THE SHOCK COMPRESSION LABORATORY AT THE UNIVERSITY OF CALIFORNIA, DAVIS. S. T. Stewart and D. K. Spaulding, Department of Earth and Planetary Sciences, University of California, One Shields Avenue, Davis, CA, 95616 (sts@ucdavis.edu).

Introduction: The UC Davis Shock Compression Laboratory is a new facility for experimental studies of planetary materials at extreme pressures and temperatures and planetary collision phenomena. The laboratory, formerly at Harvard University, has been relocated to a state-of-the-art, 3000 sq ft. dedicated facility at UC Davis with expanded capabilities for investigation of impact processes and planetary origins.

The laboratory specializes in training students and postdoctoral researchers in shockwave techniques for the Earth and Planetary Sciences. Through collaborative access, the laboratory will serve as a unique resource to the planetary science community. In addition, the facility is part of a newly funded University of California Center for Frontiers in High Energy Density Science.

Major Equipment: The laboratory contains two light gas gun systems as well as a suite of shock physics diagnostics suited for equation-of-state (EOS) experiments, recovery of shocked samples, and other diverse high-pressure materials applications.

Single-Stage Launch System. The laboratory's single-stage launch system was relocated and recently recommissioned at UC Davis. With a 6-m long, 40-mm diameter barrel, it is designed for large-area planar impact experiments. Using either a compressed He breech or conventional gunpowder, projectiles weighing up to ~150 grams can be launched from 10's of m/s to ~2.6 km/s. At these velocities, pressures of several tens of GPa can be attained in most geologic media using standard metal projectiles. Experiment packages can be mounted near the muzzle in an evacuated chamber (~100 mtorr) for precise EOS and thermodynamic characterization upon shock and/or release. An enclosed recovery chamber may be placed from 1 to 6 m downrange of the muzzle for soft recovery experiments and post-shock extraction and analysis of samples.

An additional rifled barrel permits spin-separation of the sabot for dynamic strength, penetration/deformation or ballistic impact experiments in which an arbitrarily shaped projectile is desired.

Two-Stage Launch System. We have recently acquired and installed a new two-stage (80-mm/25-mm) launch system from Physics Applications Inc. (Dayton, Ohio). Hydrogen is compressed in the first stage of the system using a piston driven by a powder charge. Expansion of the compressed gas accelerates the 25-mm diameter projectile to peak velocities of 7 to 8 km/s, accessing multi-Mbar pressures (e.g. comparable to the terrestrial core pressures).

In both launch systems, projectile velocity is measured via arrival time using a calibrated multi-laser system and/or electrical shorting pins with an accuracy of better than 1%.

Controlled Sample Environments. A number of target configurations are possible based on the specific experimental need. Preheated or cooled targets are possible on either platform and liquid N_2 cryogenic targets have been employed in the past. Magnetic experiments may be performed in the presence of a tunable field using a set of *in situ* electromagnetic coils. Our lab has also developed sample capsules for controlled recovery experiments on refractory or volatile materials and which permit reliable post-shock extraction and analysis.

Experimental Diagnostics: Optical and electromagnetic diagnostics are used to make time-resolved measurements of the sample state. Shock and/or particle velocity is measured with a two-channel Valyn velocity interferometry system (VISAR). The VISAR employs a 5-W, 532-nm continuous wave laser that is fiber-fed to and from the sample. PVDF (piezoelectric polyvinylidine fluoride), piezoelectric pins and self-shorting gauges are also employed to measure arrival times or stress history throughout a sample. Various in-house self-shorting tilt-gauge designs are routinely employed to monitor impact planarity which is typically less than a few mrad.

The laboratory specializes in thermodynamic studies of equations of state and phase boundary measurements on planetary materials. A 6-channel (visible and IR) pyrometer permits observation of the thermal state of the sample, with sensitivity approaching room temperature. Signals are recorded on 12 bit, GHz oscilloscopes. The UC Davis facility was built with a copper grounding grid embedded in the main experiment room floor in preparation for electrical resistivity measurements. Plans are underway for expansion of diagnostic capabilities, including addition of fast imaging and spectroscopic diagnostics.

The UC Davis Shock Compression Laboratory is a unique facility for academic exploration of high-pressure materials science for planetary applications. More information is available at sarahtstewart.net.

Acknowledgements: The commissioning of the new facility was funded by the NASA Planetary Major Equipment Program, Lawrence Livermore National Laboratory, and UC Davis.

Fig. 1. Main Experiment Room, UC Davis Shock Compression Laboratory. The facility is a component of the new UC Center for Frontiers in High Energy Density Science.

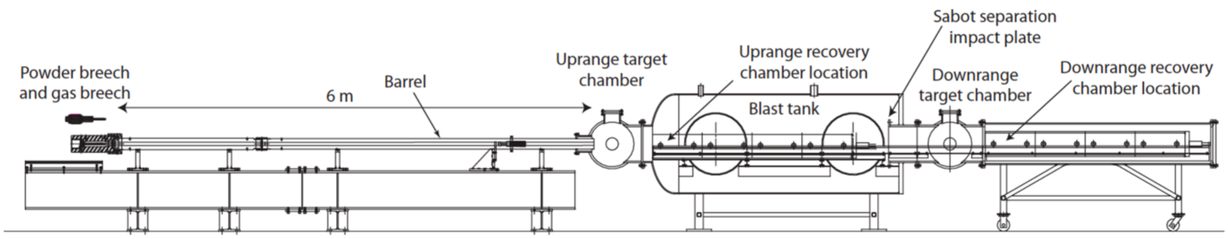

Fig. 2. Schematic of the 40-mm single-stage launch system, capable of firing metal flyer plates to ~2.6 km/s and achieving pressures of 10's GPa in rocks and minerals.

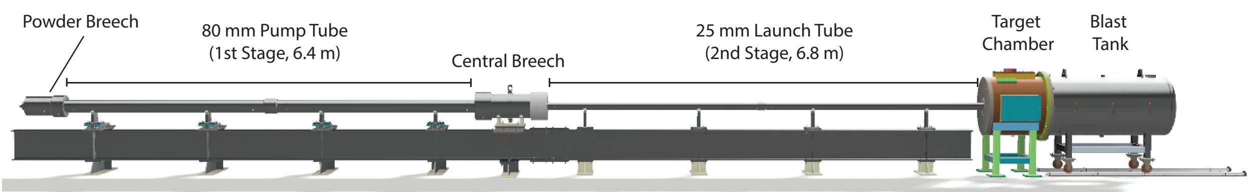

Fig. 3. Schematic of the 80/25-mm two stage launch system, capable of firing metal flyer plates up to ~8 km/s and achieving pressures of 100's GPa in rocks and minerals.