Extrasolar planets: a radiation diet

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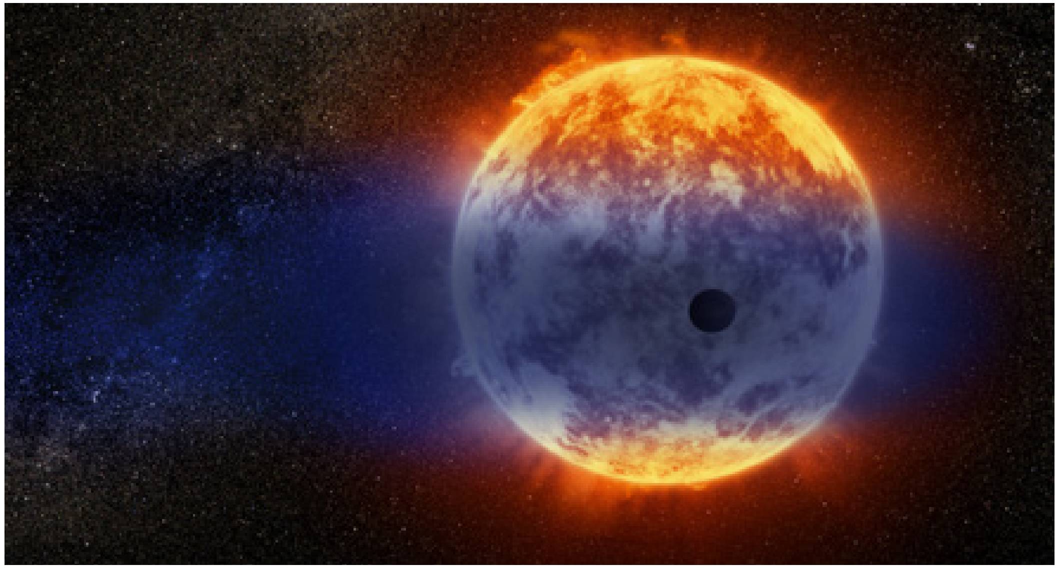
One of the unexpected results of XMM-*Newton* was the relationship found between a star's X-rays emission and its exoplanets. Close-in exoplanets suffer from a strong "erosion" from the incoming stellar high energy irradiation, yielding a mass loss that can be dramatic for less massive exoplanets. Low mass stars, like the Sun, have as their outermost layer the corona. The stellar corona is a hot (between 1 and 30 million degrees) set of magnetic loops that confine stellar plasma, very much related to the stellar activity phenomena. Other manifestations of stellar activity are photospheric spots, flares, and coronal mass ejections. The corona emits copious X-ray and extreme-ultraviolet (EUV) photons. Energetic photons with wavelengths shorter than 912 Å (X-ray and EUV photons) have enough energy to strip electrons from hydrogen atoms. These photons heat and expand the exoplanet's atmosphere, leading to its eventual loss as it escapes the gravitational field of the exoplanet. This leaves the now charged ions at the mercy of the stellar wind, which can rapidly remove them. Evidence of planet atmosphere "evaporation" has been found in cases such as GJ 436 b or WASP-69 b through the UV line H Lyman alpha, or the infrared helium triplet (the latter is also directly related to irradiation by the stellar X-rays). The observed distribution of mass and radius of exoplanets shows also patterns indicating that planet erosion could be acting strongly on the evolution of Neptune-mass planets (the "Hot Neptune Desert"), or planets with few times the mass of Jupiter.

The role of the X-rays is essential to understand the phenomena that yield planetary atmospheric erosion, and even the evolution of the mass and size of those planets orbiting their host stars in short-period orbits. As new exoplanets with increasingly lower masses are found, the subject becomes more interesting, as it approaches the evolution of Earth-mass planets in close-in orbits. The higher sensitivity of *Athena* will improve our knowledge of the X-ray emission of exoplanet host stars. Its capacity to acquire high-resolution spectra in stellar fields will also be used to construct better coronal models. Current research in exoplanet atmospheres already requires the use of this coronal modelling to understand stellar radiation in the X-rays and EUV. *Athena* will have an important word to say about exoplanet atmospheres.



Planet erosion as an effect of X-rays ionizing irradiation from the corona of a low mass star. The mass being lost from the planet forms a sort of comet-like tail that is observed in Lyman alpha or the He line at 10830 Å. Artistic impression. Credit: NASA, ESA, and A. Feild (STScI). Bourrier et al. 2018, A&A 620, A147

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