National Aeronautics and Space Administration

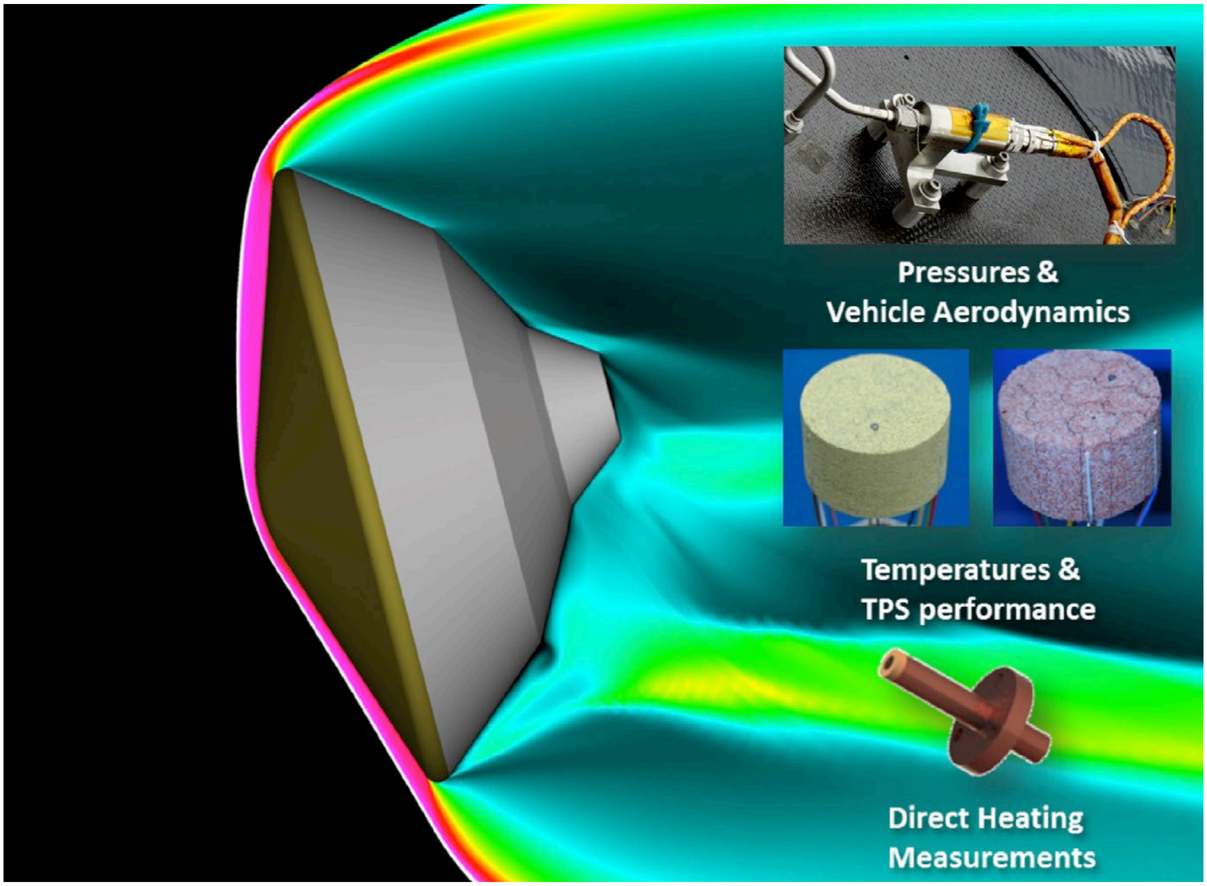
Space Technology

NASA Langley Research Center Flight Projects Directorate Office

Mars Entry, Descent and Landing Instrumentation 2 (MEDLI2)

The Mars Entry, Descent and Landing Instrumentation 2 (MEDLI2) will collect data during the Mars 2020 mission's entry through the planet's atmosphere to enable improved designs of future Mars entry systems for robotic and crewed missions. Understanding aero-thermal environments, thermal protection system performance, and aerodynamic performance characteristics of the Mars 2020 entry vehicle also extends to designing entry systems for other destinations, such as Venus, Titan, and the gas giants.

The Mars 2020 spacecraft will enter Mars' atmosphere traveling about 12,500 miles per hour (mph). MEDLI2 will collect data in the last 7 minutes of flight. That's about how long it will take to slow the spacecraft from 12,500 mph to just under 2 mph. MEDLI2 includes three types of sensors (thermocouples, heat flux sensors, and pressure transducers) and a data acquisition and signal conditioning unit (the Sensor Support Electronics Unit) to record the heating and atmospheric pressure



MEDLI2 will measure entry, descent and landing performance data on the Mars 2020 heat shield and backshell.

experienced during entry and through parachute deployment. Instrumentation is applied to both the heat shield and the backshell, including locations through the thermal protection system.

