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Venus surface optical imaging from a balloon or a probe during descent : Monte Carlo simulation and the proposal of the experiment on TV-camera in transparency windows of a 1.02 and 0.85 microns.

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Abstract

Introduction

The problem of imaging of the planet surfaces is a priority for space exploration, since the surface is crucial to study the origin mechanisms . However, if for other planets in the solar system conducted hundreds of experiments in this direction, for Venus there are only a few . This is due to an optically dense cloud cover in the upper atmosphere of Venus. Until now, the global picture is obtained only in radio wavelengths. First spacecraft to the board which was carried out large-scale location of Venus was on the Pioneer Venus Orbiter (1978), which carried out radar mapping of the surface. AMS Venus 15/16 (1978) have got on board the DBR with a resolution of 1-2 km, and Magellan (1989) had a DBR with a resolution of 100 m.

During 1975-1982 Soviet leanders, being on a surface, have taken a number of panoramas with the high resolution of the order of shares of meter. Thus, there is a gap between the resolution of 100 m and shares of meter and it should be filled. Such experiment could be imaging from undercloud layer in a transparency window of 1 microns. Idea is not new, but technical study was not conducted.

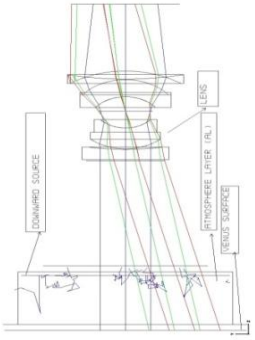
Proposal of the experiment

For balloon experiment should be below main cloud deck(MCD) (H<48 km) and not below area with the temperature accessible to conventional electronics. Having accepted the maximal temperature for 125 °C, we shall receive a corridor of heights of 48-43 km.

Other possibility to use lander at descent from MCD to the surface. In this case it can be used not only a window of 1 micron but also 0.85 and 0.65 microns.

	Venus atmospheric probe(VAP)	Venus lander (VL)
Duration of the descent time, 55-0 km	50 min / 70 min	30 min / 40 min
Active time on the surface	15 min (not guaranteed) / 0	60 min / 50 min
Science	: imaging,	: imaging
Stabilization	parachute	tail-plane
Ballistic coefficient M / Cd * A	minimum	maximum

Figure1.Optical model.



Our own optical in-situ experiment1978-1982(VENERA 9,10,11,12,13,14 –Venus landers) on measurements of the radiation field in the atmosphere of Venus, CA 9 / 10 (Ekonomov et al, 1979) and 13/14 (Moshkin et al 1983) gave

information from the clouds to the surface in 0.5-1.15 mkm.[1] They were the base of V.I. Moroz analytical estimates in the article [2] .Estimates have confirmed an imaging experiment realizability

3D Monte-Carlo simulation

In turn to verify these analytical estimates we have executed 3D numerical simulation with Monte-Carlo method to check up an imaging experiment realizability.

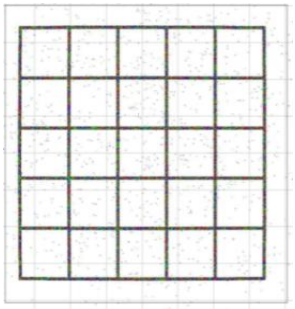
Optical 3D model

Optical 3D model consists of an 2D image-B/W picture that simulates the surface of Venus, the adjacent planeparallel layer(AL), simulating the atmosphere of Venus, in which the bulk scattering and absorption are taking place and the lens building an image of the surface of Venus in the focal plane of TV-camera. Scattering is of Rayleigh model

The Venus surface radiates upwards, towards an TV-lens. The part of radiation undergoes scattering in atmosphere and after scattering gets into lenses together with radiation not exposed to scattering. Besides the sunlight impinges in the day time on a AL and after scattering in it gets on lenses from below. All it reduces contrast of the image in a focal plane.

Summary and Conclusions

As a result of parametric calculations dependence of contrast on height is gained. The experiment realizability is confirmed. Also the animation movie simulating descent to a surface is synthesised.



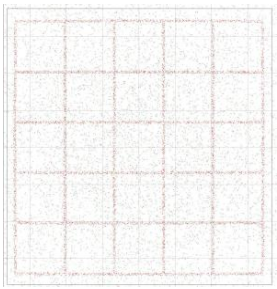


Figure2. Without scattering / with bulk scattering.

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[2] Moroz V.I. :Estimates of visibility of the surface of Venus from
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