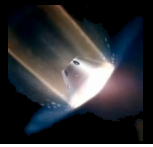
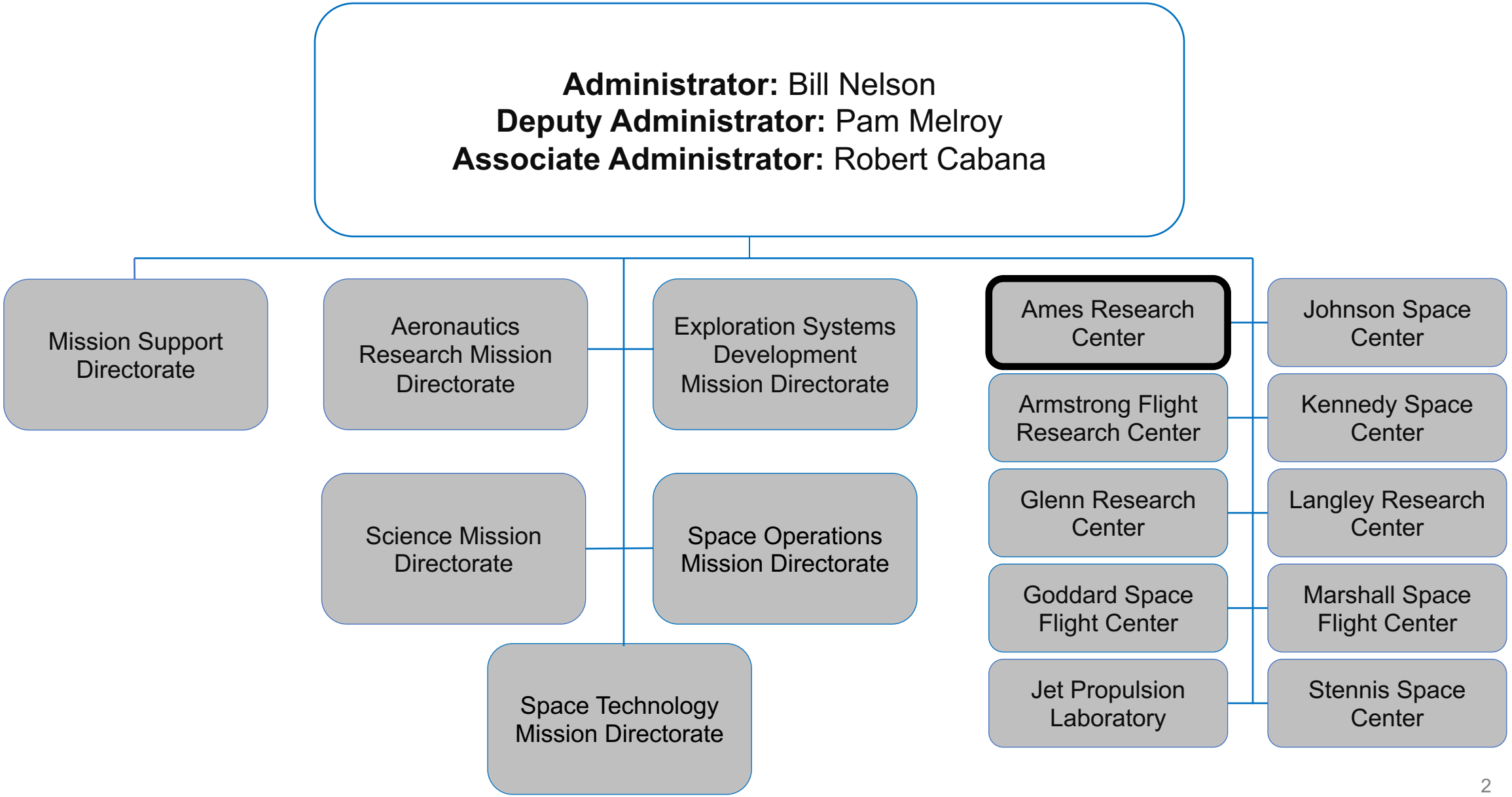



