MEDLI Aerothermal Environment Reconstruction Efforts

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The Mars Science Laboratory (MSL), scheduled to launch in December 2011, is equipped with an heat shield instrumentation suite. The suite, named MEDLI for MSL Entry Descent and Landing Instrumentation, includes a series of pressure ports, thermocouples, and isotherm sensors embedded in the thermal protection material. Pressure ports and transducers are part of MEADS (Mars Entry Atmospheric Data System), while thermocouple and isotherm sensors make up the MISP (Mars Integrated Sensor Plug). This paper focuses primarily on the response of the MISP plugs (T1-T7) to Martian atmospheric entry (Figure 1).

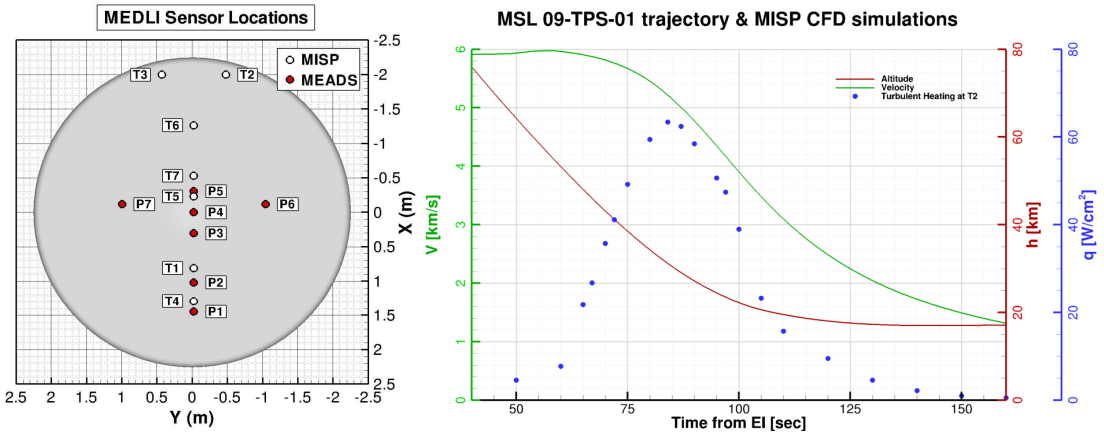

Figure 1. MEDLI sensor locations (left); Sample heating pulse and MSL trajectory (right)

The science goals of the MISP ports are to verify turbulence transition, stagnation region heating, catalytic augmentation, subsurface material response, and surface recession of the ablative heat shield. However, MISP can only directly measure discrete in-depth temperatures, thus the remaining science objectives must be addressed through data-analysis and aerothermal environment reconstruction using computational fluid dynamics (CFD) and material response codes.

This paper will describe the MISP science objectives and the current state of reconstruction efforts. These efforts focus on coupled CFD and material response models to simulate anticipated effects of transition and catalycity on MISP sensors, and include sensitivity studies on MSL design trajectories. Additionally, this paper will discuss arc-jet and material properties tests planned in support of the MISP reconstruction.