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EXTRASOLAR PLANETS : TODAY AND TOMORROW

Invited

FORMATION OF GIANT PLANETS AND BROWN DWARVES

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According to the prevailing core instability model, giant planets begin their growth by the accumulation of small solid bodies, as do terrestrial planets. However, unlike terrestrial planets, the growing giant planet cores become massive enough that they are able to accumulate substantial amounts of gas before the protoplanetary disk dissipates. Models predict that rocky planets should form in orbit about most stars. It is uncertain whether or not gas giant planet formation is common, because most protoplanetary disks may dissipate before solid planetary cores can grow large enough to gravitationally trap substantial quantities of gas. Ongoing theoretical modeling of accretion of giant planet atmospheres, as well as observations of protoplanetary disks, will help decide this issue. Observations of extrasolar planets around main sequence stars can only provide a lower limit on giant planet formation frequency. This is because after giant planets form, gravitational interactions with material within the protoplanetary disk may cause them to migrate inwards and be lost to the central star. The core instability model can only produce planets greater than a few jovian masses within protoplanetary disks that are more viscous than most such disks are believed to be. Thus, few brown dwarves (objects massive enough to undergo substantial deuterium fusion, estimated to occur above ~ 13 jovian masses) are likely to be formed in this manner. Most brown dwarves, as well as an unknown number of free-floating objects of planetary mass, are probably formed as are stars, by the collapse of extended gas/dust clouds into more compact objects.