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Atmospheric Loss of Sub-Neptune's and Implications for Liquid Phases of Different Solvents on Their Surfaces

J.J. Leitner (1), H. Lammer (2), P. Odert (3), M. Leitzinger (3), M.G. Firneis (1) and A. Hanslmeier (3)

(1) Institute for Astronomy, University of Vienna, Austria,
(2) Austrian Academy of Sciences, Space Research Institute, Graz, Austria,
(3) Department of Physics (IGAM), University of Graz, Austria
(leitner@astro.univie.ac.at / Fax: +43-14277-9518)

Motivation and Background Question

In the research platform "Alternative Solvents as a Basis for Life Supporting Zones in (Exo-) Planetary Systems" [1, 2 *this meeting*] one fundamental question is how liquid phases of exotic solvents for the origin of exotic life can arise. Exotic solvents and exotic life include the consideration of solvents different than water (e.g. methane, ammonia or formamide) and of metabolisms not only based on a double bond between carbon and oxygen (C=O). Atmospheric loss and evolution and solar wind erosion with respect to different spectral types of the central stars is considered as a potential way to synthesize liquid phases on resulting surfaces of exoplanets.

Atmospheric Loss

The recent detection of lower mass exoplanets gives rise to the question if these close-in hot Neptune's or Sub-Neptune's could lose their hydrogen envelopes so that their cores remain. We investigate thermal evaporation of hydrogen from the exospheres of such exoplanets by assuming that they originated or migrated inside the habitable zones of lower mass host stars. The hydrogen atmospheres of such Sub-Neptunian bodies are exposed to extremely high X-ray and EUV (XUV) radiation fluxes from their host stars. This exposure results in heated and expanded upper atmospheres and high thermal hydrogen escape rates. We applied a formula which includes effects of the Roche Lobe and a heating efficiency and which is in good agreement with hydrodynamic escape models.

Surface and Internal Dynamics

With respect to the mass and composition of the resulting planets/the remaining cores the question on their internal heat transport mechanisms and in particular: their convection regime is of high importance for further studies on the origin and evolution of exotic life. We will present first results and parameter studies in order to define restrictions on potential dynamical processes for such planets. Density models will be used to estimate the internal structure of the planets and the resulting thermal gradient.

References

[1] Firneis et al. (2009) Abstracts of the General Assembly of the Austrian Society for Astronomy and Astrophysics, September 2-4, 2009, Innsbruck, Austria.

[2] Firneis et al. (2009) EPSC Abstracts, Vol. 4, *this meeting*.