XUV-driven hydrodynamic atmospheric expansion of hydrogen-rich giant exoplanets

G.F. Jaritz[1,2], H. Lammer[1], D.F. Vogl[1], N. Erkaev[3], H.K. Biernat[1,2], W.W. Weiss[4]

[1] *Space Research Institute, Austrian Academy of Sciences, Schmiedlstrasse 6, A-8042 Graz, Austria*
[2] *Institute for Geophysics, Astrophysics and Meteorology, University of Graz, Universitätsplatz 5, A-8010 Graz, Austria*
[3] *Institute for Computational Modelling, Russian Academy of Sciences, RU-660036~Krasnoyarsk--36, Russia,*
[4] *Department for Astronomy, University of Vienna, Türkenschanzstr. 17, A-1180 Vienna, Austria*

Recent observations by the Hubble Space Telescope (HST) of atomic hydrogen absorption in the Lyman-α line indicate that the upper atmosphere of the short-periodic giant exoplanet HD209458b at an orbital distance of about 0.045 AU from its host star is extended up to about 3 planetary radii. We show that the observations can be understood in terms of loss of neutral hydrogen atoms by a hydrodynamically driven planetary wind. We show that hydrogen-rich upper atmospheres of other short-periodic exosolar gas giants and smaller Uranus-class bodies may also experience hydrodynamic conditions, resulting in extended upper atmospheres and energy-limited hydrogen loss rates. We show that the atmospheric expansion is a combination between various physical parameters, which depend on the X-ray and extreme ultraviolet (XUV) flux of the star, the planetary mass, the planetary size as well as the planets mesopause or effective temperature. The result of our study indicate that hydrogen-rich giant exoplanets at orbital distances less than 0.05 AU may evaporate to their core-size during XUV active stellar periods of their young host stars until heavy gas constituents prevent the hydrodynamic process. Our suggestions can be proven due to the detection of large remaining cores by the European space borne telescope CoRoT scheduled for launch in 2006 from the Kuru space port in French Guiana or the Plesetsk Cosmodrome in the north of Russia.