# Entry Systems and Technology Division (Code TS)

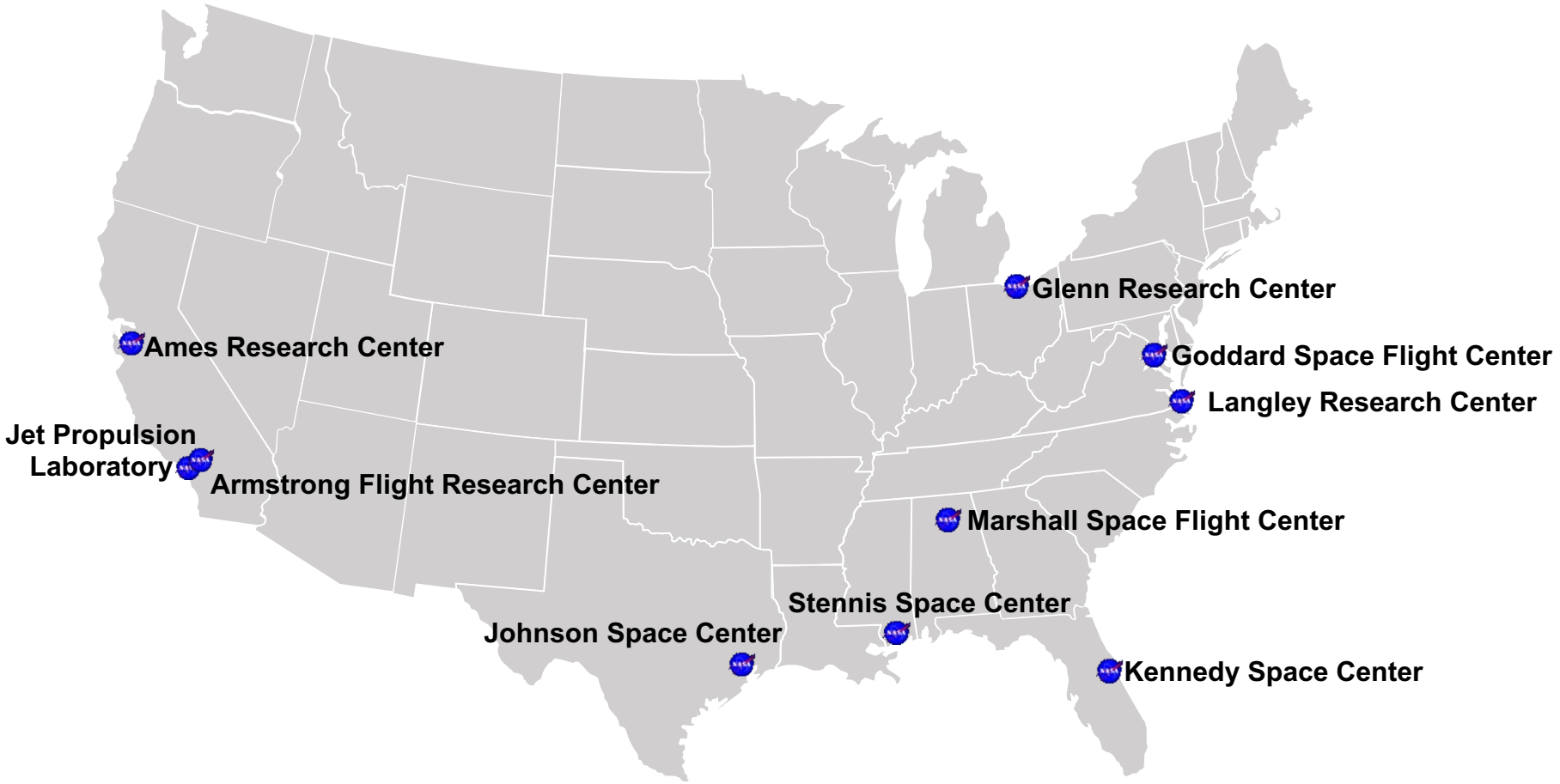
NASA Ames Research Center

August 2022

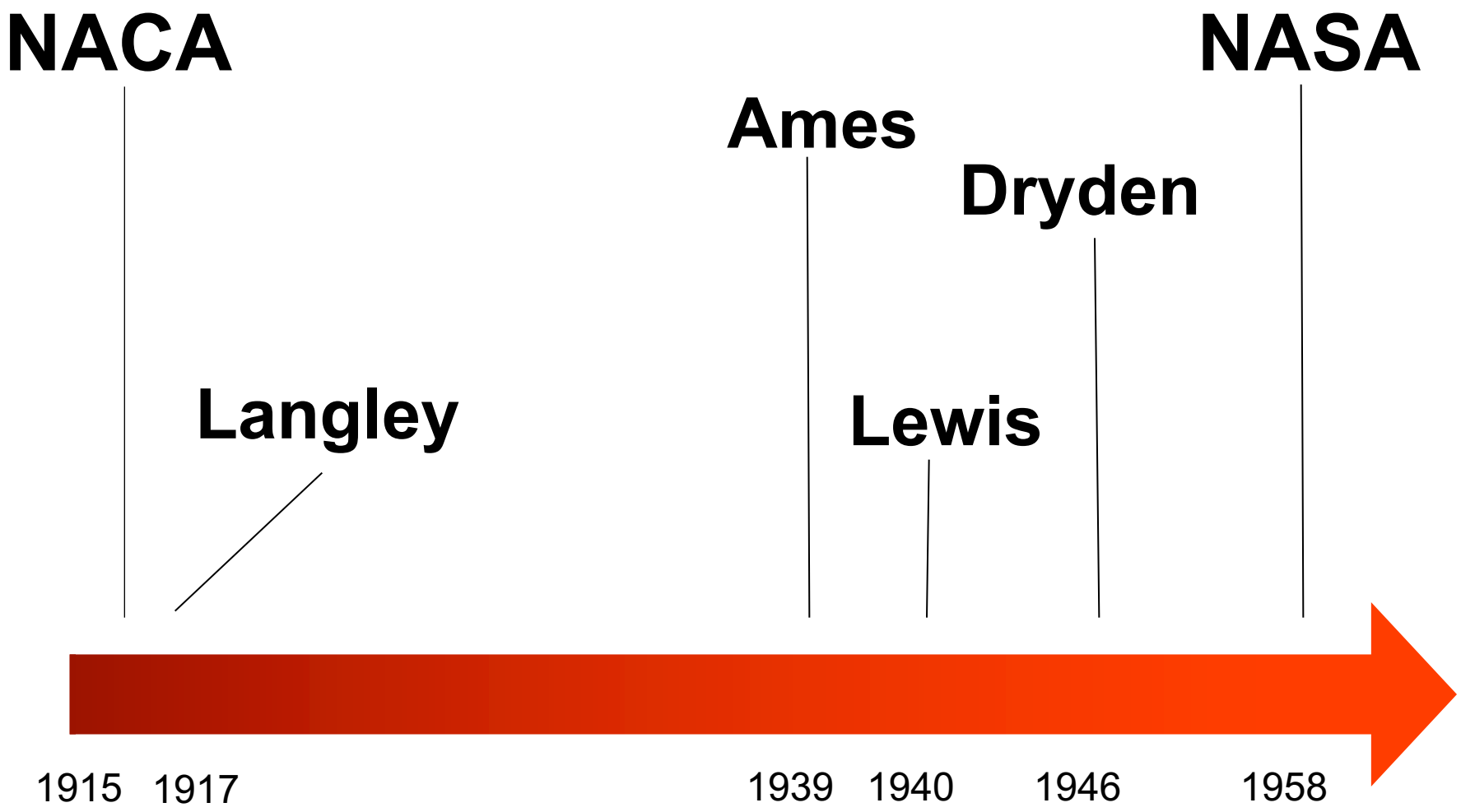
# National Aeronautics and Space Administration



# NASA Field Centers



# NACA Laboratories




- The National Advisory Committee for Aeronautics (NACA) was formed on March 3, 1915, with a charter to "supervise and direct the scientific study of the problems of flight, with a view to their practical solution."

# Joseph Sweetman Ames

- In 1936, the Chairman of NACA (National Advisory Committee for Aeronautics) was Dr. Joseph Ames, president of Johns Hopkins University. Dr. Ames had served as a member of the Committee since its formation and Chairman since 1927.
- Dr. Ames established an Office of Aeronautical Intelligence within NACA to maintain cognizance of the world's aeronautical activities and literature. As part of its operation, the Office maintained a liaison post in Paris. In 1936, the reports from Paris highlighted the buildup of aeronautical research and development in Germany with the construction of aeronautical facilities which could leave the United States at a disadvantage. NACA's lead in aeronautical research was waning and the intentions of Germany's leader, Adolf Hitler, were a source of worry.

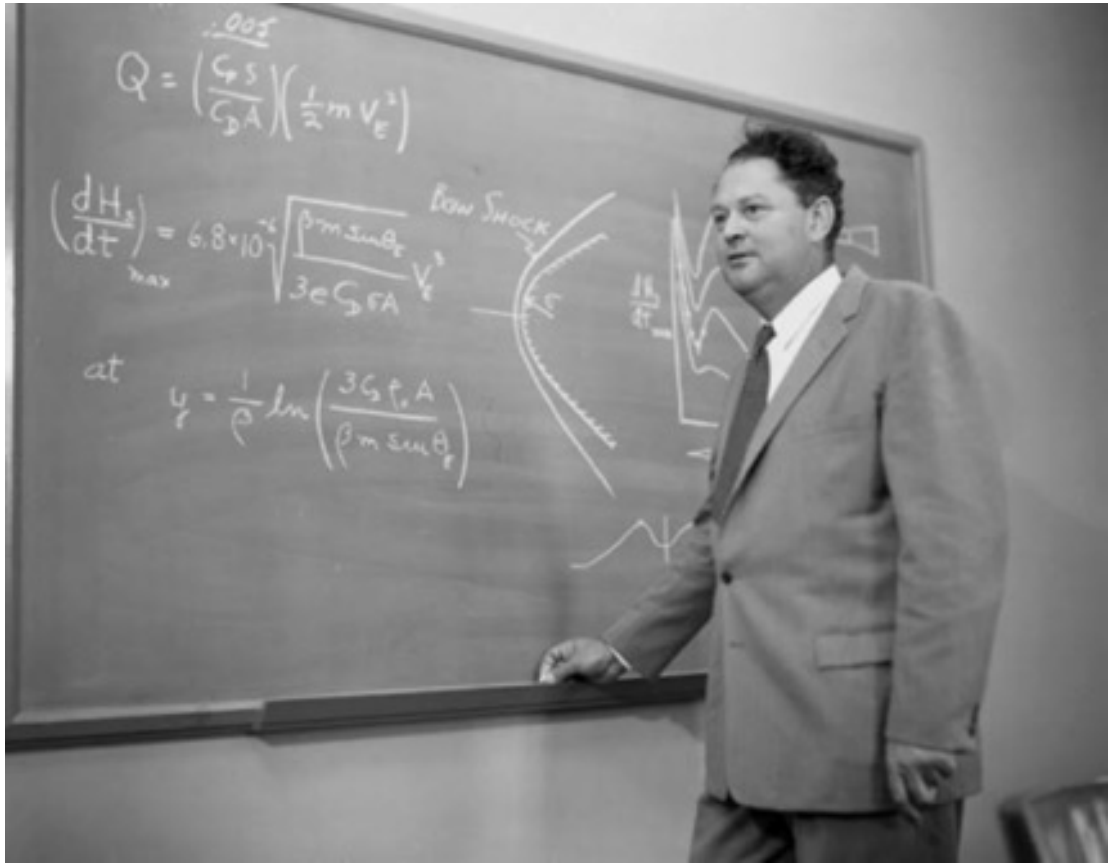
# Ames, the West Coast Sibling of Langley

- Ames was established with the purpose of partnering with Langley to ensure American leadership in aeronautical research in response to the growing threat of Nazi Germany. The bill authorizing the establishment of Ames was enacted into law on August 9, 1939. In less than a month, Hitler launched his attack on Poland and World War II began.
- The staff of Ames was initially built around a nucleus of experienced individuals from Langley.
- Smitty DeFrance had joined the staff of Langley in 1922 and was responsible for the design and construction of most of Langley's major research facilities. DeFrance was formally appointed Ames Engineer-in-Charge on July 25, 1940. He soon thereafter became the Center Director and served in that role until his retirement in 1965. He is longest serving Ames Center Director by far at 25 years.

Competition-Sensitive Information: Use of or disclosure of information contained on this sheet is subject to the restriction on the title page of this document.

