The Particle Accretion in Microgravity Free-Float Experiment: Protoplanetary Aggregate Formation. A. D. Whizin[1], D. D. Durda[1], C. S. Tsang[1], and S. D. Love[2], [1]Southwest Research Institute, [2]NASA Johnson Space Center. (author contact: awhizin@swri.edu).

Introduction: The earliest stages of the terrestrial planet formation processes occur in the microgravity environment of the solar nebula, where the accretion of dust aggregates ultimately leads to the formation of protoplanetesimals. The exact mechanisms related to their growth are poorly understood and in order to better inform planet formation models we need to understand certain properties of the aggregates that control their growth. The objectives of the experiments we describe here are to determine the effects of particle size, number density, and composition on the accretion of dust-scale

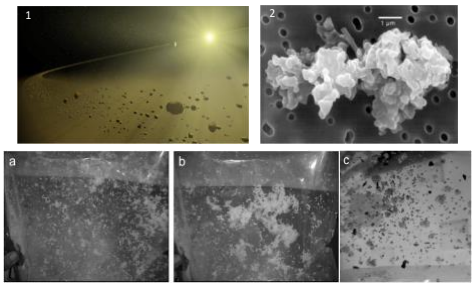

Figure 1: (1) Artist rendering of an early solar nebula. (2) SEM image of IDP dust aggregate of many small sub-micron particles. (a, b) Aggregates and individual particles of sugar and (c) other materials that were allowed to float for several hours aboard the ISS (a, b, c figures from Love et al 2014).

grains in microgravity conditions. This work enhances and builds upon previous microgravity free-float experiments initially performed by astronaut Don Pettit aboard the International Space Station (Figure 1), and by co-author Durda on parabolic aircraft flights. In the Pettit experiments bags of finely grained materials like coffee and sugar were agitated and left to free-float immediately showing the aggregation of the highly cohesive materials.

Experiment: We built and flew a parabolic flight experiment to study the dependence of fundamental properties of different relevant analog minerals on the growth of porous clusters (aggregates) in microgravity (Figure 2). Each experiment frame has two camera arms with GoPro cameras mounted on each end to collect data. In this experiment, we used olivine, UCF-1 CI simulant, enstatite, crushed Allan Hills 83100 CM2 carbonaceous chondrite and Northwest Africa 869 L3-6 ordinary chondrite.

Results and Conclusions: The aggregate pixel areas were determined and plotted for each frame, and for each of the experiment boxes. Interestingly, we

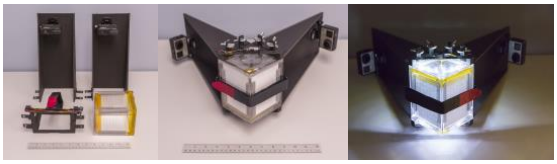

Figure 2: The experiment frame and camera arm mounts used in the parabolic flight experiments. GoPro's are mounted on each arm for a stereoscopic view. LED lights are activated during flight for extra illumination to observe the fine-grained dust's behavior.

observed the greatest aggregation in the smallest particle sizes and the CI simulant and ALH 83100 meteorite. Boxes containing higher number densities saw larger and more abundant aggregate formation.

We find in initial results that the composition of the dust was not as important to aggregate formation as the particle size distribution (Figure 3), and to lesser degree, the number density in the initial cloud.

We have performed 90 parabolas so far with the various particle sizes and compositions in each of the three boxes (270 nominal data points). We will present the results and findings from our analysis of the floccule formation and the implications for planet formation.

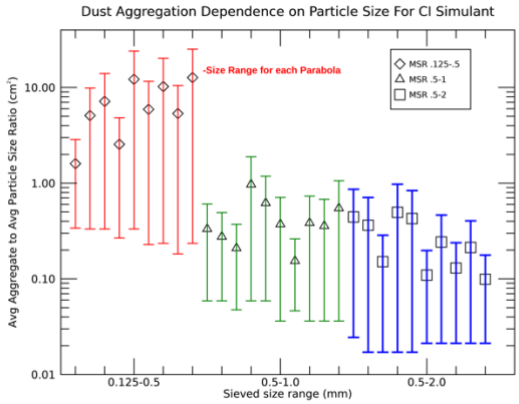

Figure 3: The average aggregate sizes obtained from the tracked clip image sequences and plotted in three bins according to their respective particle size distributions.