On the Chemistry of Hydrides of N Atoms and O^+ Ions

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Previous work by various authors has suggested that the detection by Herschel/HIFI of nitrogen hydrides along the low-density lines of sight toward G10.6-0.4 (W31C) cannot be accounted for by gas-phase chemical models. In this paper we investigate the role of surface reactions on dust grains in diffuse regions, and we find that formation of the hydrides by surface reactions on dust grains with efficiency comparable to that for H_2 formation reconciles models with observations of nitrogen hydrides. However, similar surface reactions do not contribute significantly to the hydrides of O^+ ions detected by Herschel/HIFI that are present along many sight lines in the Galaxy. The O^+ hydrides can be accounted for by conventional gas-phase chemistry either in diffuse clouds of very low density with normal cosmic-ray fluxes or in somewhat denser diffuse clouds with high cosmic-ray fluxes. Hydride chemistry in dense dark clouds appears to be dominated by gas-phase ion–molecule reactions.

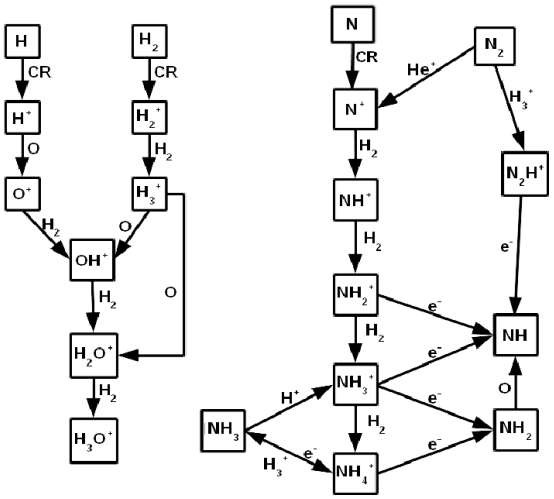

Figure 1: The main routes in the gas-phase chemistry forming hydrides of N and O^+. Diagrams modified from [1] and [2].

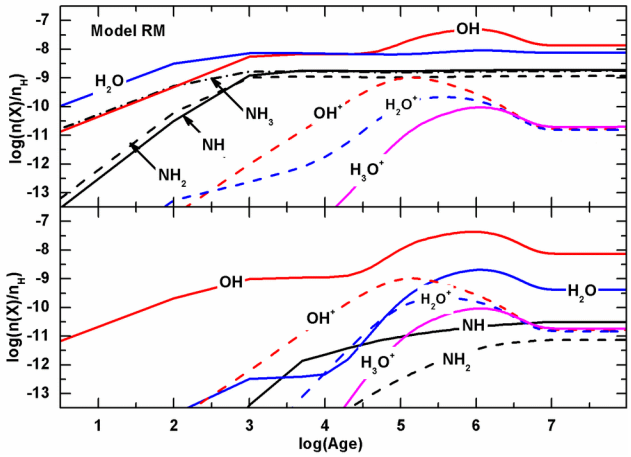

Figure 2: The time evolution of the fractional abundances of all the hydrides in the Reference Model (RM) with (top) and without (bottom) surface reactions.

References

[1] Hollenbach, D., Kaufman, M. J., Neufeld, D., Wolfire, M., & Goicoechea, J. R. 2012, ApJ 754, 105

[2] Le Gal, R., Hily-Blant, P., & Faure, A. 2014, in SF2A-2014: Proceedings of the Annual meeting of the French Society of Astronomy and Astrophysics, ed. J. Ballet, F. Martins, F. Bournaud, R. Monier, & C. Reyle´, p.397–401