ON THE FORMATION OF COMETARY ATMOSPHERE

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An improved model of the formation and evolution of cometary atmosphere in conditions of varied insolation was developed. Self consistent approach includes join treatments of the processes of heat and mass transfer in nucleus and gas-dust envelope (inner coma), the latter being produced due to sublimation of a body resembling that of Halley comet and consisting mainly of water ice mixing with mineral dusty component.

Mathematically the problem was splitted into three principal blocks to accomodate some physical constrains and to overcome computational difficulties, all these blocks being interrelated. The first one serves to determine the temperature distribution over the surface and in subsurface layer. Quasi-three dimensional equation of thermal conductivity was solved for multicomponent composition of the condensed phase, both orbital motion and rotation of nucleus being taken into account. The energy balance at the surface depends on the optical depth of inner coma and effectiveness of sublimation including effect of inverse flow of molecules in the adjoining gas layer.

The second block deals with the behaviour of subliming molecules outflow and distribution of macroparameters (temperatures, velocities, densities) in the inner coma. Specific attention was paid to correct definition of the boundary conditions in the close vicinity of nucleus. A thin Knudsen layer at the boundary of phase separation was distinquished and specifically studied. Here maxellisation of the initially nonequilibrium function of molecules distribution is acomplished and thus dramatic change of macrocharacteristics of the flow occure. For carrier (gas) phase a numerical kinetic approach based on the Monte Carlo algoriphm was utilized while disperse phase characteristics were obtained using some analytical functions. Gas-dust flow at more distant ranges was evaluated in hydrodynamical approximation accounting for momentum and energy exchange between phase and numerous photochemical reactions in the multicomponent medium.

Finally, the third block served to determine the field of brightness in the cometary vicinity. Here we utilized the first order approximation of the theory of multicomponent scattering and the anysotropy phase function for some classes of meteor particles was introduced.

The respective numerical procedure for join solution of set of equations specifying the above blocks was developed and implemented. The results obtained are discussed and summarized in terms of principal patterns of gas-dust flow, kinetic processes in the inner coma, macroparameters involved depending on the distance from the nucleus, non-gravitational disturbances in the orbital motion of comet Halley and variation of

the brightness depending on phase angle.

References:

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