# Langley Notables – Ames Forebearers

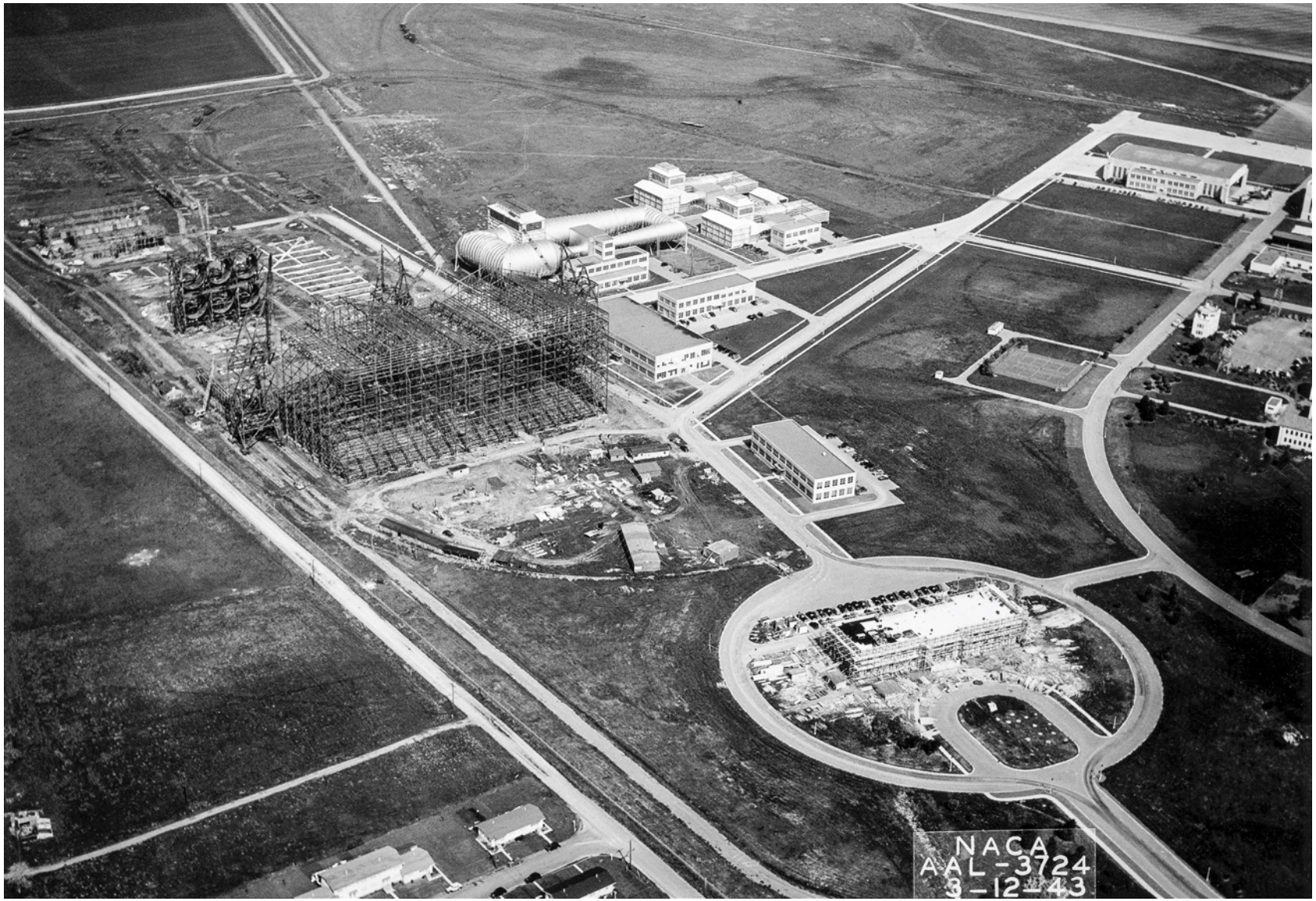
- Along with Smitty DeFrance and Jack Parsons, some 30 notables from Langley came out to start Ames including:
- Ferril R. Nickle, January 29, 1940;
- Carlton Bioletti, March 1;
- Arthur B. Freeman, March 2;
- Edward Ray Sharp, March 11 (left in August and later became Director of Lewis Research Center) ;
- Manie G. Poole, March 11;
- **H. Julian Allen, April 13;**
- George E. Bulifant, April 17;
- Howard W. Kirschbaum, April 29;
- John P. Houston, April 29;
- Edward W. Betts, May 21; and
- James A. White, June 3.



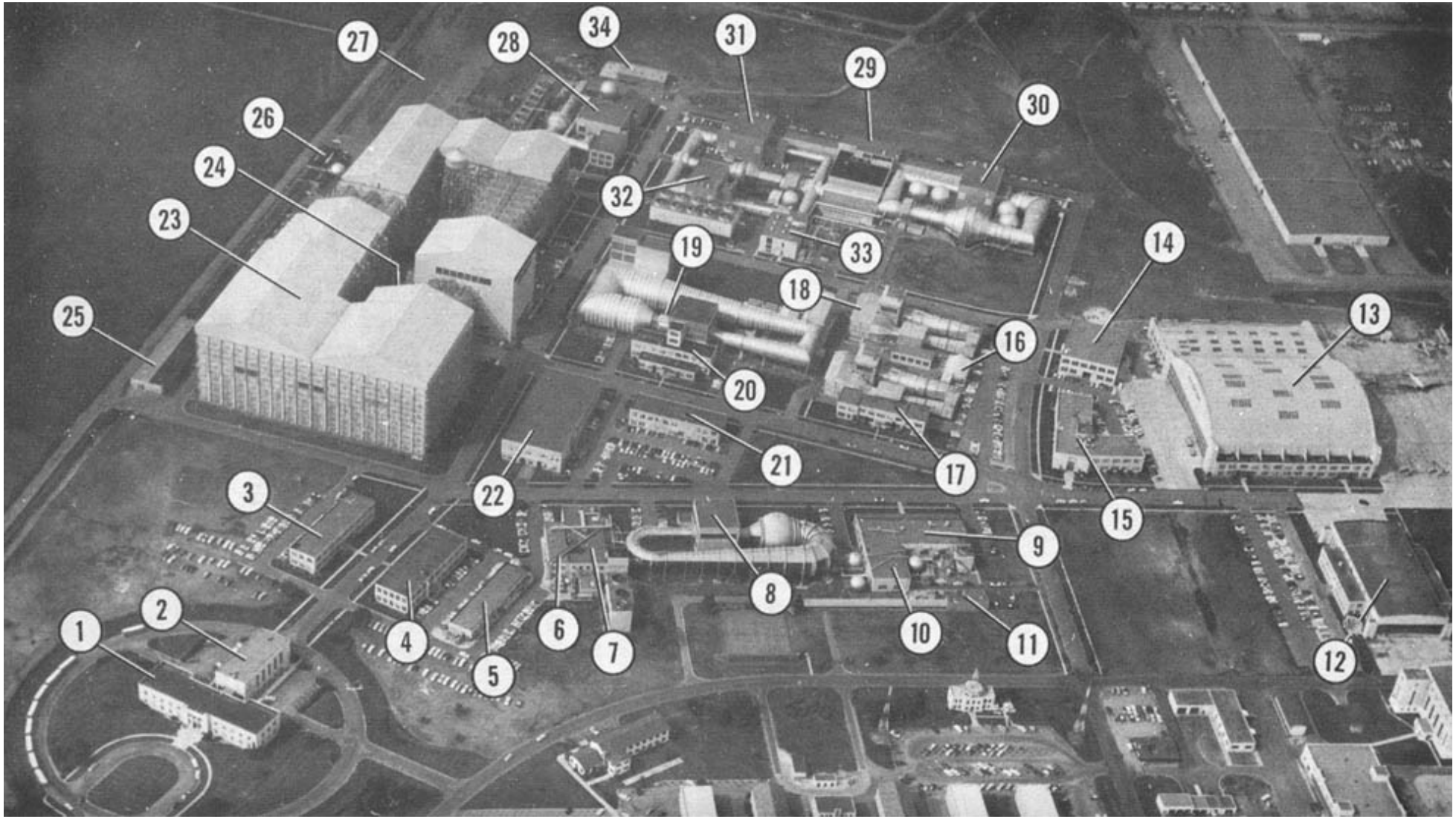
H. Julian Allen
(Career: 1936 – 1969)
Blunt Body Concept – 1951

# Ames – May 21, 1940

# Ames Aeronautical Laboratory 1943

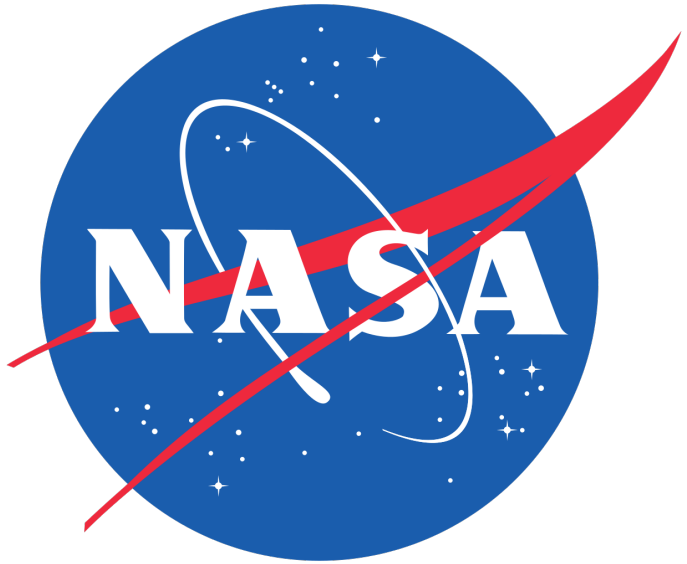


# Ames Aeronautical Laboratory March 1958



# Formation of NASA

- President Eisenhower signed the National Aeronautics and Space Act into law on July 29, 1958. Although it had generally been assumed that Hugh Dryden, the head of the NACA, would be appointed administrator, three weeks later, on August 19, T. Keith Glennan – the President of Case Institute of Technology since 1947 and a former member of the Atomic Energy Commission – was sworn in at the White House as NASA's first Administrator, with Dryden as his Deputy Administrator.
- NASA formally opened for business on October 1, 1958.



