FUV-driven atmospheric escape from hot Jupiters

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Since the first discovery in 1995, many hot Jupiters have been detected. For some hot Jupiters, it is thought that the atmosphere escapes due to the radiation from the central star. Such processes can change the evolution of close-in giant planets. A light close-in giant planet can lose a significant amount of mass because of its weak gravity. Thus, atmospheric escape can possibly explain the small number of light planets near the central star (so-called sub-Jupiter desert).

Recent theoretical studies of atmospheric escape from hot Jupiters incorporate the Extreme-UV (EUV; >13.6 eV) heating. EUV heats the gas through photoionization of hydrogen. It does not yield any metallicity-dependent trend. On the hand, some recent observations suggest that sub-Jupiter desert depends on the metallicity of the central star. There can be other heating processes which depends on metallicity.

In this study, we show that Far-UV (FUV; <13.6eV) drives atmospheric escape, using hydrodynamical simulation including radiative transfer and non-equilibrium chemistry. FUV can heat gas through the photoelectric effect of dust grains. The process is well known in the study of inter-stellar medium, but not considered in the atmospheric escape studies.

We find that FUV can drive atmospheric escape if the central star is hot (>6000K), and close-in giant planets around the hot stars can evaporate in ~100Myr. We also find that FUV-driven atmospheric escape depends on the metallicity of the planetary atmosphere and the central star. The heating rate and the mass loss rate increase in the case of metal-rich planets. However, both the rates decrease for the case of metal-rich central stars because FUV fluxes decrease in the metal-rich stars. We discuss the FUV-driven atmospheric escape and its dependence on the metallicity of planets and stars.

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