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Formation of Direct Collapse Black Holes by Super-Competitive Accretion

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"Stars in the early universe were likely massive. This talk provides an overview of their formation processes and characteristics, then examine the potential for supermassive star formation and the subsequent emergence of direct collapse black holes (DCBHs) in some environments, e.g., characterized by strong far-ultraviolet (FUV) radiation, dense shocks, or dynamic heating from mergers. Challenging the traditional viewpoint, our numerical studies demonstrate that, even in environments with some metallicity (less than approximately 0.1% of solar values)—where dust cooling leads to cloud core fragmentation and the emergence of numerous low-mass stars—accretion flows can still preferentially channel gas to central massive stars, enabling their growth to supermassive objects, similar to the primordial case. This super-competitive accretion process allows only a few stars to become supermassive, along with a large number of low-mass stars. Beyond the 0.1% solar metallicity threshold, metal-line cooling prevents such growth due to smaller accretion rates. Previous analyses have overlooked stellar radiative feedback; however, our recent radiation hydrodynamics simulations have confirmed these findings: the mass spectrum's upper limit remains largely unaffected, while stellar feedback significantly reduces the number of low-mass objects.
This new channel of DCBH formation through super-competitive accretion introduces a novel paradigm for the formation of seed black holes, relaxing the constraints imposed by metallicity and increasing the abundance of seed black holes. The talk concludes by assessing whether seed black holes formed in this manner could explain the population of current supermassive black holes."

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