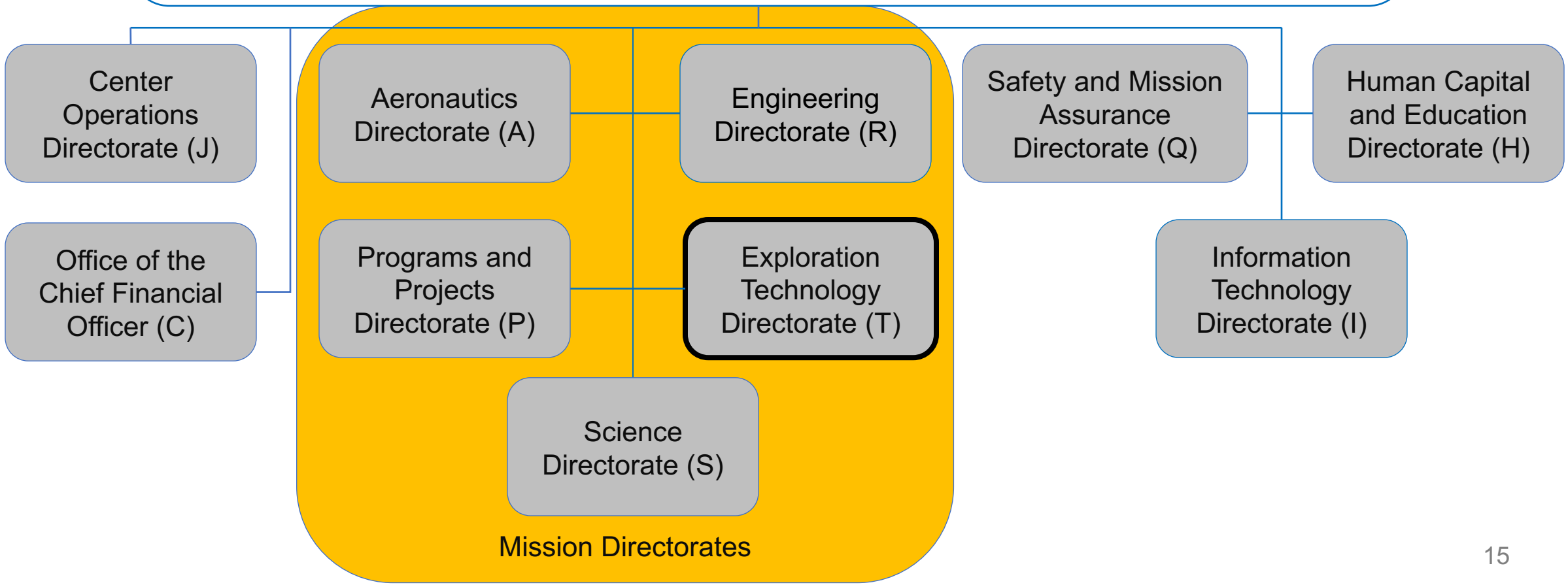
# Ames Research Center – August 27, 1959

# Ames Research Center – August 14, 1964

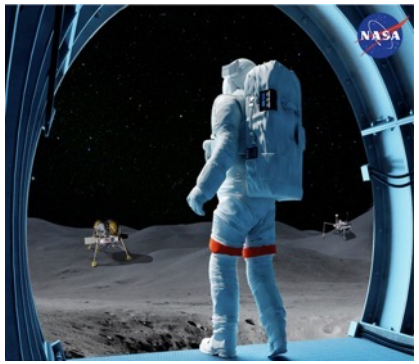
# Ames Research Center – December 14, 1965

# Ames Research Center

**Center Director:** Eugene Tu
**Deputy Center Director:** Carol Carroll
**Associate Center Director:** Amir Deylami
**Associate Director for Research and Technology:** David Korsmeyer

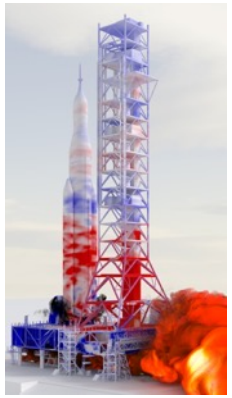


# Exploration Technology Directorate

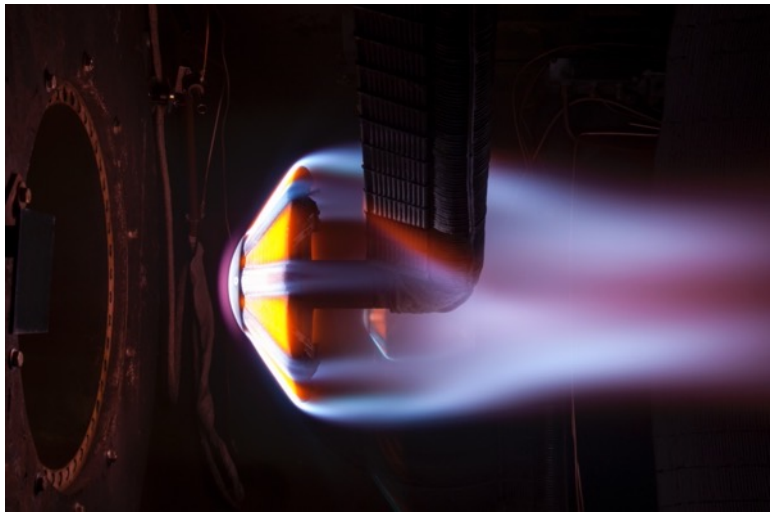


Human Systems Integration Division

Intelligent Systems Division



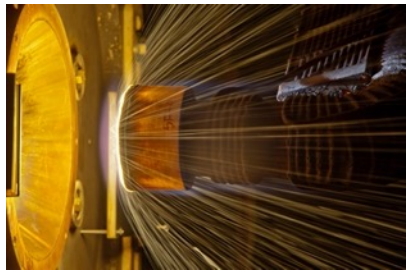
NASA Advanced Supercomputing Division



Entry Systems and Technology Division

# Ames 8 Core Competencies

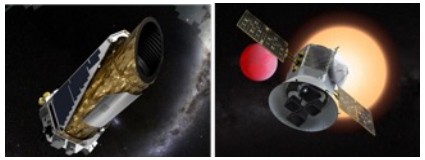
Air Traffic Management



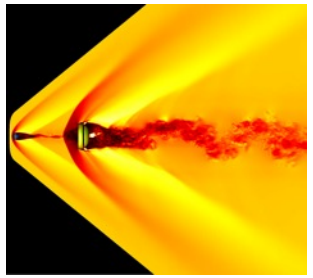
**Entry Systems**


Advanced Computing & IT Systems

Intelligent / Adaptive Systems



Cost-Effective Space Missions

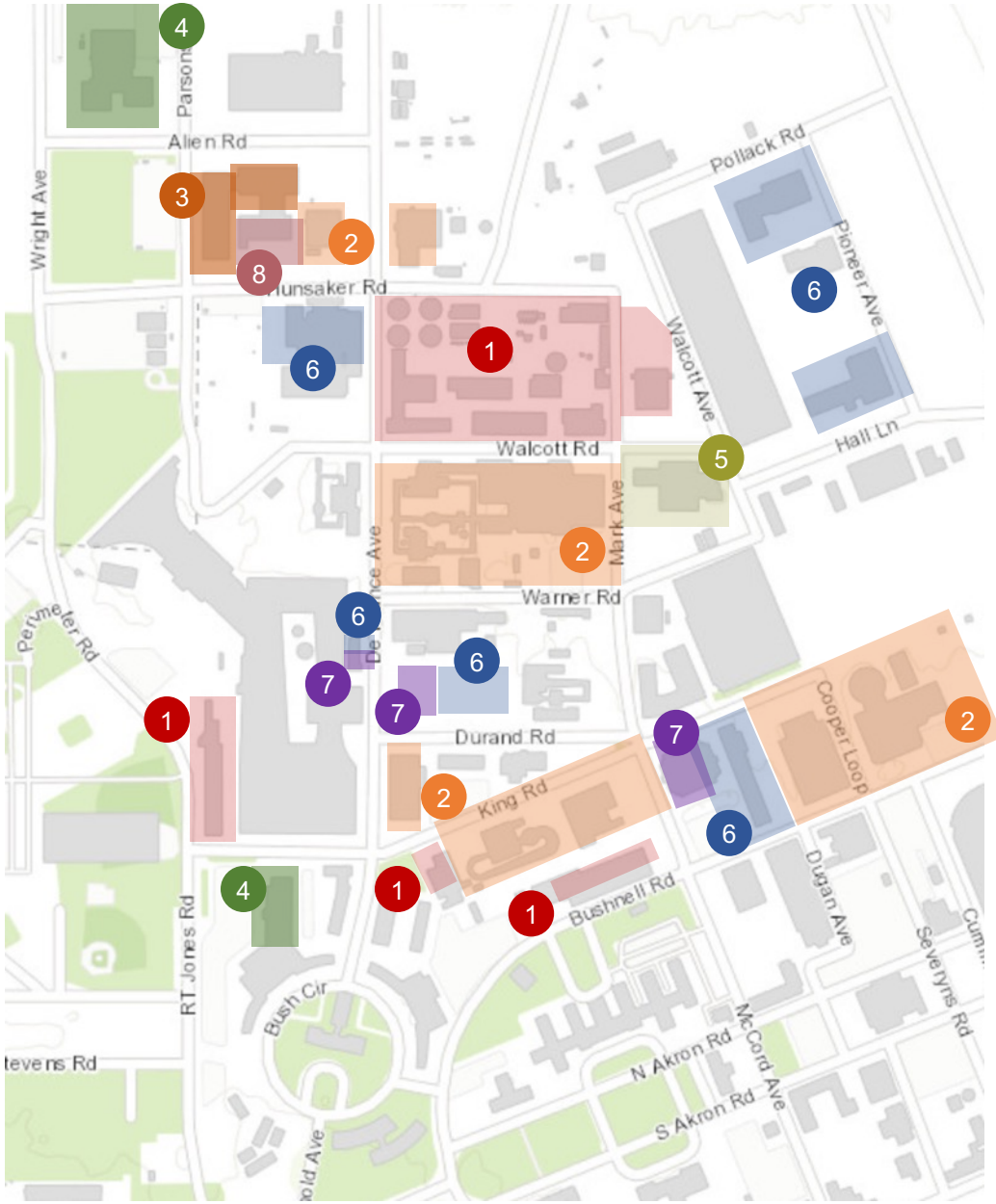


Aerosciences

Astrobiology and Life Science


Space and Earth Sciences

# Ames Core Competency Map




1. Entry Systems
2. Aerosciences
3. Intelligent / Adaptive Systems
4. Advanced Computing & IT Systems
5. Cost-Effective Space Missions
6. Space and Earth Sciences
7. Astrobiology and Life Sciences
8. Air Traffic Management

