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Radiation shielding of young protoplanetary disks

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Most stars form in stellar clusters that dissolve into the galactic field on timescales of tens to hundreds of millions of years. Planet formation takes place in a protoplanetary disk around young stars, disks that have typical lifetimes of a few millions years. The process of planet formation thus typically takes place in a stellar cluster environment. Understanding the impact of this environment on protoplanetary disks, and subsequently on planet formation, requires multi-scale, multi-physics models. Using the Torch model, we couple the collapse of a giant molecular cloud, the formation of stars, and stellar feedback, with the evolution of protoplanetary disks around the newly formed stars. These disks evolve viscously, and are subject to truncation due to stellar encounters and to external evaporation due to radiation from nearby massive stars. We show that gas in the star forming region shields protoplanetary disks from external photoevaporation for at least 0.5 Myr after the formation of the first massive stars. We also find that truncations due to encounters are less effective than external photoevaporation in casuing disk mass loss, even accounting for shielding, and that shielding allows disks to retain more solid material for planet formation.

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