

THE MICROWAVE SPECTRUM OF VENUS

by

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ABSTRACT

This report discusses the radio measurements of Venus, and presents computation of the theoretical microwave spectra expected for several different atmospheric models. The models in best agreement with the microwave data are those in which the planetary surface temperature is approximately 700°K, and the microwave spectrum is formed by atmospheric absorption at wavelengths shorter than 3 cm. Four absorption mechanisms which match the prior microwave spectral data are; nonresonant absorption by collision-induced dipole moments in CO₂ and N₂, nonresonant absorption by clouds with absorption coefficients proportional to v^2 , absorption and scattering by large air-borne particles, and resonant absorption by molecules with permanent dipole moments.

In order to further discriminate between these atmospheric models a multi-channel microwave radiometer was designed, constructed, and used for observations of Venus during the spring and summer of 1964. The 28-foot paraboloid used for these observations was calibrated using measurements of the antenna pattern and an extensive series of lunar observations. The frequencies observed were 21.1, 21.9, 23.5, 25.5, 29.5, and 32.4 Gc/s, a critical region of the microwave spectrum. The observed average brightness temperatures of Venus and relative uncertainties were: 502±82°K, 404±28°K, 450±23°K, 428±20°K, 463±32°K, and 430±24°K, in order of increasing frequency. The absolute accuracies range from 10 to 20%. The microwave data also shows evidence of spectral fluctuations near 1.4-cm wavelength, which are consistent with data of other observers during the same period.

The atmospheric models most consistent with these results are those incorporating resonant absorbers, or those incorporating both scattering and resonant or nonresonant absorbers.

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