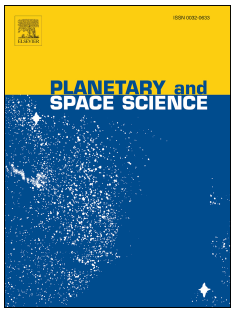
Accepted Manuscript



Electron-impact vibrational excitation of the hydroxyl radical in the nighttime upper atmosphere

L. Campbell, M.J. Brunger

PII: S0032-0633(17)30263-5

DOI: 10.1016/j.pss.2017.10.010

Reference: PSS 4412

To appear in: *Planetary and Space Science*

Received Date: 24 July 2017

Revised Date: 3 October 2017

Accepted Date: 16 October 2017

Please cite this article as: Campbell, L., Brunger, M.J., Electron-impact vibrational excitation of the hydroxyl radical in the nighttime upper atmosphere, *Planetary and Space Science* (2017), doi: 10.1016/j.pss.2017.10.010.

Electron-impact vibrational excitation of the hydroxyl radical in the nighttime upper atmosphere

L. Campbell[a], M. J. Brunger[a]

[a] *College of Science and Engineering, Flinders University, GPO Box 2100, Adelaide SA 5001, Australia*

Abstract

Chemical processes produce vibrationally excited hydroxyl (OH) in a layer centred at an altitude of about 87 km in the Earth's atmosphere. Observations of this layer are used to deduce temperatures in the mesosphere and to observe the passage of atmospheric gravity waves. Due to the low densities and energies at night of electrons at the relevant altitude, it is not expected that electron-impact excitation of OH would be significant. However, there are unexplained characteristics of OH densities and radiative emissions that might be explained by electron impact. These are measurements of higher than expected densities of OH above 90 km and of emissions at higher energies that cannot be explained by the chemical production processes. This study simulates the role of electron impact in these processes, using theoretical cross sections for electron-impact excitation of OH. The simulations show that electron impact, even in a substantial aurora, cannot fully explain these phenomena. However, in the process of this investigation, apparent inconsistencies in the theoretical cross sections and reaction rates were found, indicating that measurements of electron-impact excitation of OH are needed to resolve these problems and scale the theoretical predictions to allow more accurate simulations.

Keywords: hydroxyl radical, electron impact, vibrational excitation, mesosphere

*Corresponding author. Email: laurence.campbell@flinders.edu.au