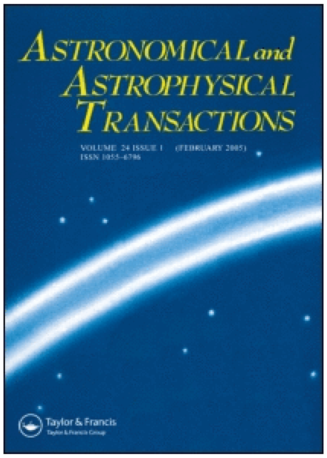

Astronomical & Astrophysical Transactions
The Journal of the Eurasian Astronomical Society
Publication details, including instructions for authors and subscription information:
http://www.informaworld.com/smpp/title~content=t713453505

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Online Publication Date: 01 July 1995
To cite this Article: Kruchinenko, V. G. and Hajdukova, M. (1995) 'Some problems of the physical theory of meteors', Astronomical & Astrophysical Transactions, 8:3, 239 - 240
To link to this article: DOI: 10.1080/10556799508203310
URL: http://dx.doi.org/10.1080/10556799508203310

Astronomical and Astrophysical Transactions, 1995,
Vol. 8, pp. 239–240
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SOME PROBLEMS OF THE PHYSICAL THEORY OF METEORS

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(Received November 13, 1992)

Fundamental equations of classical physical theory of meteors were obtained using various initial assumptions and therefore they are incompatible in their essence. The destruction process is neglected with good reason in the solution of the heating equation, but so far as the problem was approached at no initial condition, the time of heating the meteoroid to the temperature necessary for intensive surface ablation is equal to infinity (Levin, 1956; Ceplecha, Padavet, 1961). Hence, the integration of the equation with an infinite limit yields an asymptotic solution which corresponds to a steady-state process and contradicts the real unsteady conditions of the superficial layer heating. By the time the destruction starts, the heat stored in the body is sufficient to evaporate the layer whose depth is equal to the distance from the surface, x_0, where temperature is reduced e-fold (Levin, 1956). Yet, in the ablation equation which is "included" at the time when the destruction starts, the body heating is not taken into account at all, and besides, the destruction occurs universally, where the atmospheric density is above zero, i.e. on the heating site.

We have obtained solutions relating to meteoroid heating in the Earth's atmosphere with an initial condition (Kruchinenko and Shaido, 1974; Voloshchuk *et al.*, 1989). The solutions coincide with that mentioned above when the heating time tends to infinity. They are applicable in the abnormal environment (the term was suggested by Opik, 1958), i.e. both for fragments separating from the major body at an arbitrary height and for artificial meteors. For little meteoroids, there has been a relationship established to account for thermal radiation at the site of heating (Kruchinenko and Hajdukova, 1981). Theoretical results show a satisfactory consent to the data of both natural and artificial meteor observations.

The statement of the problem has been justified and the problem of surface destruction has been solved with allowance for the inner heating (Kruchinenko, 1976; Kruchinenko and Shaido, 1977; Voloshchuk *et al.*, 1989). The classical ablation equation follows from the solution obtained in the particular case if the temperature gradient on the body surface is equal to zero. Consequently, the universally known equation is true, in the strict sense, only for small, fully heated-up meteoroids and for large bodies which range up to the conditions when the superficial heated layer becomes extinct, and the velocity of body size reduction exceeds the thermal front velocity. For meteorite-forming bodies, the ratio of the thermal front velocity to the size reduction velocity is such that during their entire flight in the atmosphere they have a thin heated-up layer and can melt till very small heights.

We have pioneered in introducing the definition of the thermal front velocity in the physics of meteors (Kruchinenko and Shaido, 1974), $\dot{x} = x_0/t_0$, where t_0 is the characteristic time of the meteor process, $t_0 = H^*/v \cos Z_r$, H^* is the height of the homogeneous atmosphere, v is the velocity of the meteoroid and Z_r is the zenithal distance of the radiant. In view of the correlation of the meteoroid ablation time and the time of their heating-up, there have been obtained new data on the parameters and character of the thermodestruction of a surface layer. In particular, it is shown that while using the solution of the thermoelastinc problem in the quasistatic formulation, the break-up at the body center or formation of the system of stressrelieving cracks (formation of the dust-ball-like bodies) are possible only for a limited in dimension class of bodies: $\pi x_0 \leq r_0 \leq 5 \times 10^{-3}$ m for stone meteoroids and $\pi x_0 \leq r_0 \leq 10^{-2}$ m for iron meteoroids. The masses of these bodies are in the region of minimum of the statistical fragmentation function.

On the basis of the theoretic dependences obtained and results of photographic observations, one can obtain a criterion for meteor bodies melting off: if the dynamic viscosity ratio does not exceed 0.20 g cm^{-1} s^{-1} (temperature of the breaking surface no more than 2800 K), the body will loss its mass primarily through melting and spraying the fluid film.

The meteor rotation condition $P_0 \ll t_0$ (P_0 is the period of one revolution) is valid for meteors in the optical and radiolocation range as a consequence of collisions with minor parts in interstellar space. For meteorite-forming bodies, this condition is not valid. Otherwise they will be destroyed by the centrifugal force prior to the entry in the atmosphere.

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