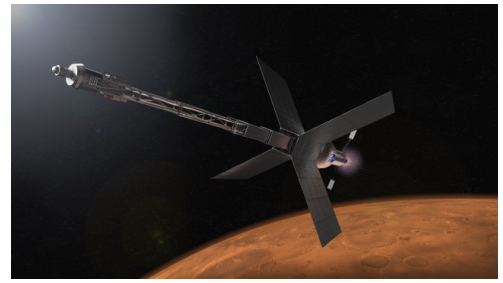
STMD Space Technology Research Grants (STRG) Program – Space Technology Research Institutes (STRI) Overview and Introduction

Dr. Matt Deans – Program Executive, STRG

STRG Program Overview

Engage Academia: *tap into spectrum of academic researchers, from graduate students to senior faculty members, to examine the theoretical feasibility of ideas and approaches that are critical to making science, space travel, and exploration more effective, affordable, and sustainable.*



NASA Space Technology Graduate Research Opportunities (NSTGRO) - ~$84k per year, ~2 to 4 years

- Graduate student research in space technology; research conducted on campuses and at NASA Centers and not-for-profit R&D labs

Early Career Faculty (ECF) - ~$200k per year, up to 3 years

- Focused on supporting outstanding faculty researchers early in their careers as they conduct space technology research of high priority to NASA's Mission Directorates

Early Stage Innovations (ESI) - up to $250k per year – NTE $650k total, up to 3 years

- University-led, possibly multiple investigator, efforts on early-stage space technology research of high priority to NASA's Mission Directorates
- Paid teaming with other universities, industry, and non-profits permitted

Lunar Surface Technology Research (LuSTR) Opportunities - up to $2M total, up to 2 years

- University-led efforts addressing high priority lunar surface challenges
- Short duration, high value grants with emphasis on technology development and potential infusion
- Paid teaming with other universities, industry, and non-profits encouraged

Space Technology Research Institutes (STRI) - up to $3M per year, planned for 5 years

- University-led, integrated, multidisciplinary teams focused on high-priority early-stage space technology research for several years

Accelerate development of groundbreaking high-risk/high-payoff low-TRL space technologies

STRI Overview

STRI Goals: *To strengthen NASA's ties to the academic community through long-term, sustained investment in research and technology development critical to NASA's future. These institutes invest in large, multidisciplinary, university-led research efforts where the research institutes construct enables coordination of experts from a wide range of fields and organizations in a single distributed research structure.*

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- Bio-Manufacturing for Deep Space Exploration
  - The Center for the Utilization of Biological Engineering in Space (CUBES), PI: Adam Arkin, University of California, Berkeley
- Computationally Accelerated Materials Development for Ultra High Strength Lightweight Structures
  - The Institute for Ultra-Strong Composites by Computational Design (US-COMP), PI: Greg Odegard, Michigan Technological University

STRI 18

- Smart Deep Space Habitats (SmartHabs)
  - Resilient ExtraTerrestrial Habitats research institute (RETHi), PI: Shirley Dyke, Purdue University
  - Habitats Optimized for Missions of Exploration (HOME), PI: Stephen Robinson, University of California, Davis

STRI 20

- High-Power Electric Propulsion Ground Testing and Modeling Extensible to In-Space Operation
  - Joint AdvaNced PropUlsion InStitute (JANUS), PI: Mitchell L. R. Walker, Georgia Institute of Technology
- Revolutionary Advancements in Multidisciplinary Modeling and Simulation of Entry Systems
  - **Advanced Computational Center for Entry System Simulation (ACCESS), PI: Iain D. Boyd, University of Colorado**

STRI 22

- Accelerating Additive Manufacturing Certification with Model-Based Tools
  - Institute for Model-Based Qualification & Certification of Additive Manufacturing (IMQCAM), PI: Anthony Rollett, Carnegie Mellon University
- Quantum Technologies for Remote Sensing
  - Quantum Pathways Institute, PI: Srinivas Bettadpur, University Of Texas, Austin

