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Energetic Oxygen in the Terestrial Exosphere

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There are numerous processes in the terrestrial atmosphere which involve the production of translationally energetic atoms with energies considerably above thermal energies. These “hot" atoms can play an important role in enhanced reaction rates, nonthermal emissions, and the enhanced nonthermal escape of atmospheric species. Such nonthermal escape mechanisms play an important role in the evolution of the atmosphere of Earth [1]. The dissociative recombination of O_2^+, that is $O_2^+ + e^- \rightarrow O^* + O^*$, produces energetic oxygen atoms in the terrestrial exosphere in a range of altitudes where the production of hot atoms is greatest and a substantial coronae of hot oxygen is expected [2, 3]. These energetic oxygen atoms can transfer their energy to H and D and create additional energetic populations of H and D. The existence of extended corona of energetic H and O in the atmospheres of the terrestrial planets is now well established both from theoretical models and observations. There is a continued interest in a better understanding of the physics of the processes that produce and maintain these steady state nonequilibrium distributions. In the rarefied atmosphere of the high altitude portions of these planetary atmospheres, collisional relaxation of nonthermal distributions is slow. The extent of the departure from equilibrium distributions depends on the strengths of the processes that perturb the distributions from equilibrium and the collisional relaxation processes that restore the distributions to Maxwellians. If there is a significant population of energetic atoms with speeds in excess of the escape speed of the planet, these extended coronae can have an important effect on the rate of loss of atmospheric species, both directly and indirectly. This paper examines the altitude dependence of the nonequilibrium energetic oxygen distribution function with a Boltzmann equation driven by the energetic oxygen source term owing to dissociative recombination. The solution is parametrized with observed O_2^+ and O density profiles. We also employ the Bhatnager-Gross-Krook model of the collision operator in a local Boltzmann equation to demonstrate the two scale height oxygen density profile.

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References

[1] B. D. Shizgal and G. G. Arkos, Nonthermal escape of the atmospheres of Venus, Earth and Mars, Reviews of Geophysics, **34**, 483-505 (1996).

[2] V. I. Shematovich, D. V. Bisikalo, and J.-C. Gérard, Energetic oxygen atoms in the polar geocorona, J. Geophys. Res. **111**, A10301 (2006).

[3] R. E. Johnson, et al, Exospheres and atmospheric escape, Space Sci. Rev. **139**, 355-397 (2008).