Close analysis of MEDLI2 flight data is vital to future NASA exploration of the red planet. Extending on groundbreaking entry data collected by the MEDLI instrument flown aboard the Mars Science Laboratory (MSL) mission, MEDLI2 will explore regimes not addressed during the MSL 2012 mission and seek answers to questions generated from examining MEDLI/MSL data.

Additional and complementary measurements will come from increased sensor locations for heat shield and back shell observations. MEDLI2 will provide measurements of the heating and pressures on the Mars 2020 entry vehicle's backshell, an area with minimal pressure flight data and no heating flight data. Previously existing data are limited to single pressure-point observations from the Viking entry systems of the 1970s. Since that time, no other backshell observations have been collected for a Mars entry. MEDLI2 will also provide the first real observations of backshell conditions of local heat flux and estimated thermal protection sys-tem performance. This unique data set will enable a significant reduction in modeling uncertainty.

MEDLI2 will also provide a wider ranging examination of the heating on the heat shield. The Mars entry heating levels are so high that the spacecraft's thermal protection system is designed to dissipate heat by burning away during entry into the Mars atmosphere. By embedding thermocouples within the thermal protection system, MEDLI2 will be able to measure how the temperature within the thermal protection system changes throughout the entry, allowing researchers to compare flight data with predicted data and to update analytical models. In addition, the MEDLI aerodynamic measurements were unable to provide high fidelity data in the supersonic regime where the impact of winds and low altitude density are of interest in the final conditions at deployment of the parachute. MEDLI2 will be extending the observation capability to improve the under-standing of winds and density in the supersonic regime.

Because the Mars environments and atmosphere are dramatically different from those available in Earth-based testing facilities, and because of the small amount of relevant flight data available, design and testing of the entry system to withstand such environments relies primarily on modeling and simulation tools. As a consequence, the Mars 2020 spacecraft is designed with large safety margins at the expense of payload mass. Results of the MEDLI and MEDLI2 experiments will help NASA ensure these margins are correctly sized on future missions, enabling more robust robotic studies and, in time, human journeys to and discovery on Mars.

MEDLI2 represents a true collaboration within NASA with funding provided by three of the four NASA Mission Directorates: Space Technology (lead organization; funded through Game Changing Devel-opment Program), Human Exploration and Operat-ions, and Science. Implementation of MEDLI2 occurs through a collaboration of three NASA centers: Langley Research Center, lead center; Ames Research Center, science lead; and Jet Propulsion Laboratory, accommodation and integration lead.

The Flight Projects Directorate (FPD) at NASA's Langley Research Center successfully completes flight projects from concept definition through launch. FPD drives new business, develops strong teams through effective partnerships, and improves processes and procedures. FPD projects support the Aeronautics, Space Technology, Science, and Human Exploration Mission Directorates.

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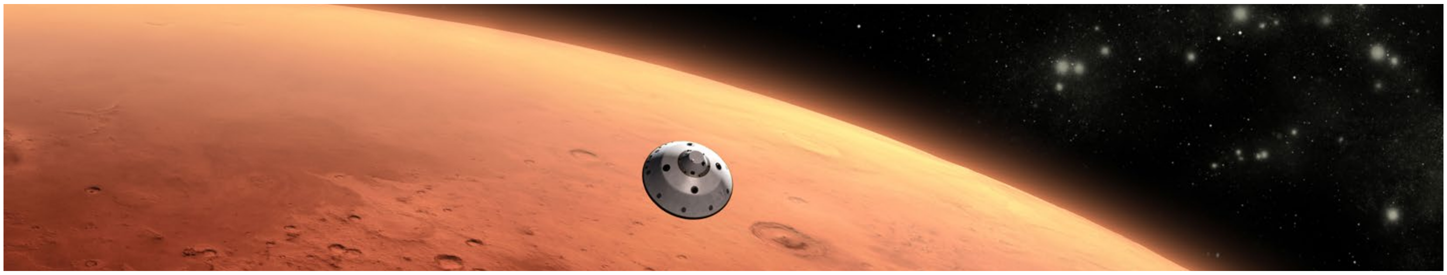

When MEDLI2 makes it to Mars at the start of the next decade the data it gathers will help plan for future crewed missions to the planet.

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