# Entry Systems and Technology Division

Vision: Routine atmospheric entry for robots and humans exploring the Solar System

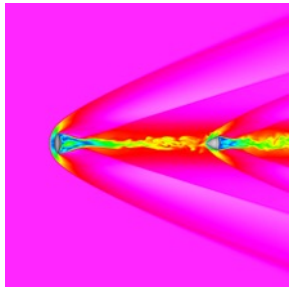
Mission: To develop innovative entry systems technologies from concept to hardware while providing sustaining engineering for all NASA planetary atmospheric entry missions

Motto: Per Ignem Semper Invicta (Through Fire, Ever Invincible)

# Division Organization

- The Entry Systems and Technology Division (TS) is comprised of four separate branches which each play a critical role that when integrated create one of the most unique organizations in the Agency.

Aerothermal environment determination



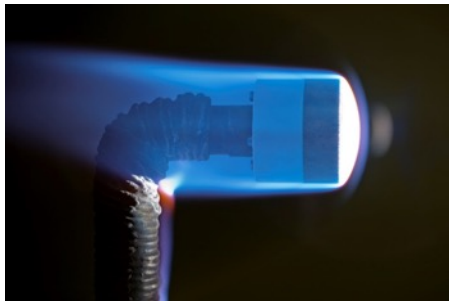
TSA: Aerothermodynamics Branch

Systems engineering and integration for aeroshell development

TSS: Entry Systems and Vehicle Development Branch

Development of thermal protection systems (TPS) materials

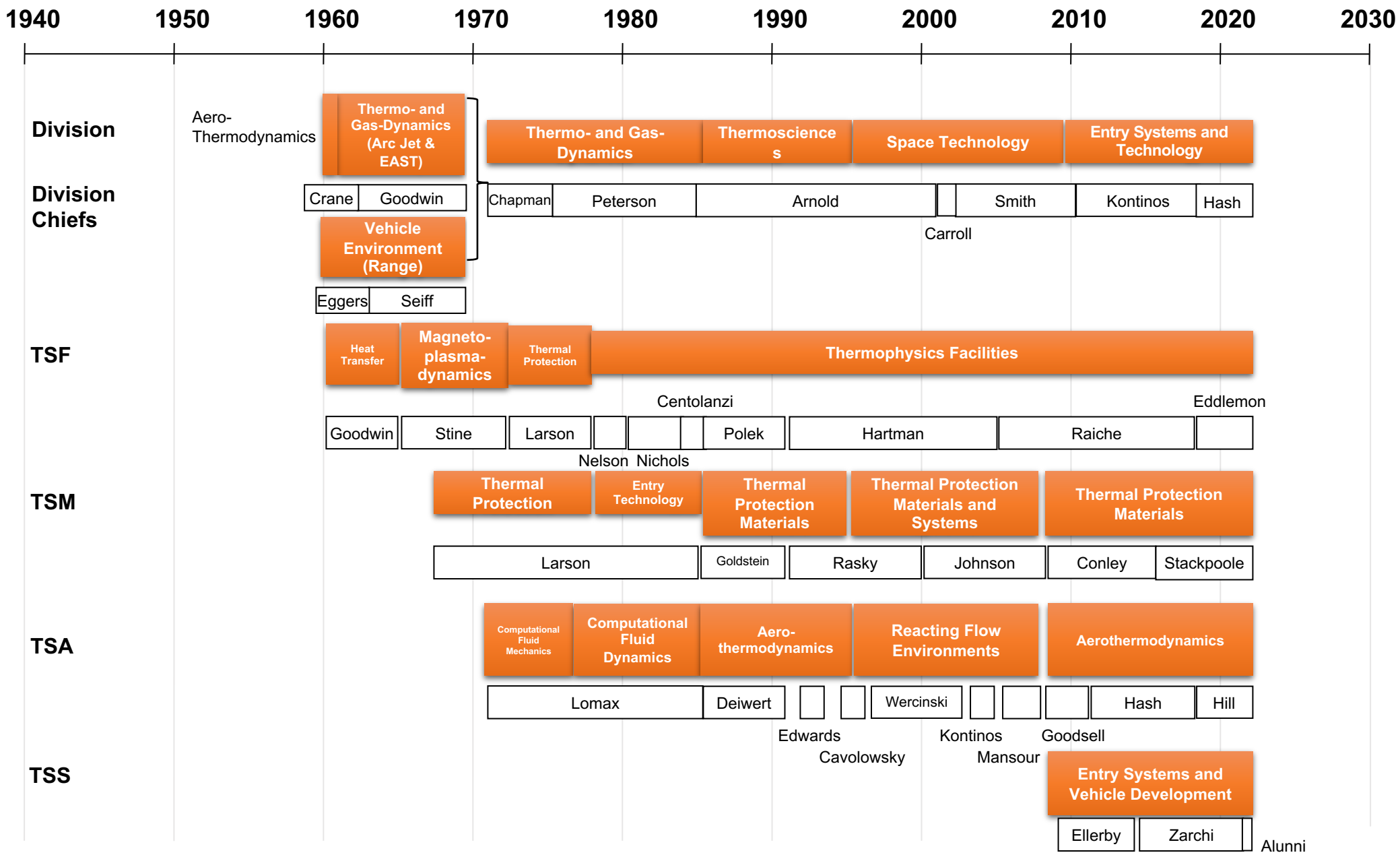
TSM: Thermal Protection Materials Branch



Arc jet testing to verify performance

TSF: Thermophysics Facilities Branch

# Organizational Evolution



# EDL Phase Lead

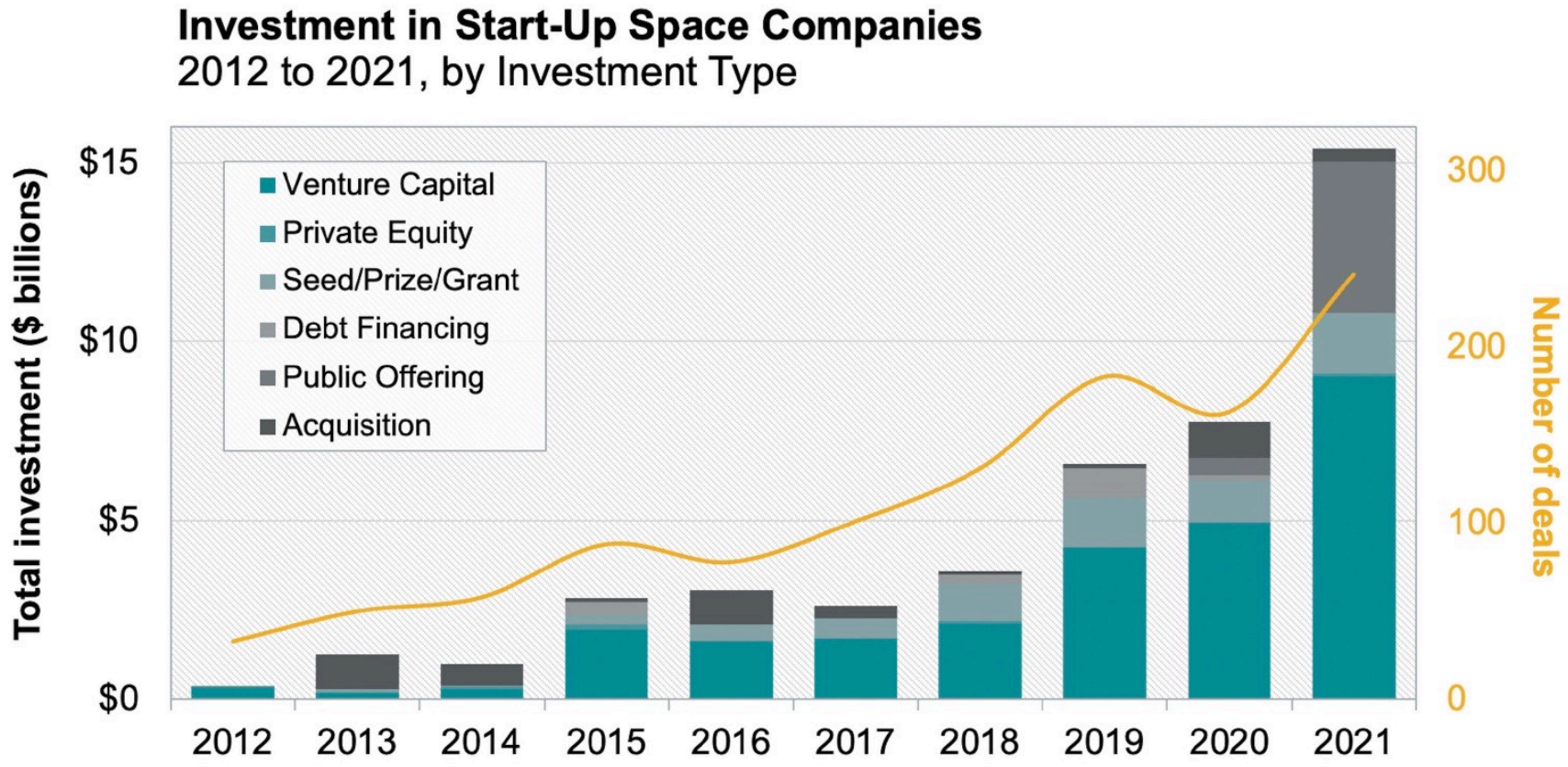
- The EDL Phase Lead role is very important to ensuring mission success. The 2005 Genesis Mishap Investigation Board Report stated that a contributing factor to the mishap root cause of “Inadequate System Engineering Process” was the “lack of a Systems Engineer assigned to the end-to-end entry, descent, and landing (EDL) function.” “Contributing Factor 2.1: Facts: No one on the Systems Engineering Team had been assigned individual Responsibility, Accountability, and Authority (RAA) for the entire EDL sequence and for oversight of the system design and operations plans to execute that phase.”

