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Yomogida et al. (13th Lunar and Plan. Symp.(Tokyo)), studied whether fine powders of iron and of several oxides and silicates could be sintered under pressure to form meteorite-like materials. However, the present work appears to be the first to try to form fluffy, compressible aggregates from fine particles. We first attempted to simulate the inter-particle van der Waals bonds by sintering powdered glass of grain size 2 μm and 30 μm; this produced weakly cohesive materials which were slightly compressible. We have also studied ultrafine particle aggregates of dimension ~ 0.1 μm, which tend to cohere even when uncompressed. Finally, we are studying whether certain binding agents may bring about cohesion of fine glass powders. At the time of this meeting we hope to have developed one or more fine particle aggregates which exhibit all properties of fluffiness, compressibility, and cohesion. It will then be possible to collide them together in an evacuated chamber and observe the resulting conditions of accumulation or fragmentation.

13.14-P

COAGULATION OF PROTOPLANETARY DUST

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An experimental setup has been developed to investigate collisional processes between protoplanetary dust particles. The collision velocities of the order-of-mm-sized particles can be varied from ~0.1m/s to ~10m/s. As analogue materials, fluffy agglomerates of n-pentacosane coated glass spheres were used. The experimental results show that three different issues can be distinguished:

(1) the particles stick together after collision (coagulation)
(2) the particles bounce off after collision (restitution)
(3) the particles disintegrate as a result of collision (fragmentation).

The coagulation probability increases with decreasing velocity, whereas fragmentation can only be observed for the highest velocities. At intermediate velocities, restitution dominates with a characteristic dependence of the coefficient of restitution on the impact parameter. For understanding the physics of low velocity collisions of fluffy agglomerates, a theoretical model was developed taking into consideration the high deformability of the agglomerates as well as attractive van-der-Waals forces between colliding particles. Extrapolation of the model allows predictions on the collisional behaviour of icy or stony agglomerates. In particular, the upper velocity limits for coagulation can be determined.

13.15-P

Search for Orbiting Material and Planet-like Objects around Nearby Stars by Spectral Correlation Studies

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Because the light from potential planet-like objects or ring material orbiting around a given star arises from the stellar flux, scattered in the atmosphere or reflected on the ground, their spectra should strongly correlate with the stellar spectrum, but they are Doppler shifted due to their relative velocity as seen from the Earth. We have suggested a new method of detection which consists in looking for secondary maxima in the cross-correlation function between spectra of the star and its close surrounding space, *i.e.* for caracteristic samples of photons which are arranged in a ghost position. Because the characterization of orbiting objects is based on their orbital velocity rather than on their mass or their distance to the central star, this approach is more appropriate to the search for close objects. Also, it is not limited to compact objects. When compared to other methods, the performances of this approach strongly depend on the shape of the autocorrelation function of the stellar spectrum. It appears much promising when looking at stars which present a spectrum with strong emission features.

In the present paper, we discuss the comparative performances of our method when applied to a selected sample of candidate stars, and its possible applications in a near future.

13.16-P

The McDonald Observatory Planetary Search

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The McDonald Observatory Planetary Search program is designed to detect Jovian mass planetary systems around nearby solar type stars by detection of the stellar reflex motion around the star-planet barycenter. The scientific goals of this program are to accumulate the necessary information on the frequency of planetary formation as a function of stellar mass, age, and composition. The survey of 33 F, G, and K dwarfs and subdwarfs was started in September 1987. All observations are made with the McDonald Observatory 2.7-m telescope coudé echelle spectrograph with a CCD detector. The original survey used telluric O_2 lines as a radial velocity reference system, to achieve routine radial velocity precision of 15 m s^{-1}. We have now built and installed an I_2 absorption cell as the velocity reference. This cell enables us to achieve precision of about 5 m s^{-1} on most program stars. The results to date on several interesting program stars will be presented.

13.17-P

Numerical Modeling of the Formation of Giant Planets with Rotation

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We present models of giant planet formation including angular momentum. The calculations are carried out in a one-dimensional quasi-spherical approximation, assuming hydrostatic equilibrium. The approximation of quasi-sphericity limits the calculations to relatively slowly rotating models. As in previous calculations without rotation, (Bodenheimer and Pollack 1986), the so-called "core-accretion" model is adopted. Angular momentum transport is included for both radiative and convective zones, along the lines of previous work (Korycansky 1990). Convective regions are assumed to be driven to uniform rotation, with transport coefficients based on mixing-length theory. Radiative regions are driven to states of marginal stability, on timescales derived from linear theory and previous hydrodynamical modeling.

The calculations are carried up to masses approximately equal to that of Saturn. Angular momentum transport is highly effective, producing models with a strong concentration of angular momentum in the outer convective zones that develop at envelope masses above 30 $M_\oplus$. Near the end of the calculation, gas accretion was turned off, and the models allowed to contract. The ratio of centrifugal force to gravity at the outer radius then rises high enough to invalidate the quasi-spherical approximation. At that point, mass is assumed to be shed to form a disk. We find that up to ~ 1$M_\oplus$, and ~ 80% of the angular momentum, are lost to a disk. Such values of disk mass and angular momentum are amply sufficient for satellite system formation. As a result of the loss of angular momentum, however, the final planetary models have only one-third to one-half the present-day value of angular momentum of Saturn, indicating that two-dimensional models are needed for realistic models of the formation of the giant planets.

References: Bodenheimer, P. and Pollack, J. (1986), *Icarus*, **97**, 391.
Korycansky, D. G., (1990), Ph.D. thesis, Univ. California Santa Cruz.

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