

# Sensors for Ablative Thermal Protection Systems

Readiness level:  
 TRL 1-3: Concept  
 TRL 4-6: Prototype  
 TRL 7-9: Demonstrated

NASA Ames Instrumentation Workshop

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Technology / Application

**Problem:**

Uncertainty in computational models of ablative thermal protection system (TPS) performance leads to high design margins.

- Results in higher TPS mass and reduced payload mass

**Application:**

NASA missions that will encounter the atmosphere of any celestial body

- Earth, Mars, Venus, Saturn, Jupiter, Titan...

**Purpose:**

Measure aerothermal environment and performance of ablative thermal protection systems during atmospheric entry.

**Technology:**

Adapt sensing technologies to ablative thermal protection system materials

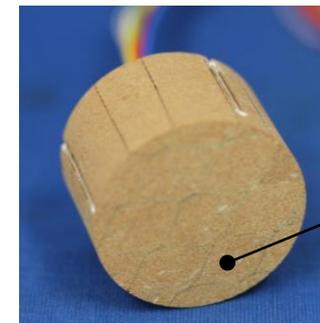
- Instrumented plugs include embedded thermocouples and isotherm following sensors (e.g. HEAT sensor\*)
- Radiometers measure shock layer radiation

*\*Oishi, T., Martinez, E., Santos, J., "Development and Application of a TPS Ablation Sensor for Flight," AIAA 2008-1219.*

**Challenges:**

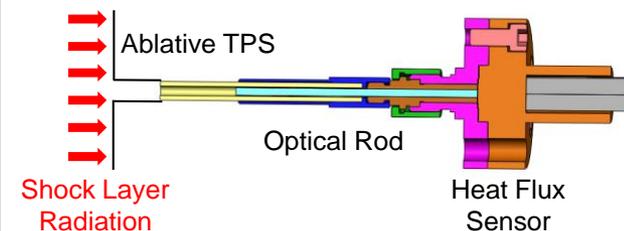
- Must show "do no harm" to the primary mission
  - Requires extensive arc jet testing and other environmental testing
- Mission Infusion: Instrumentation sometimes only benefits the next mission
- Logistical and technical issues of integration

**Orion EFT-1 Instrumented Plug**



Embedded thermocouples and HEAT sensor

**Orion EFT-1 Radiometer**



Funding / Timeline

**Instrumented Plugs:** Flew on MSL (MEDLI, SMD, 2012), Orion EFT-1 (Earth, HEOMD, 2014) and will fly again on Orion EM-1 (2018) and Mars 2020

**Radiometer:** Flew on Orion EFT-1 (Earth, HEMOD, 2014) and will fly again on Orion EM-1 (2018)

*All Discovery missions with atmospheric entry components are now required to include entry instrumentation (same requirement anticipated for New Frontiers AO)*

POC

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