ACCRETION PROCESSES IN A PROTOPLANETARY NEBULA:
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Many theories on the origin of the Solar System require the presence of relatively large solid bodies (planetesimals)\(^{(1)}\), \(^{(2)}\), that colliding each other, or capturing solid and gaseous matter from the nebula, can grow up to planetary sizes.

The question arises, how the planetesimals can be formed from a cocktail of gas and dust coming from an interstellar cloud\(^{(3)}\).

To check theories about planetesimals formation we considered the accretion of solid grains in the outer regions of the Solar nebula, where solid material can survive to the increase of temperature due to the evolution of the gravitational collapse\(^{(4,5,6)}\).

The results of this kind of approach are that direct interactions among solid grains give particles quite similar in mass, reaching a "mass limit" of about \(10^{-6}\ \text{g}\) in a time of \(10^6\ \text{ys}\).

This result is weakly dependent on the initial mass distribution and on the physical conditions of the nebula.

Chemical and physical properties of grains, have instead some influence: metallic grains (iron and graphite) have accretion efficiency greater than insulating ones.

These results are not in agreement with the hypothesis of planetesimals formation in the external region of the nebula. However, since experimental evidences exist of accretion processes in the Solar System, as craterization of the inner planets, inclusions in meteorites and so on, we attempt another approach to this problem.

We have studied the accretion conditions in the inner region of the nebula where, in some evolutive phases, melted or vaporized grains are present.

During a further cooling of the nebula\(^{(7)}\), in presence of liquid and vaporized material, solid and liquid particles can grow by:

a) condensation processes, as a consequence of a phase transi-
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tion, liquid-solid, vapour-liquid, vapour-solid;
b) accretion by collisions among solid or liquid particles.

We studied the latter process using a numerical solution of the coagulation equation (2,4).

The accretion by condensation has been studied under the hypothesis of chemical equilibrium (8). Critical quantities are the accretion time scales and the physical parameters affecting the evolution of the nebula.

REFERENCES: