(λ = 1 — 5 μm; λ = 4 — 11 μm) with the spectral resolution of about 2 cm^{-2} and 1:1 illumination, and a spectropolarimeter (λ = 200 — 400 nm) with the spectral resolution of about 5 nm. This complex is designed to measure the heat spectrum of Earth and solar radiation reflected diffusely by the Earth's atmosphere. The second complex consists also of two Fourier-spectrometers with the same parameters but with illumination of about (1/10)—(1/20). It will be used for study of vertical distributions of temperature, molecule concentration of various gases and aerosols, as well as of their day-night variation. The solar and lunar radiation against the Earth's atmosphere will be observed with the step of 1 — 2 km at different attitudes above the Earth's limb.

Observations should be carried out one or two times per month on round-the-clock basis in the automated mode to reveal the seasonal and 24-hourly effects.

The results will be used to model the heat regime of the atmosphere and to establish the causes of the ozonosphere variations, to construct the maps of ecological state of various regions of Earth and to estimate the water resources, etc.

«Vertical» Experiment

SPACE-BORNE MILLIMETRE-WAVE NADIR OZONE SOUNDER (SMNOS)

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The principal method to study the atmospheric composition is the molecular spectroscopy of constituent gases. The majority of intense rotational transitions of these gases fall into the millimetre and sub-millimetre wave bands [1].

The purpose of the experiment is to develop a space-borne millimetre-wave spectral complex (SMNOS) for monitoring the global distribution of the total content of the atmospheric ozone. A characteristic feature of the SMNOS complex is its capability to monitor the atmospheric ozone distribution from a satellite orbit not along the line tangent to the atmosphere but vertically down (in the nadir direction). Such an approach eliminated the need for a large antenna system, which would have to meet a number of strict requirements to the design of the complex.

The sounder input is a scalar horn antenna with the diameter of 10 cm. The stable local oscillator will operate near the frequency of 142 GHz with the output power of 10 mW and the frequency stability of 10^{-7}. The uncooled balanced diode mixer with beam leads combines RF signal from the antenna and LO signal to give IF signal at the frequency of 1.5 GHz. The loss by insertion is about 6.1—6.6 dB. The gain of the uncooled low-noise IF amplifier is equal to 60 dB and its noise temperature is 50 K. The noise temperature of this heterodyne down converter is equal to 700 K (DSB). The complex is connected with the recording device, which is capable of operating in a wide frequency range (bandwidth of 500 MHz), as well as in the multi-channel filter-bank mode (10 channels, each with 100 kHz bandwidth). The difference of optical thickness in the spectral channels and the wide-band (reference) channel is used to detect the spectral ozone line against the background of the ascending thermal radiation from the Earth's surface and the atmosphere.

The complex operation is carried out by periodical calibration of its sensitivity against two blackbody radiators (300 K and 100 K). The entire SMNOS complex is thermostated with the accuracy of 1 K. The on-board computer will control its operation.

Analysis shows that the sensitivity of the SMNOS complex can be sufficient for detection of the ozone contained in the atmosphere at the level of 10^{15} $mol \cdot cm^{-2}$. This is two orders of magnitude lower than the average level of the full ozone content in the Earth's atmosphere.

Reference

1. A Parrish «Millimeter-wave Environment Remote Sensing of Earth's Atmosphere» // Microwave J.—1992.—**35**, N 12.—P. 24—57.