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Exogenic Volatiles in the Extended Exospheres of Extrasolar Giant Planets

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Abstract

Our understanding of the observations of volatiles in extrasolar giant planet (EGP) exospheres is quite incomplete at the present. The volatiles, water products, alkalis, or other trace gases detected in transmission spectra are assumed to emanate from the gas giant itself (endogenic) and are typically modeled using hydrostatic atmospheric escape models to fit observations. Here, we examine the possibility of an exogenic source, such as a stable, orbiting satellite [1,2], and its influence on the geometry and spectral line of the observed feature. The gas distribution then, rather than being spherically symmetric about the gas giant, can be influenced by transient clouds or rapidly rotating gas tori. By analogy, we present a simple geometrical model for EGPs with relatively long orbital periods able to host an active satellite capable of sourcing an extended exosphere on Gyr timescales. Our model takes into account possible source rates from such a putative satellite, and estimates optical depth and column density for expected species. Our analysis finds that the expected exogenic Na column densities can be of the same order of magnitude of Na observed at an EGP by high resolution spectrographs [3]. Moreover, we describe how to spectrally differentiate between an endogenic and an exogenic source.

References

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