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Disk Instability from the Perspective of Dust-Settling

There are more than one accepted theories for formation of super-massive planets at a distance ranging from around 5 to 20 AU. Although the general consensus leans towards the theory of core accretion, numerical simulation over the past couple of decades has brought alternatives into the picture. One of the most promising alternative is the fragmentation mechanism in which giant planets are formed directly from the contraction of a clump of gas produced by gravitational instability. In our current work we investigate whether grain growth and subsequent settling can affect the stability criteria of the disk at these distances. We develop a Montecarlo algorithm to study the physics of grain growth and how grains of different sizes are subject to sedimentation. We then calculate a full wavelength dependent opacity with the evolved grain distribution, followed by a thermal profile of the disk using radiative transfer. We take a prototype disk which is hot on the surface and has a quiescent mid-plane, which, because of being less turbulent allows the grains to grow more efficiently. In this context, we examine the gravitational stability of the layered accretion disk experiencing dust-settling and review the possibilities of super-massive planet formation at the range of distances concerned. The whole work is carried out for a high mass and a low mass disk and the stability of the otherwise gravitationally stable low mass disk is investigated. We also present a steady state grain abundance and the opacity profile at different time of disk evolution. We compare that with the standard viscous accretion disk.