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DUSTY PLASMAS

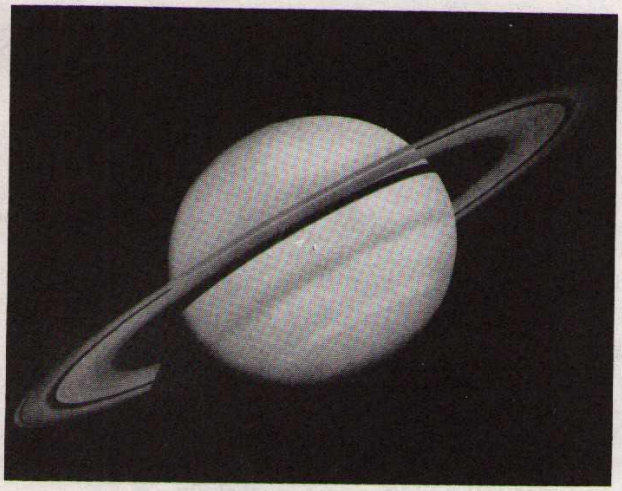
H Alfvén, the Nobel laureate Swedish physicist, once said that the formation of the Solar system from a primeval cloud could only be understood if the effects of the presence of "charged dust particles" in the plasma cloud are propably taken into account. Since then the role of these tiny fragments of matter, known to be present in many space and laboratory plasmas, has been increasingly investigated and many new effects due to their presence have been discovered.

Their origin can be very diverse: they can be a result of pollution (e.g. rocket exaust) in the earth's atmosphere, the end product of fragmentation of a larger body, as in planetary rings, or emitted from a solid body as in the environment of comets (from the nucleus in this case) or in Tokamaks where impurities are emitted from the internal walls of this laboratory plasma device. In the presence of an ionized gas (plasma) the dust particles can become charged by plasma currents and/or photoelectric effects due to radiation from a nearby star (e.g. radiation from the Sun in cases such as planetary rings and comets).

The resulting system is known as a "dusty plasma": a plasma containing dispersed particles of solid material carrying charges that can be much larger than the charge on an individual plasma particle. These massive, highly-charged components introduce strong inhomogeneities in the plasma thus modifying its properties. For instance as the most recent results show, the propagation of waves in plasmas can be strongly affected: the presence of charged dust can cause damping of the waves (as if they met with some kind of "friction") and enhancement of the scattering cross section, that is an increase of the pressure exerted by the radiation on the particles. The importance of research on dusty plasmas has been steadily increasing as observations, both earth-based and from space probes, confirmthat dusty plasmas are ubiquitous occurring also in places such as thunderclouds, interstellar clouds, circumstellar disks, Nova ejecta, protoplanetary clouds etc.

Some examples of systems where the presence of dusty plasmas has been used to explain some of their features are given over:

Umberto de Angelis (Ext: 5780)



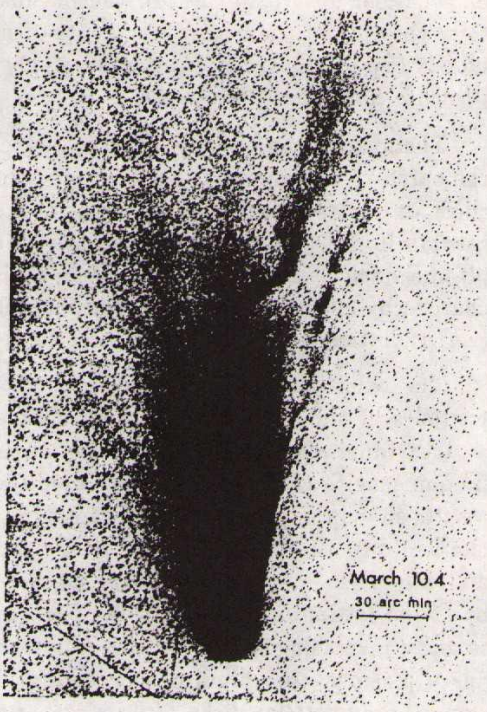
Planetary rings

The charged dust particles are subject not only to the planet's gravitational force but also to electromagnetic forces that significantly affect their orbits

Cometary tails

The "filamentation" occurring in the tails of the comets as they approach the sun could be a result of separation of different dust components due to radiation pressure.

This picture of Halley's Comet shows the filaments in the ion tail and a disconnection event which occurred on March 10th, 1986.



Noctilucent clouds

Noctilucent clouds are clouds of tiny ice crystals that form high (80km) in the atmosphere at mid-latitudes in the summer. They can be seen in the long summer twilight as bright silvery-blue clouds lit up by the Sun long after ordinary clouds have turned dark. In this country they are best seen from Scotland.

EISCAT experiments have shown enhanced scattering of radio signals from these clouds: this may originate because of dust pollution enhancing the scattering process.