MODELS OF SPECTRAL RADIATION HEAT TRANSFER FOR MARTIAN SPACE VEHICLES

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ABSTRACT

It is necessary during exploring of Solar system planets with space probes to solve radiation gasdynamics equations as precise as possible. Building models of radiation heat transfer in aero-thermodynamics have wide spectrum of applicability: planetology, physics of atmosphere and ionosphere, problems of interacting solar radiation and planets.

In this paper the entering of space vehicle in Martian atmosphere is considered.

The spectral heat transfer equation in nonscattering media in cylindrical geometry is resolved with finite difference method in curvilinear coordinates. The relation between wave number and absorption coefficient is depicted on fig. 1. It is possible to observe peaks of radiation absorption in the range of 3000 cm^{-1} (CO_2) and 65000 cm^{-1} (CO^{4+}).

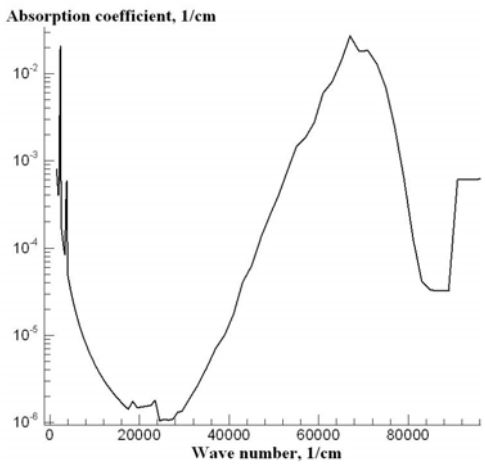

Fig. 1 Absorption coefficient

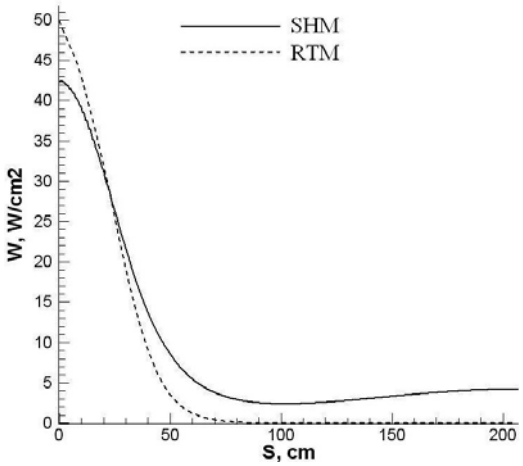

Fig. 2 Comparing of density flux

The contribution of this paper is the comparing of radiation flux density, predicted by P_1 approximation of spherical harmonics method (SHM) and Ray-tracing method (RTM) and calculation of volume radiation heat power generation.

Radiation flux density, provided with spectral groups with relative small absorption coefficient of radiation, is low too, and is not considered in further calculations any more.

Despite of big inaccuracies brought in by P_1 approximation, the relative difference of radiation flux density for two methods, mentioned above for the front stagnation point is approximately 10% (fig. 2).

Still, calculations under consumptions of lower absorption coefficients is taking substantially greater CPU time and bring in greater inaccuracy into integral flux density, so the question about correct radiation flux density from spectral groups with relative small coefficient of absorption calculation is actual.