EPSC Abstracts,
Vol. 4, EPSC2009-519, 2009
European Planetary Science Congress,

The hot oxygen coronae of Venus and Mars - revisited

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Abstract

Suprathermal oxygen atoms produced by means of photochemical reactions in planetary thermospheres can play an important role for the escape of atmospheric species by direct (i.e. thermal) or indirect (e.g. pick up) processes. In either case the non-thermal energy distribution functions at the exobase must be known in order to estimate the hot oxygen exosphere density profiles. For this purpose hot particles generated via dissociative recombination of O_2^+ are traced along their stochastic way through the thermospheres of Venus and Mars by using a 3D Monte-Carlo model and the kinetics and transport characteristics of these particles are determined. The simulation considers the collision of the suprathermal particles with the background gas, energy transfer, and the tracing of secondary and cascaded hot atoms, which are generated in collisions of the hot particles with ambient constituents. A nonlinear electron dissociative recombination coefficient as well as energy and mass dependent collision cross sections are also taken into account. The exosphere density is obtained from the corresponding energy density and angular distribution at the exobase altitude by using a test particle model which traces the ballistic trajectories of hot O atoms in the exosphere. Our study indicates that upon taking into account proper input parameters, the hot oxygen corona both at Venus and Mars appears to be less dense than suggested by previous simulations.