National Aeronautics and
Space Administration

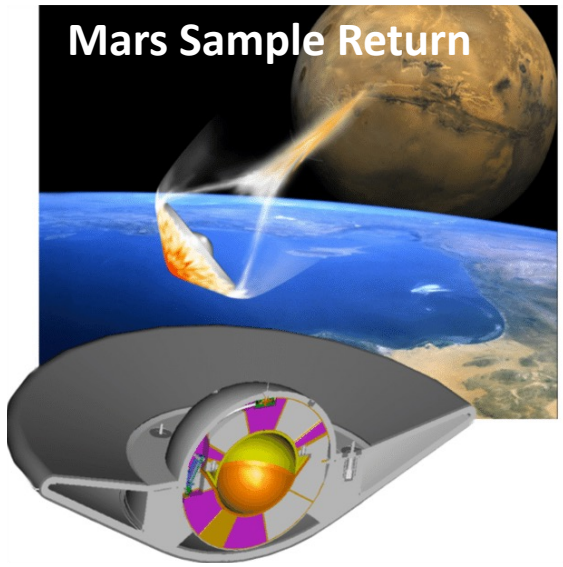
ACCESS Rationale

Michael J. Wright, EDL Strategic Capability Lead (Acting)
Eric Stern, ACCESS NASA Technical Lead

NASA's Space Technology Mission Directorate

November 29, 2023

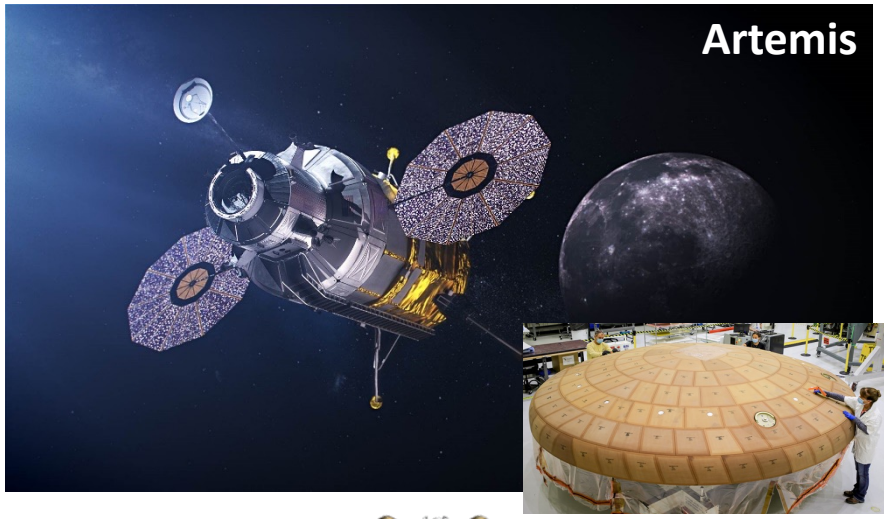
ACCESS STRI: Motivations



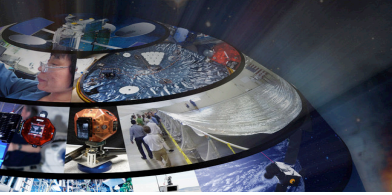
Missions like operational crewed Moon/Mars exploration and Mars sample return demand an ability to quantify entry system reliability prior to flight

Key Needs:

- Risk and performance based architecture trades
- Establish system reliability for flight certification
- Bridge ground-to-flight testing gap; reduce system risk
- Support sustainability and block upgrades



Topic designed to <u>complement</u> and <u>supplement</u> in-house research, leveraging an academic base created from NASA & DOD entry system funding. Institute products address multiple EDL gaps and are directly relevant to the "Land 20 Tons" and "EDL to Enable Planetary Science" Envisioned Future Priorities.



ACCESS STRI: Intended Scope

Objective: Fundamentally advance the SoA in modeling and simulation of entry systems for future NASA missions; emphasis on tools to predict system response to off-nominal events of critical importance.

Required Elements:

1. Detailed modeling of kinetic rates and physical processes that govern key chemical kinetic, material behavior, and fluid dynamic phenomena. **[295, 296, 324, 325]**
2. Tightly-coupled multi-disciplinary analysis of aerodynamics, aerothermodynamics, shock layer radiation, material response, and thermostructural behavior. **[329]**
3. High-fidelity modeling of thermal protection material damage initiation/propagation, and failure mode identification. **[295, 296, 1440]**
4. Rigorous techniques for uncertainty quantification and established methodology to make physics-based reliability estimates for NASA entry system concepts. **[323]**

Other Considerations:

- Model validation is key across all objectives
- Effective solution will likely require emerging heterogeneous Peta- and Exascale computing technology **[330]**

ACCESS is NASA's Primary investment in 323 and 329 at this time

[xx]: EDL&PL Gap Addressed