Computing the Atmospheric Mass Loss of Exoplanets from Stellar Wind of Main Sequence Stars

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The atmosphere of a planet is a main requirement for the development of life. However, this atmosphere can be slowly stripped away by stellar winds, streams of charged particles released from the upper atmosphere of a star, its corona. In this project, the main goal is to determine the effects that stellar winds will have on the atmospheres of GJ 1132b, Kepler-138d, K2-3d, GJ 3053b, K2-3c, 55 Cnc e, GJ 9827d, K2-18b, GJ 97658b, and GJ 1241b. These planets were selected because they have known atmospheres. However, it is not known whether these atmospheres are primordial or secondary. Understanding the processes that shape the evolution of the atmosphere of these planets is crucial to interpret the atmosphere that is seen today with Hubble. The atmospheric mass loss of these planets in g/s was modeled and the values were computed for a timescale of 5 Gyr, the approximate age of the planets. Assuming a constant density and velocity of stellar wind through time stellar wind was not sufficient to strip the primordial atmosphere mass of any of the 10 planets. To model the stellar wind more accurately, the aging of the star was taken into account. The mass loss equation was computed as a function of time, using a rotation-period age relationship, and then integrated with an upper limit of 100 Myr, the estimated time in which planets lose their primordial atmosphere. With this model, Stellar wind was sufficient to strip the primordial envelope of GJ-1132b and GJ-1214b. Due to the presence of an atmosphere as detected by the Hubble Space Telescope, it is likely that GJ-1132b and GJ-1214b currently have a secondary atmosphere. These findings can help scientists interpret the atmospheres of exoplanets and understand their habitability without direct spectroscopic observations.

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