Bayesian inference of occurrence rates of super-Earths in systems with cold-Jupiters around low-mass stars

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Transit observations of exoplanets with space telescopes (e.g., Kepler) have revealed an abundant class of close-in super-Earths (SEs). The occurrence rate of giant planets in wide orbits (also known as cold Jupiters or CJs) can be studied using the data obtained via radial velocity (RV) observations, which have been conducted for more than 20 years. As the occurrence rates of SEs and CJs are estimated, the correlation between SEs and CJs can also be discussed. According previous studies, it is likely that CJs coexist with SEs, and this is expressed by a high conditional probability P(SE|CJ) of about 90%.

Recently, observations of super-Earths around low-mass stars have attracted increasing attention. In fact, several new RV surveys of M dwarfs have been initiated; these operations include IRD-SSP with the Subaru telescope and CARMENES. We are interested in whether the conditional probability of P(SE|CJ) is also high around M dwarfs.

In this study, we present an estimate of the conditional probability of P(SE|CJ) around M dwarfs using Bayes' inference. We find that the conditional probability of the existing SEs under the existence of CJs is quite high even around M dwarfs. We also discuss whether the existence of CJs enhances the growth of SEs. It is likely that the high conditional probability of P(SE|CJ) is simply a reflection of the high amount of solids available for planet formation. For a more robust discussion, more RV observation data are needed. In addition, dynamical simulations that include the effects of CJs on SEs are also required.

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