INVESTIGATION OF PARTICLE MOVEMENT AFTER DISRUPTION. W. C. Elmer and M. M. Strait, Dept. of Chemistry, Alma College, Alma, MI, USA. E-mail: elmer1wc@alma.edu

Introduction: The disruption of meteorites has been studied for many years to track the behaviors of the particles after disruption events. Models have been constructed to mirror these disruptions [1,2,3]. As time has progressed, these models have improved to more closely resemble the actual disruption events, but there is still room for improvement. This work includes analysis of the size, mass, and velocity of expelled particles in order to provide real sample data for the production of more accurate models. Video images of disruption events of various meteorites are taken with high-speed cameras at the NASA Ames Vertical Gun Range [4]. These video files are analyzed to measure particle velocity and size.

Experimental: A video file is converted into a TIFF stack and opened using the program ImageJ. Particles are monitored as they travel, with close attention being paid to the detectors that are placed around the sample prior to the disruption event. In addition to the distance measurements taken prior to the shot in the AGVR gun chamber, the distance tool in ImageJ can help provide an accurate travel distance for each particle.

The video frame in which a particle passes through a given detector is coupled with the frame rate of the camera to find the travel time. The distance traveled is divided by the travel time to yield the velocity of the particle, which is then matched to particle size. Particle size is initially determined by approximation using the distance tool in ImageJ. Scanning of the individual detectors using the computer program CyberViewX accurately measures the size of the hole left by specific particles. These two measurements can be correlated with actual particles that were collected and weighed after the disruption. A visual representation of velocity determination can be seen in Figure 1.

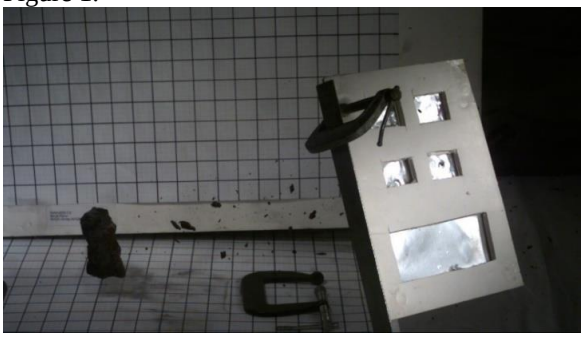

Figure 1. A screenshot of the computer used to analyze a video file clearly shows the disrupted rock with the expelled particles travelling toward the detector on the right.

Results and Discussion: Video files from eleven different shots were analyzed. Many particles were observed being ejected from each sample after the collision, although only a small fraction of them made contact with the detectors. The particles varied in size, some being too small to distinguish before they left a visible hole in the detector. Particle velocity ranges from 4.381 m/s to 150.563 m/s.

Currently, there seems to be a trend in the data. Although specific particle sizes are yet to be determined, the first wave of particles that pass through the detectors are typically some of the smallest. While there are still a number of very small particles that travel slower, the fastest are always small. The bigger particles seen usually travel much slower, averaging somewhere between 10 and 20 m/s. Some of the slowest-moving particles are observed making contact with a detector without passing completely through it – normally travelling below 10 m/s.

Table I. A sample selection of particle data. The table shows the approximate size of the particle along with the velocity of the particle when it hits the detector.

Volume (mm^3)	Velocity (m/s)
4.189×10^{-6}	150.563
4.189×10^{-6}	150.563
4.189×10^{-6}	146.642
4.189×10^{-6}	135.362
4.189×10^{-6}	73.413
4.189×10^{-6}	55.206
0.054	39.908
3.942	34.504
5.131	32.892
8.379	22.688
11.294	7.943
14.933	13.170

At this point, only the velocities of individual particles have been determined. The next measurements will be the particle sizes using the scanner and CyberViewX. Finally, the masses of any particles that can be matched to a particle of interest from a certain video clip will be recorded and analyzed. These results will be tabulated and compared graphically to determine any relationships between them. Moving forward, the particles will be categorized by size and compared to their respective velocities. This will permit the development of definitive conclusions that can be passed along for the improvement of meteorite disruption models using data from actual meteorite samples.

References: [1] Asphaug E. and Agnor C. (2005) *BAAS, 37,* 623. [2] Jutzi, M. et al. (2009) *Icarus, 201,* 802-813. [3] Flynn, G. J. et al. 2015. Planetary and Space Science 107:64-76. [4] Flynn G. J. and Klock W. (1998) LPS XXIX, Abstract #1112.