M. A. Kolosov and O. I. Yakovlev. A Study of Propagation of Radio Waves in the Solar System Using Soviet Space Stations. When radio waves are propagated in the solar system, the radio waves can pass through the atmospheres of planets, through the interplanetary and the circumsolar plasma they can also be reflected by the surfaces of the planets and the Moon. Systematic studies were conducted in 1962–1972 in the USSR of propagation of radio waves in radiocommunication with stations of the types "Luna," "Mars," and "Venera." The report reviews these studies.

The satellite "Mars-2" carried out a repeated radio probing of the atmosphere of Mars.[1] As this station was being occulted behind the planet, the change in frequency and amplitude of the radio waves was measured on the Earth. The altitude-dependences of the pressure, density, and electron concentration were determined from these data. The following mean values were obtained for the equatorial regions of Mars: pressure near the surface = 7 mbar, concentration of atoms at the surface = 2.3×10^{17} cm^{-3}, temperature at 10 km altitude = 220°K, altitude scale in the troposphere = 11 km, electron concentration at the lower ionospheric maximum = 7.5×10^4 cm^{-3}, altitude of the regular lower ionospheric maximum = 110 km, electron concentration at the main ionospheric maximum = 1.7×10^5 cm^{-3}, altitude of the main maximum = 138 km, altitude scale of the upper ionosphere = 35 km, and electron concentration at 220 km altitude = 3.4×10^4 cm^{-3}.

The launched stations "Venera-4–8" made it possible to get direct experimental data on propagation of decimeter radio waves in the dense atmosphere of Venus.[2] They showed that 1000-MHz radio waves are not attenuated while being propagated throughout the

thickness of the atmosphere of Venus. Rapid slight fadings of the field intensity are observed at the stations become immersed in the atmosphere of Venus. Fluctuations of 5–8% depth were recorded as the stations "Venera-7–8" lay on the surface of the planet. If these fadings are due to fluctuations in the refractive index involving turbulence of the atmosphere, then the structure constant $c_n \approx 10^{-7}$ cm$^{-1/3}$. This indicates an elevated turbulence of the atmosphere of Venus.

The satellites "Luna-11–14 and 19" made possible systematic studies of reflection of radio waves by different regions of the lunar surface.[3] Measurements of the coefficients of reflection and radio-wave spectra made it possible to determine the dielectric constant, the density of the surface rocks, and the degree of roughness of the surface. The mean dielectric constant for depths up to 9 m proved to be 3, while the density was 1.5 g-cm^{-3}.

The roughness of relief as characterized by the slopes of the surface for different regions lay within the range 2–15°. The method of radio-wave reflection showed great effectiveness in studying the relief of Venus. It is possible in principle to image planets by the principle of radio holography.

The station "Mars-2" made possible a radio probe of the Sun's corona. Fluctuations of phase, frequency, and amplitude, and diffuseness of the radio spectrum were observed during the radio probing of the circumsolar plasma.[4]

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