A particle-based Monte Carlo simulation of the Martian ionosphere

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I have been developing a new model for the Martian upper thermosphere and exosphere using DSMC (Direct Simulation Monte Carlo) method to investigate the atmospheric escape from Mars. In this study, simulation of ionosphere is newly included at a very simple level that ensures charge neutrality.

At Mars, the interaction of the solar photons and the solar wind with the atmospheres is ultimately the source for almost all atmospheric processes. The solar photons and the photoelectrons that they produce may interact with thermospheric neutral species producing dissociation, ionization, excitation, and heating. I am working on adding this energy deposition of solar EUV photons and the photoelectrons to the model.

Because of their low mass, for a given high energy, photoelectrons possess a velocity that is four to five orders of magnitude larger than the heavy particles. This means that DSMC simulations in which the electrons are allowed to move freely require very small computational time steps and long simulation times to complete. Then, I used the simple plasma modeling method which is to apply the principle of ambipolar diffusion by requiring that the average ion and electron velocities be equal.

In this paper, I present initial results.