

Young planets under extreme UV irradiation: Upper atmosphere modelling of the young exoplanet K2-33b

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The K2-33 b is a planet of ~ 5 Earth radii orbiting the young M-type host star, recently emerged from the interplanetary disc. The extreme youth of the system (<20 Myr) gives the unprecedented opportunity to study the earliest phases of planetary evolution, at a stage when the planet is exposed to an extremely high level of high-energy radiation emitted by the host star. Since the planetary mass remains unknown (the estimated upper limit is 5.4 Jupiter mass), we perform a series of 1D hydrodynamic simulations of the planet's upper atmosphere considering a range of most probable possible planetary masses in the range from super-Earth to the twice of Neptune. To account for internal heating as a result of contraction, we set the temperature range from the black body temperature of the planet of 850 K to 1300 K. As the result, we obtain temperature profiles mostly controlled by the planet's mass, while the equilibrium temperature has a secondary effect. For planetary masses below 7-10 Earth mass, the atmosphere is exposed to extremely high escape rates, driven by the planet's weak gravity and high thermal energy, which increase with decreasing mass and/or increasing temperature. For higher masses, the escape is instead driven by the absorption of the high-energy stellar radiation. A rough comparison of the timescales for complete atmospheric escape and age of the system indicates that the planet is more massive than 10 Earth masses.