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The interplay of multiplicity and infall

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Traditionally, star formation has been viewed as a distinct phase where a collapsing gas and dust cloud forms a protostar and its disk. However, recent observations and simulations reveal that star formation is prolonged and dynamic, especially in binary and multiple star systems. Chaotic late infall continues long after the initial collapse, feeding planet-forming disks through filamentary streamers and interacting with the surrounding medium. In binary systems, these interactions are further influenced by companion stars. Using 3D non-ideal magnetohydrodynamics simulations, we show the significance of post-collapse accretion modes, including massive infall and Bondi-Hoyle-Lyttleton accretion, in both single and multiple star systems. Infall replenishes the disk's mass for planet formation and induces disk misalignment, which may be observable. In binary systems, companion stars can enhance these effects, leading to more complex accretion patterns. Our results explain the correlation between stellar mass and disk size, and the intrinsic scatter in this relationship, particularly in multiple star systems. We also explore the implications of infall for the solar system's history and propose that Peter Pan disks—disks around stars older than 10 million years—may be younger than previously thought. This phenomenon could be more prevalent in multiple star systems. Overall, our results emphasize interpreting planet formation within the dynamic framework of star formation in both single and multiple star systems.

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