Mass Loss Leaves Close-In Exoplanets Exposed to the Core

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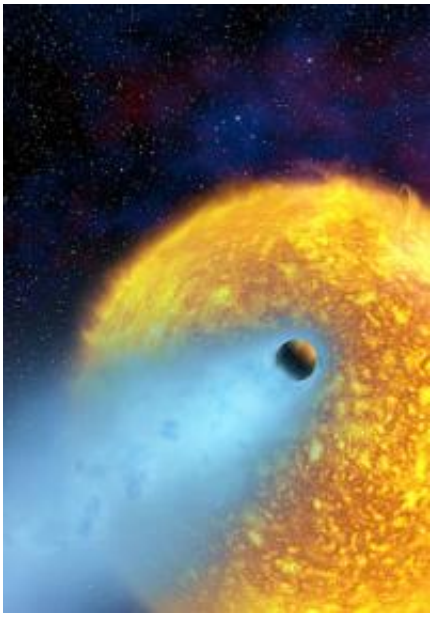

Artist's impressions of an evaporating gas giant. Credits: ESA, Alfred Vidal-Madjar, NASA

(PhysOrg.com) -- An international team of scientists has found that giant exoplanets orbiting very close to their stars could lose a quarter of their mass during their lifetime. The team found that planets that orbit closer than 2% of an Astronomical Unit (AU), the distance between the Earth and the Sun, may lose their atmospheres completely, leaving just their core.

The team, led by Dr Helmut Lammer of the Space Research Institute of the Austrian Academy of Sciences, believe that the recently discovered CoRoT-7b "Super Earth", which has less than twice the mass of the Earth, could be the stripped core of a Neptune-sized planet. Dr Lammer is presenting results at the European Week of Astronomy and Space Science at the University of Hertfordshire.

The team used computer models to study the possible atmospheric mass loss over a stellar lifecycle for exoplanets at orbiting distances of less than 0.06 AU where the planetary and stellar parameters are very well known from observations. The 49 planets considered in the study included hot gas giants, planets with masses similar or greater than that of Saturn and Jupiter, and hot ice giants, planets comparable to Uranus or Neptune. All the exoplanets in the sample were discovered using the transit method, where the size and mass of the planet is deduced by observing how much its parent star dims as it the planet passes in front of it.

"If the transit data are accurate, these results have great relevance for planetary formation theories", said Dr Lammer, who is presenting results at the European Week of Astronomy and Space Science at the University of Hertfordshire.

"We found that the Jupiter-type gas giant WASP-12b may have lost around 20-25% of its mass over its lifetime, but that other exoplanets in our sample had negligible mass loss. Our model shows also that one major important effect is the balance between the pressure from the electrically charged layer of the planet's atmosphere and the pressure from the stellar wind and coronal mass ejections (CMEs). At orbits closer than 0.02 AU, the CMEs - violent explosions from the star's outer layers - overwhelm the exoplanet's atmospheric pressure causing it to lose maybe several tens of percent of its initial mass during its lifetime."

The team found that gas giants could evaporate down to their core size if they orbit closer than 0.015 AU. Lower-density ice giants could completely lose their hydrogen envelope at 0.045 AU. Gas giants orbiting at more than 0.02 AU lost about 5-7% of their mass. Other exoplanets lost less than 2%. Results suggest that CoRoT-7b could be an evaporated Neptune-like planet but not the core of a larger gas giant. Model simulations indicate that larger mass gas giants could not have been evaporated to the mass range determined for CoRoT-7b.

Provided by Royal Astronomical Society (news : web)