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Rapid Formation of Super-Earths Around Low-Mass Stars

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NASA's TESS mission is expected to discover hundreds of M dwarf planets. However, few studies focus on how planets form around low-mass stars. We aim to better characterize the formation process of M dwarf planets to fill this gap and aid in the interpretation of TESS results. We use six sets of N-body planet formation simulations which vary in whether a gas disc is present, initial range of embryo semi-major axes, and initial solid surface density profile. Each simulation begins with 147 equal-mass embryos around a 0.2 solar mass star and runs for 100 Myr. We find that planets form rapidly, with most collisions occurring within the first 1 Myr. The presence of a gas disc reduces the final number of planets relative to a gas-free environment and causes planets to migrate inward. Because planet formation occurs significantly faster than the disc lifetime, super-Earths have plenty of time to accrete extended gaseous envelopes, though these may later be removed by collisions or a secondary process like photo-evaporation. In addition, we find that the final distribution of planets does not retain a memory of the slope of the initial surface density profile, regardless of whether or not a gas disc is present. Thus, our results suggest that present-day observations are unlikely to provide sufficient information to accurately reverse-engineer the initial distribution of solids.