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Formation and evolution of planetary systems around stars of different masses and metallicities

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The formation and evolution of planetary systems are linked to their host stellar environment. Here we employ a pebble accretion planet formation model to explore the correlation between planetary properties and stellar mass/metallicity. Our numerical results reproduce several main aspects of exoplanetary observations. First, we find that the occurrence rate of super-Earths ηSE follows an inverted V-shape in relation to stellar mass: it increases with stellar mass among lower-mass dwarfs, peaks at early-M dwarfs, and declines toward higher-mass GK stars. Second, super-Earths grow ubiquitously around stars with various metallicities, exhibiting a flat or weak ηSE dependence on stellar metalicity. Third, giant planets, in contrast, form more frequently around stars with higher-mass/metallicity. Lastly, we extend a subset of simulations to 1 Gyr to investigate the long-term evolution of the systems'architecture. By converting our simulated systems into synthetic observations, we find that the eccentricities and inclinations of single-transit systems increase with stellar metallicity, while these dependencies in multi-planet systems remains relatively weak. The alignment between our results and observations provides key insights into the connection between planet populations and stellar properties.

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