Faster Better Cheaper

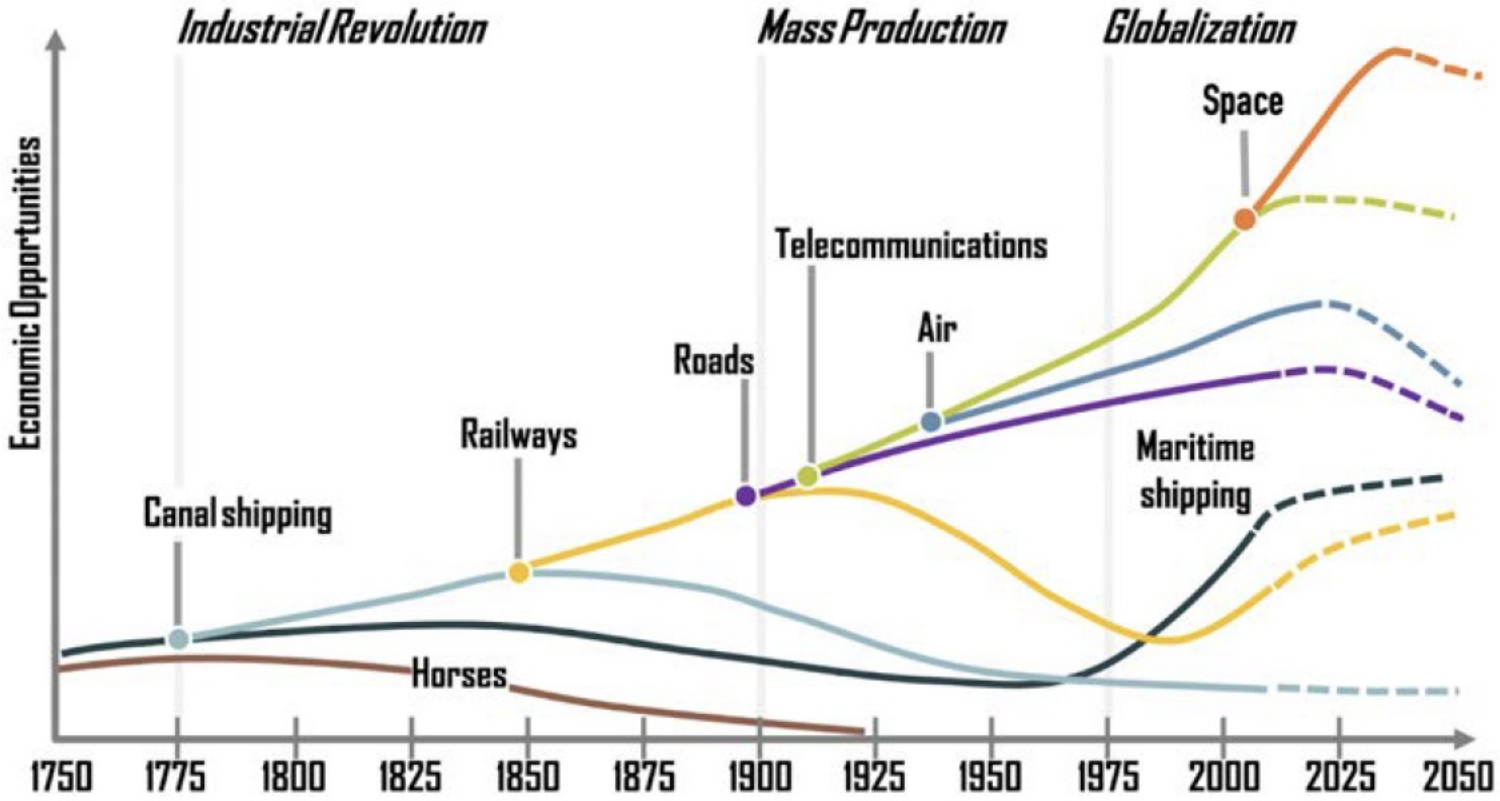
| Mission | Mission Center | Aeroshell Prime | Launch Date | EDL Date (Red = Failure) | Body | EDL Phase Lead |
|---|---|---|---|---|---|---|
| Viking 1 and 2 | LaRC | Martin Marietta | August 20, 1975; September 9, 1975 | July 20, 1976; September 3, 1976 | Mars | None |
| Pioneer Venus | ARC | Hughes | August 8, 1978 | December 9, 1978 | Venus | None |
| Galileo | JPL | Hughes | October 18, 1989 | December 7, 1995 | Jupiter | None |
| Discovery 2 Pathfinder | JPL | JPL | December 4, 1996 | July 4, 1997 | Mars | Rob Manning (JPL) |
| Mars Polar Lander | JPL | Lockheed Martin | January 3, 1999 | December 3, 1999 | Mars | Sam Thurman (JPL) |
| Discovery 4 Stardust | JPL | Lockheed Martin | February 7, 1999 | January 15, 2006 | Earth | None |
| Discovery 5 Genesis | JPL | Lockheed Martin | August 8, 2001 | September 8, 2004 | Earth | None |
| MERs | JPL | Lockheed Martin | June 10 and July 7, 2003 | January 4 and 25, 2004 | Mars | Wayne Lee (JPL) |
| Scout Phoenix | JPL | Lockheed Martin | August 4, 2007 | May 25, 2008 | Mars | Dave Skulsky (JPL) |
| MSL | JPL | Lockheed Martin | November 26, 2011 | August 6, 2012 | Mars | Adam Steltzner (JPL) |
| NF3 OSIRIS-REx | GSFC | Lockheed Martin | September 8, 2016 | September 2023 | Earth | Bill Willcockson (LM) |
| Discovery 12 InSight | JPL | Lockheed Martin | May 5, 2018 | November 26, 2018 | Mars | Rob Grover (JPL) |
| Mars 2020 | JPL | Lockheed Martin | July 30, 2020 | February 18, 2021 | Mars | Al Chen (JPL) |
| NF4 Dragonfly | APL | Lockheed Martin | June 2027 | November 2033 | Titan | **Mike Wright (ARC)**<br>**Deputy: Karl Edquist (LaRC)** |
| MSR EES | JPL | Lockheed Martin | October 2027 | October 2033 | Earth | Christine Szalai (JPL)<br>Deputy: Carlie Zumwalt (LaRC) |
| MSR SRL | JPL | Lockheed Martin | July 2028 | October 2030 | Mars | Steve Sell (JPL) |
| Discovery 15 DAVINCI | GSFC | Lockheed Martin | June 2029 | June 2031 | Venus | Mark Johnson (LM) |

# Commercial Space

- The United States is on the cusp of having an independent commercial space market, as embodied by Kathy Lueders tweet of September 15, 2021: “Congratulations to the @SpaceX team on the successful launch of @inspiration4x! Your mission moves @NASA closer to our goal of becoming just one of many customers in the low-Earth orbit economy.”



