Entry Systems Modeling and Ground Test Capabilities

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Entry, Descent, and Landing (EDL) comprise a relatively small portion of a mission's timeline, however, it is typically among the largest risks. Flying through a body's atmosphere reliably and accurately – from orbit to ground or via aerocapture – is a critical step toward successful in situ exploration.

This exhibit will highlight EDL simulation and ground test capabilities, both existing and under development, that could support mission design, risk reduction, and post-flight analysis for the concepts identified below.

Science Abstract		Technology Relevance
Mars Exploration		
1	9 of 14 abstracts call for surface payloads requiring EDL	Each mission requires EDL ground testing and analysis to demonstrate feasibility and verification of entry system performance requirements.
Outer Planets		
2	New Frontiers Titan Orbiter	Aerocapture at Titan requires accurate atmospheric models, aerodynamic databases, and tailored guidance & control
3	Rideshare4OuterPlanets	The Saturn Probe concept requires aerothermodynamic databases for H_2/He/CH_4 system and material response models for thermal protection design; Post-flight reconstruction may be needed for interpretation of science instruments.
4	Small Next-generation Atmospheric Probe (SNAP) for Ice Giant Missions	Uranus Probe requires aerothermodynamic databases for H_2/He/CH_4 system and material response models for thermal protection design; Post-flight reconstruction may be needed for interpretation of science instruments.
5	Uranus Orbiter and Probe (UOP)	Uranus Probe requires aerothermodynamic databases for H_2/He/CH_4 system and material response models for thermal protection design; Post-flight reconstruction may be needed for interpretation of science instruments.
6	Saturn Probe	Saturn Probe requires aerothermodynamic databases for H_2/He/CH_4 system and material response models for thermal protection design; Post-flight reconstruction may be needed for interpretation of science instruments.

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List of relevant abstracts, continued:

Science Abstract		Technology Relevance
Venus Exploration		
7	SAEVe: Seismic and Atmospheric Exploration of Venus	Aerothermodynamic database for high-speed entry in CO_2/N_2 atmosphere; Free-flight CFD of SAEVe separation; Material response model for HEEET material
8	V-BOSS: Venus Bridge Orbiter and Surface System	Aerothermodynamic database for high-speed entry in CO_2/N_2 atmosphere; Material response model for HEEET material; Potential need for post-flight reconstruction for interpretation of science instruments
9	Venus In Situ Explorer (VISE)	Aerothermodynamic database for high-speed entry in CO_2/N_2 atmosphere; Material response model for chosen TPS, possibly ADEPT; Free-flight CFD of ADEPT vehicle dynamics if chosen
Small Bodies		
10	Ceres Sample Return	Verify aero and aerothermal performance for Stardust-derived SRC; Free-flight CFD of capsule dynamics and parachute deploy
11	Comet Surface Sample Return (CSSR)	Verify aero and aerothermal performance of SRC; Free-flight CFD of capsule dynamics

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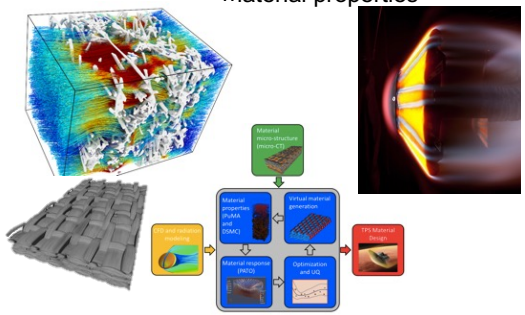
Summary of key EDL modeling and testing technologies. Showcase presentation will consist of posters and/or videos displaying simulation capabilities and test facilities.

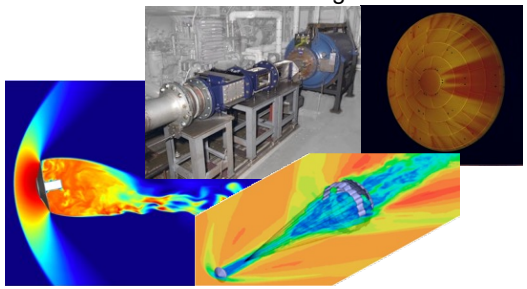
TPS Materials Modeling

Advanced material response models for HEEET and other next-gen woven composites; Arc jet testing for TPS performance qualification; Lab capabilities to characterize material properties



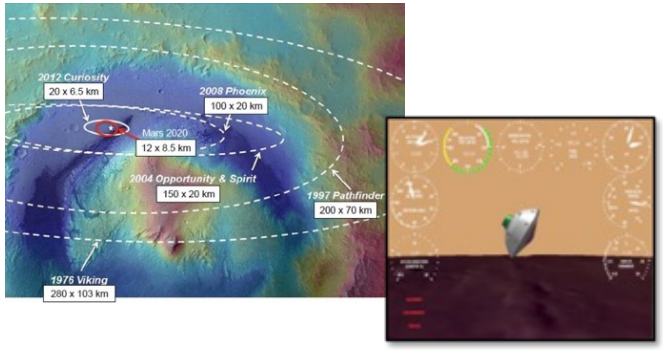
Aerosciences

Free-flight CFD for vehicle dynamics and aerocapture; Turbulent heating models; Parachute modeling; Wind tunnels to characterize aerodynamic performance and heating



Guidance, Navigation, and Control

GNC methods enable precision landing and aerocapture



Shock Layer Kinetics and Radiation

High-fidelity aerothermal simulation for Mars, Gas Giants, Venus, and return to Earth; Electric Arc Shock Tube facility measures flight-similar radiative emission