DETERMINATION OF COSMIC BODIES SIZE-VELOCITY DISTRIBUTION BY OBSERVATION OF CURRENT IMPACTS ON MARS.

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Collisions of cosmic bodies with terrestrial planets involve many physical processes such as deceleration and ablation during their flight through an atmosphere, the impact at a surface accompanied by cratering, melting and evaporation of surface material, generation of shock waves etc [1,2]. If body velocity is high enough then a thermal radiation is very important. All these processes on Mars proceed differently than on the other planets because of the low density of its atmosphere. In particular, this leads to the fact that smaller bodies of sizes of the order of 0.1-10 m strike the planet surface without being decelerated and perform some effects which may be detected by equipment placed on a board of artificial satellites, by a network of stations at the surface of Mars and even from the Earth. These observations can be used to determine size-velocity distribution of such bodies in the Solar System.

Numerical simulation of the impacts at the surface of Mars have been carried out using two-dimensional gasdynamic code with detailed consideration of the thermal radiative transfer. This work is an extension of our previous paper [3]. We have expanded a range of projectile sizes up to r_0=100 m. For such large-scale body the initial stage of the impact, involving cratering and ejection of surface material, is very important. Thus these effects have been taken into account.

At the beginning of the explosion a vapor plume is optically thick and radiation flux is determined by the shock velocity only. The results of numerical simulation of such intensely radiating waves in the atmosphere of Mars obtained using the code [4] have been used to calculate an energy emitted at this stage. As the plume temperature and density decrease it becomes transparent. It is this long-run stage, when the most part of the energy is emitted.

It has been shown that the wake formed during the body flight through the atmosphere [2] and thermal layer near the surface due to radiative heating [3] strongly change a form of the main shock wave. The existence of thermal layer causes a generation of vortex flow which may lead to an ejection of large quantities of sand from the surface. The sand and major portion of projectile and surface material can escape through the wake having lower density than that of an ambient gas. An evolution of impact explosion depends on a radius r_0 of an impactor. Fig.1 shows pressure distributions for the impact of bodies with r_0=10, 30 and 100 m (instances of time are chosen to have the same ratio r_0/t). The form and size of radiating region and its brightness temperature give information on the size and velocity of the projectile. The whole radiation energy emitted achieves 60-70 percents from the explosion energy.

One else effect not being under consideration yet is generation of acoustic-gravity waves in the atmosphere of Mars. Their propagation is determined by action of two forces: the gravitational and compression ones [4]. As on the Earth such waves may turn round the planet even two or more times and may cause large-scale disturbances of an ionospheric layer. This leads to low-frequency oscillations of electron concentration which may be detected by equipment placed on a board of artificial satellites or on surface stations. Our numerical simulations of this effect show that the ionospheric disturbances achieve some percents at distances 1000-3000 km.

So the results of our investigation of the impacts on Mars show that there are some effects the observation of which may be used to determine the size-velocity distribution of small bodies in the Solar System. The following research would give particular recommendations for organization of such observations.

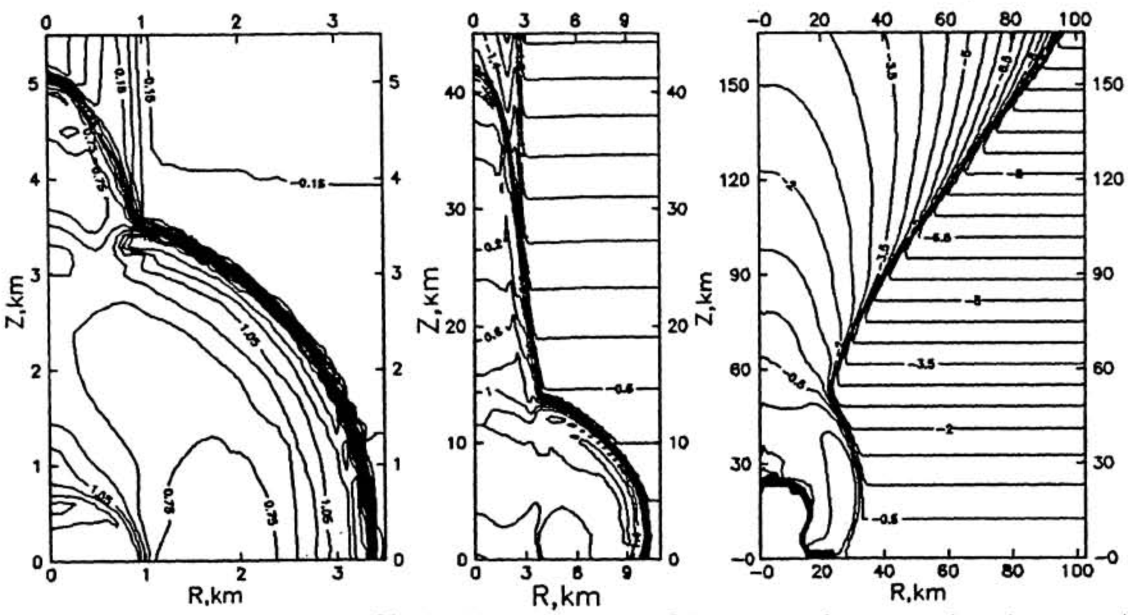

Figure 1. Pressure distributions (lines of constant ratio p/p_0) for r_0=10,30 and 100 m and t=1,3 and 10 s consequently.

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