# New Transportation Modalities Drive Economic Prosperity

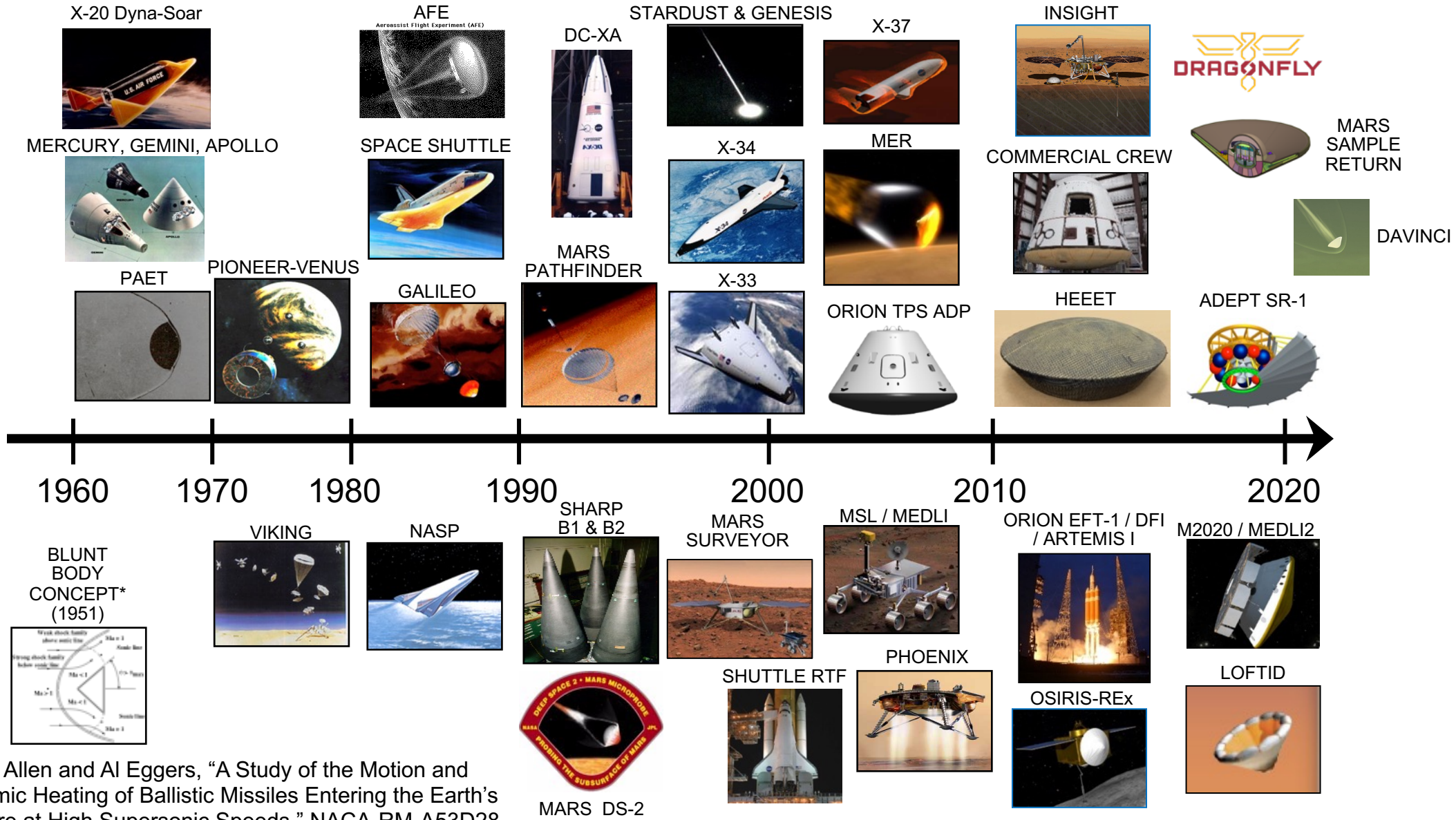



- Throughout human history, the greatest advancements in economic opportunity can be intrinsically linked to the introduction of new transportation modalities that have forever changed the economic and military influence in state affairs. NASA plays a key role in ensuring American success in the space economic sector.

# Commercial Space Entities Interested in Entry Systems

- There are 20+ known entities interested in entry systems, and several are now approaching us to establish Reimbursable Space Act Agreements to assist them with their entry systems needs.

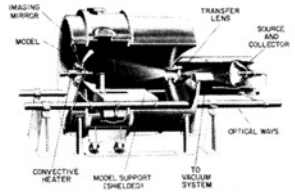
# NASA Entry Projects Supported by Ames

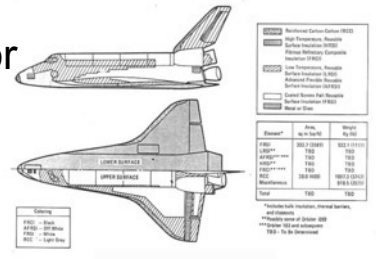


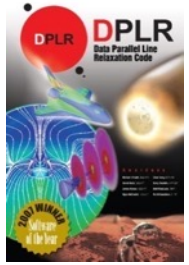

* H. Julian Allen and Al Eggers, "A Study of the Motion and Aerodynamic Heating of Ballistic Missiles Entering the Earth's Atmosphere at High Supersonic Speeds," NACA-RM-A53D28, 1953 / NACA-TR-1381, 1958.

# NASA Ames Entry Systems Inventions

Advanced Entry Heating Simulator

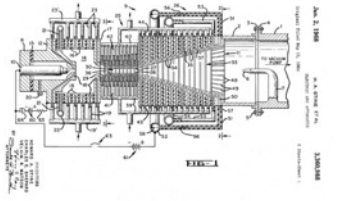




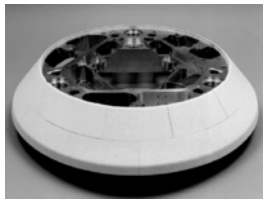

ADEPT


Constricted Arc Heater

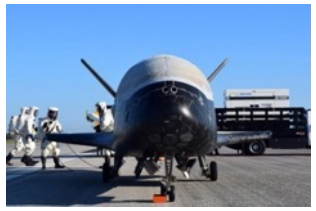


RCG
LI-2200
FRCI
AFRSI
AETB
TUFI

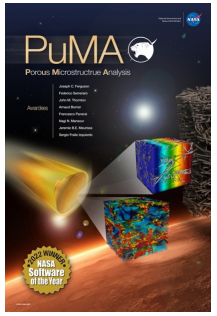
SIRCA



TUFROC

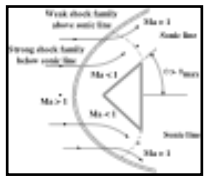


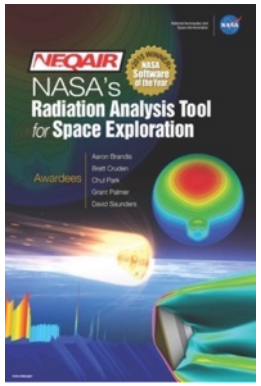
3DMAT




1960 1970 1980 1990 2000 2010 2020

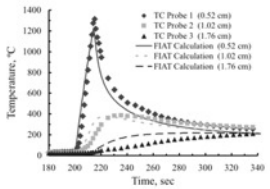
Blunt Body Concept* (1951)





