Asteroid Impact Studies: Mass And Speed Observation Nexus. J. R. Reagan[1], S. N. Congram[1], B. A. May[1], M. J. Molesky[1], M. M. Strait[1], G. J. Flynn[2], and D. D. Durda[3] [1]Dept. of Chemistry, Alma College, Alma MI (reagan1jr@alma.edu) [2]SUNY-Plattsburgh, Plattsburgh NY 12901, [3]Southwest Research Inisititute, Boulder CO 80302.

Introduction: The study of asteroids and meteorites can provide great insight into the origins and evolution of the Solar System. To study the way extraterrestrial objects disrupt, we conduct impact studies, which provide a process to determine the way meteorites disrupt in a vacuum chamber. These disruptions act as a model for how asteroids collide in the asteroid belt. We run the experiments at the NASA Ames Vertical Gun Range in Moffett Field, California. The procedure for the study involves hanging a sample in a vacuum chamber surrounded by foil detectors and launching a projectile to disrupt the sample. The event is recorded and examined using high-speed cameras, and we analyze the detectors and particles separately in the lab. Because of the difficulty of obtaining actual chondrites to test, these experiments are often run using analog samples created in the lab. While adequate for modeling the disruption patterns of chondrites, these analogs are not good representations of the more complex structure and composition of real meteoric disruptions.

In early studies, potential differences in particle velocity of olivine (chondrule) and matrix fragments were observed in research on the impact disruption of porous, inhomogeneous targets [1]. To validate these observations, we constructed different detectors. These detectors were designed to collect the particles at different time steps of the disruption. Thus we could compare the composition of the particles collected in Period 1 with Period 2 and determine if the composition was related to the velocity.

The first attempt at a detector was called the “Guillotine” (Figure 1), named so because it used a falling slot to collect particles at different times. However, this method did not collect the particles efficiently. The next attempt used cups to collect the particles at different time steps by closing lids over the cups at designated intervals (Figure 1). This method did not collect useful data, as while the first cup collected particles only from the t=1 interval, the second cup would collect particles from t=1 and t=2. Thus the sample from cup 2 was contaminated.

Next, the Mass And Speed Observation Nexus (MASON) was designed to collect particles at different time steps of the disruption using a rotating drum. Version 1 (Figure 1) had a wooden exterior with a spinning bucket in the center, which would collect particles as they went into an entrance slit. However, the wood would degas in the vacuum chamber which made it difficult to maintain the pressure. The collection method was also not well designed and gave incomplete data. The wooden exterior also made it impossible to get any high-speed camera footage of the process.

Version 2 (Figure 1) fixed many of the problems with Version 1 by making the MASON out of aluminum and plastic. The collection method was also better so that by recording the collection with a high-speed camera and using flypaper to collect the particles we got some meaningful data. However, numerous issues remained: the timing was difficult to get right, the feet were insecure and made the whole apparatus wobble and shake, and the door closure mechanism was not consistent and had a high failure rate.

The current version, Version 3, is still in development. The interior part will have a spinning collector mechanism which collects the particles from different time intervals. The slit is 1 inch by 6 inches, and the spinning mechanism only collects particles passing through the slit at the given time. The particles then fall into a collection tray which makes it easy to differentiate the particles for analysis. It is a relatively simple concept but quite complicated to make work, as there are many variables. For example, the mechanism will be running in a vacuum chamber, where the absence of gas vastly changes the manner in which a spinning fan-like bucket will behave.

Based on preliminary data from previous experiments and current tests of version 3, our results are inconclusive. Thus far there have been too many variables to collect and analyze the particles accurately, and our sample size is too small. However, there is also the issue of the analogs we are using. Because of the prohibitive cost of actual meteorites, we are restricted in the number of them which we can disrupt. We have developed pretty good analogs, but they are far more uniform than actual meteorites. So while they make good analogs for disruption experiments, we have no real data to compare between real and analogous meteorites for this aspect of the particle velocities. To fully understand the properties of meteoric disruptions, further experiments with actual samples will be required.

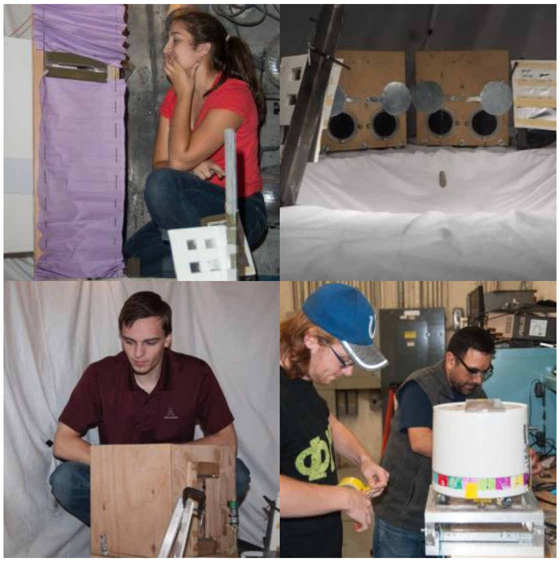

Figure 1: Left to Right: Guillotine, Cups, MASON v1, MASON v2

References: [1] Durda D. D. and G. J. Flynn (1999) *Icarus 142*, 46-55. [2] Patmore E. B. et al. (2015) *Meteoritics & Planet. Sci.*, *50*, A260.

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