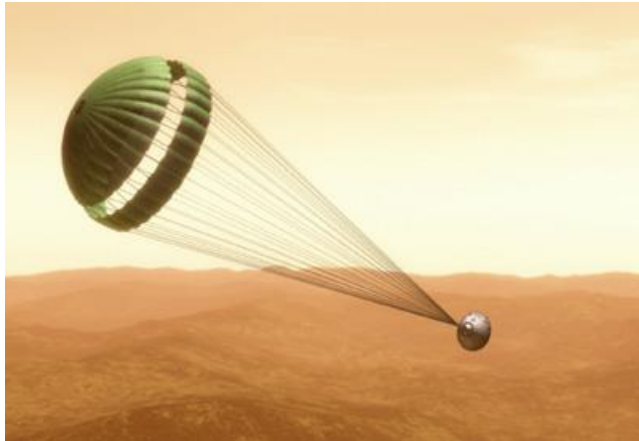


# Alternative Spacecraft Deceleration Technology



## Name of Technology:

Parachute Systems and Modeling

## Participating NASA Centers:

LaRC (Lead); ARC, JPL, JSC

## Technological Area:

Z7.03 Entry and Descent System Technologies

## Vision for the Technology:

A deployable and reusable deceleration system is needed for spacecraft on deep space exploration and Earth return missions. The deceleration system would reduce the velocity of the spacecraft from hypersonic speeds to landing on Mars and/or Earth. NASA needs a repeatable system that is more reliable and predictable than parachutes.

## Challenges:

NASA's workhorse technology for landing has always been parachutes, however these are typically made specifically for that mission. Repeatability of manufacturing and predictable behavior at large scale are significant challenges that NASA faces. Parachutes continue to be a source of problems to both NASA and its commercial partners.

Currently, the State-of-the-Art (SOA) technology is the Mars Science Lab (MSL) parachute at a diameter of 20.5 m. It is deployed when the vehicle is at Mach 2. The

testing and qualifying expense for a parachute for Mars cost \$40-50M.

Utilizing parachutes continue to have open risks, schedule challenges, and high-cost impacts.

## NASA Seeks to Meet the Following Specs:

Successful closure of this gap will be determined through:

- Outperform parachutes
  - Models predict flight performance within +/- 10%
- Elimination of mission risk items
- Prolonged/expensive testing campaigns

## Overview of Student Project:

NASA seeks innovative spacecraft deceleration system that can be deployable and reusable to Mars and return to Earth missions. Hypersonic velocities must be reduced for landing on surfaces. Both manned and unmanned spacecraft require this capability to be reliable and repeatable.

## Innovative Areas Student Projects Can Address:

- ❖ Design deployable hypersonic deceleration technologies for spacecraft
- ❖ Develop a multi-technology design to decelerate a spacecraft from hypersonic speeds

## Project Phases

- I. Conceptual and feasibility study with characteristics
- II. Proof of Concept/CFD modeling/  
Possible Lab environment testing

**Research Funded by NASA on this Topic:**

[X2.01Advanced Materials](#)

[MSL Parachute Test \(SRC-000994\)](#)

Proposal Number: 22-1- Z7.03-2439  
[GasPak: A High Output, Clean Gas Generator for Large Volume Deployable Aerodynamic Decelerators](#)

Proposal Number: 21-1- Z7.03-2654  
[Flexible Gas Barrier to Reduce Hot Gas Ingress at Surface of Hypersonic Inflatable Aerodynamic Decelerator](#)

Proposal Number: 18-1- Z7.03-1414  
[Mars Entry and Earth Return Re-Entry Drag Brake Decelerators](#)

Proposal Number: 10-1 X9.02-8810  
[Petal Brake Hypersonic Entry System](#)

Proposal Number: 09-1 X9.02-9443  
[Integrated Inflatable Ballute for Planetary Entry](#)

Proposal Number: 07-1 A2.04-9327  
[Nonlinear Aerodynamic ROM-Structural ROM Methodology for Inflatable Aeroelasticity in Hypersonic Atmospheric Entry](#)

Proposal Number: 03-S1.02-9523  
[Attached Inflatable Forebody Decelerator for Spacecraft Aerocapture](#)

Proposal Number: 171 Z7.03-8642  
[Flexible, Phase Change Fabric for Deployable Decelerators](#)

**References:**

[Z7.03 Entry and Descent System Technologies](#)

[S1.04Entry, Descent and Landing](#)

[Z7.01Supersonic Parachute Inflation Materials Testing, And Instrumentation](#)

[X9.02Advanced Integrated Hypersonic Entry Systems](#)