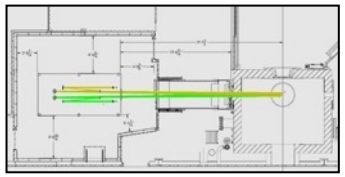

PICA

FIAT



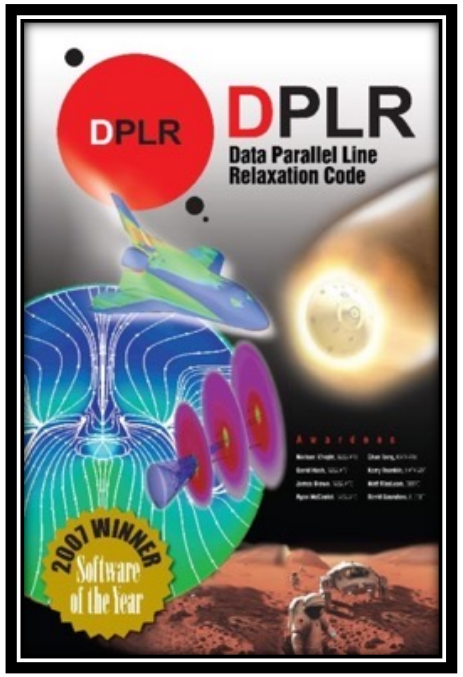

HEEET

Laser-Enhanced Arcjet Facility

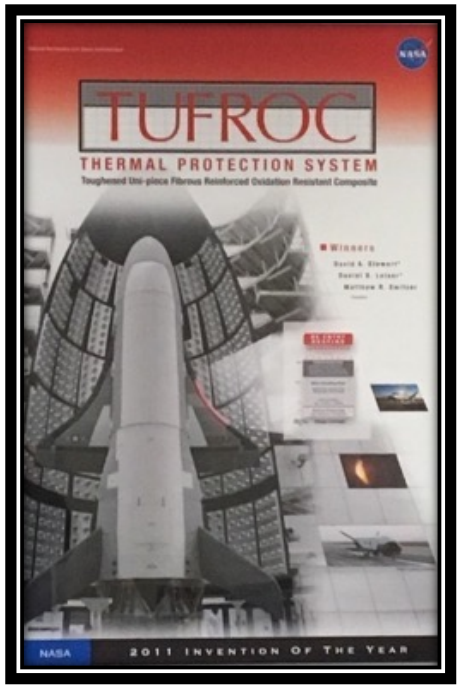


# Awards

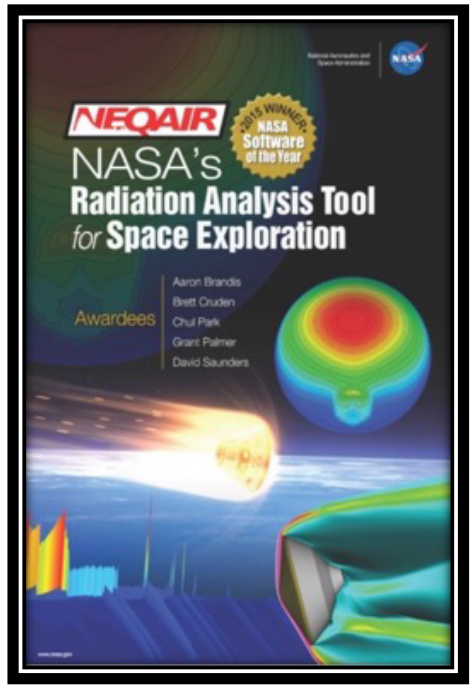

2007 Invention of the Year



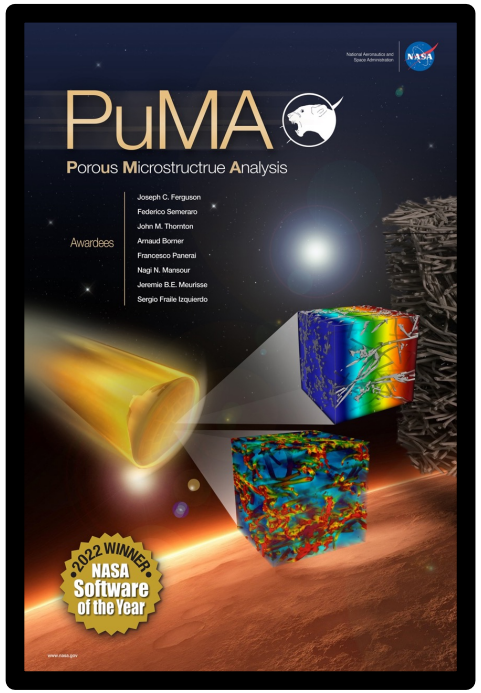

2007 Software of the Year




2011 Invention of the Year

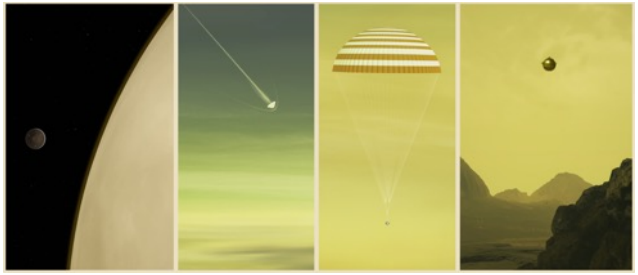



2015 Software of the Year

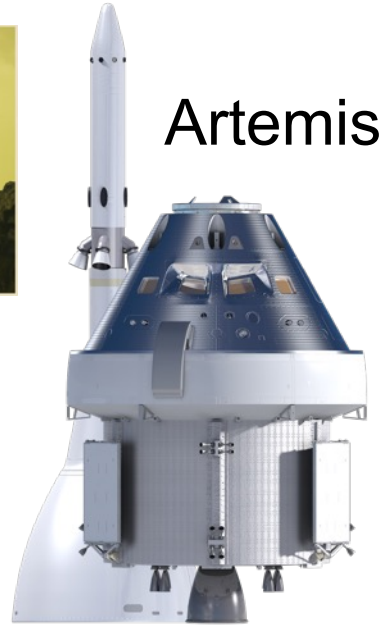



2022 Software of the Year

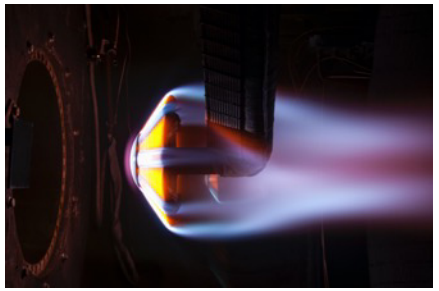
# FY22 Projects



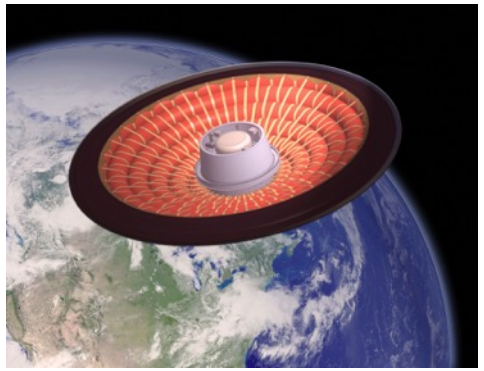
DAVINCI



Artemis

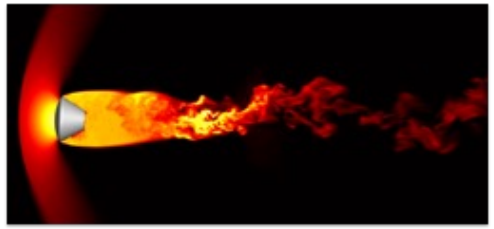


Arc Jet Modernization

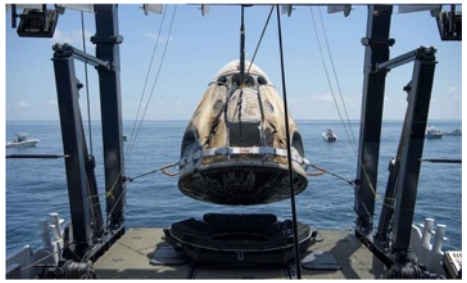


LOFTID (Low-Earth Orbit Flight Test of an Inflatable Decelerator)

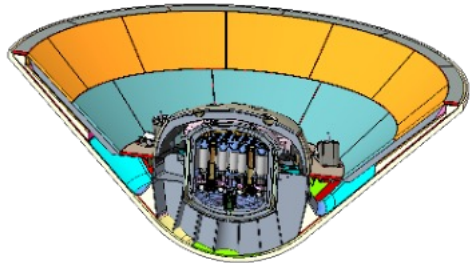
HLS Starship



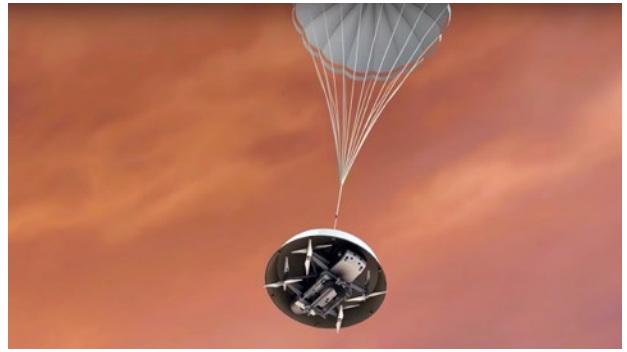
Entry Systems Modeling



Commercial Crew



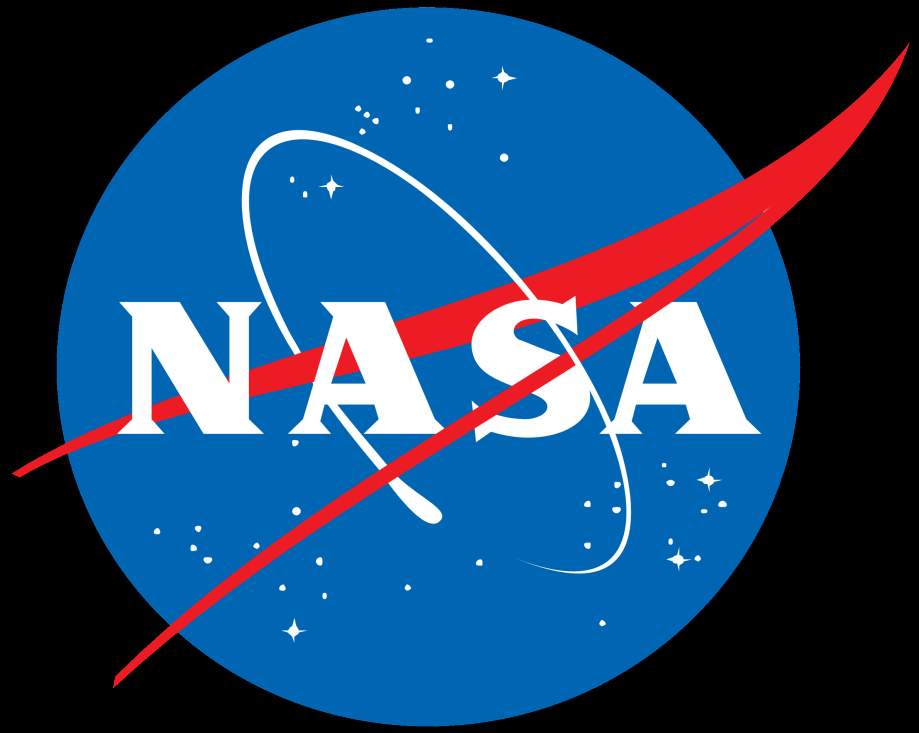
Mars Sample Return



Dragonfly

# Backup

National Aeronautics and Space Administration

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