SELF-CONSISTENT GROWTH OF DECIMETER-SIZE DUST AGGLOMERATES AND BEYOND. J. Teiser[1] and G. Wurm[1]. [1]Institut für Planetologie, Wilhelm-Klemm-Str. 10, D-48149 Münster, Germany. E-mail: j.teiser@uni-muenster.de.

Introduction: It is widely accepted that collisions between dust agglomerates lead to growth of larger bodies in the early Solar System. Collision parameters change with evolving time and depend on the model for the Solar Nebula. For the first growth phase from µm to cm size (v << 1 m/s) the growth process is well understood [1]. Eventually, collision velocities reach values of up to 60 m/s. We modeled this regime in collision experiments. A transition from slow to fast collisions occurs at decimeter size but no data exist in this size range. This would be important as the outcome of the following high speed collisions strongly depends on the make-up of the growing decimeter bodies [1]. Therefore, we also carried out collision experiments to determine the make-up of a decimeter body as key stone in the growth sequence.

Methods: For collisions between dm-size agglomerates (targets) and small particles (1-10 mm) we developed an experiment using a crossbow as projectile launcher [3]. An additional setup has been developed to determine how a dm-body evolves if exposed to a large number (literally millions) of small (~100 µm) particles impacting with ~8 m/s [4]. In this setup small particles are accelerated by gravity.

Results: Decimeter dust aggregates do grow in the parameter range studied. Dust agglomerates growing by multiple impacts of small particles are highly compressed (volume filling of 31%). This is a higher compression than possible by one-directional compression and close to values feasible by local compression (33%). We observed direct sticking as well as sticking by reaccretion due to gravity. Dm-size objects in protoplanetary disks are exposed to a head wind and reaccretion by gas drag is of the same order as gravity in the laboratory. High velocity experiments with compact targets showed that projectile thickness is the critical parameter for further growth. For increasing velocities projectiles have to be thinner to be accreted by the target. In erosive collisions ejecta always are smaller than the original projectile.

Conclusions: The size range between several cm and several dm is easily bridged by sticking collisions. Further collisions with larger projectiles are then erosive but the mass loss of the target is of minor importance with respect to the target size. Fragments ejected in erosive collisions are always smaller than the original projectile. Ejected particles, which are small enough to lead to growth, can be accreted by another large body in a secondary collision. This way, a fragmentation/accretion cascade finally leads to a net growth also in the high velocity range.

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