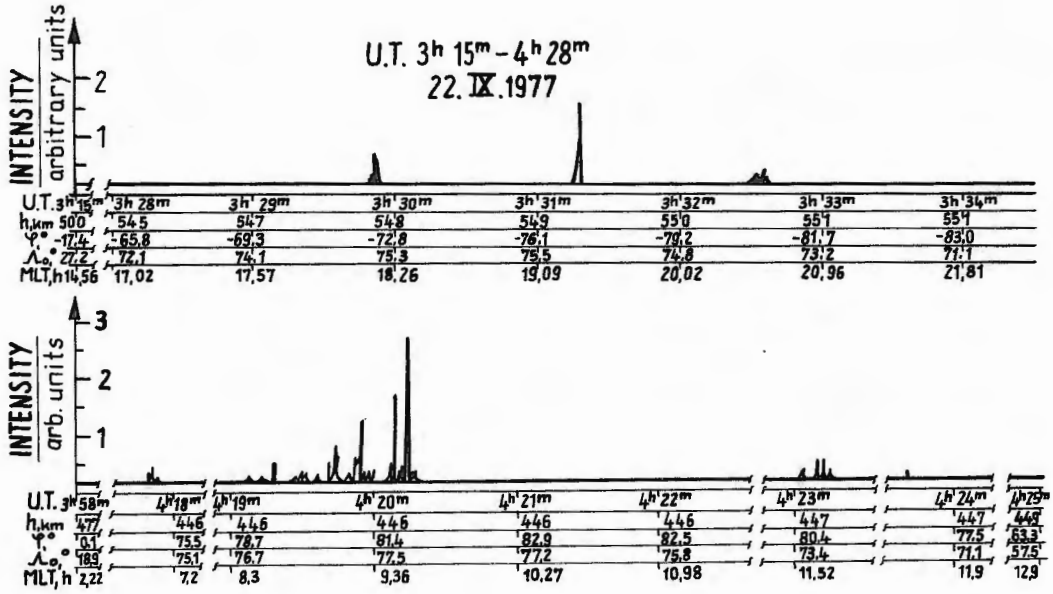

Fig. 2 Observations of aurora within the wavelength band 115-135 nm on September 22, 1977

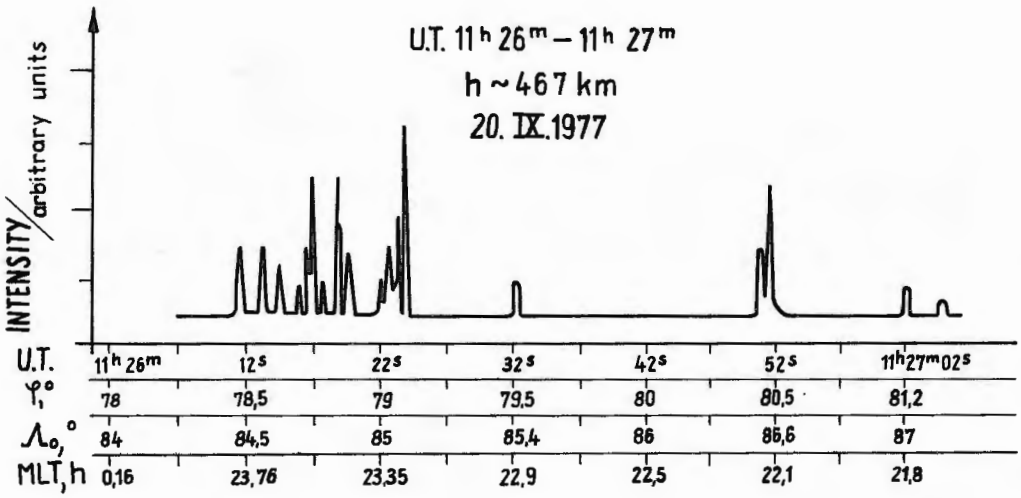

Fig. 3 Ionization chamber record on September 20, 1977; MLT $\sim 15^h$ and UT $\sim 11^h30^m$