

Genesis Mission

A National Initiative to Accelerate Discovery and Innovation with AI

NASA Ad ASTRA

September 2, 2026

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AI + HPC will change science, technology and engineering

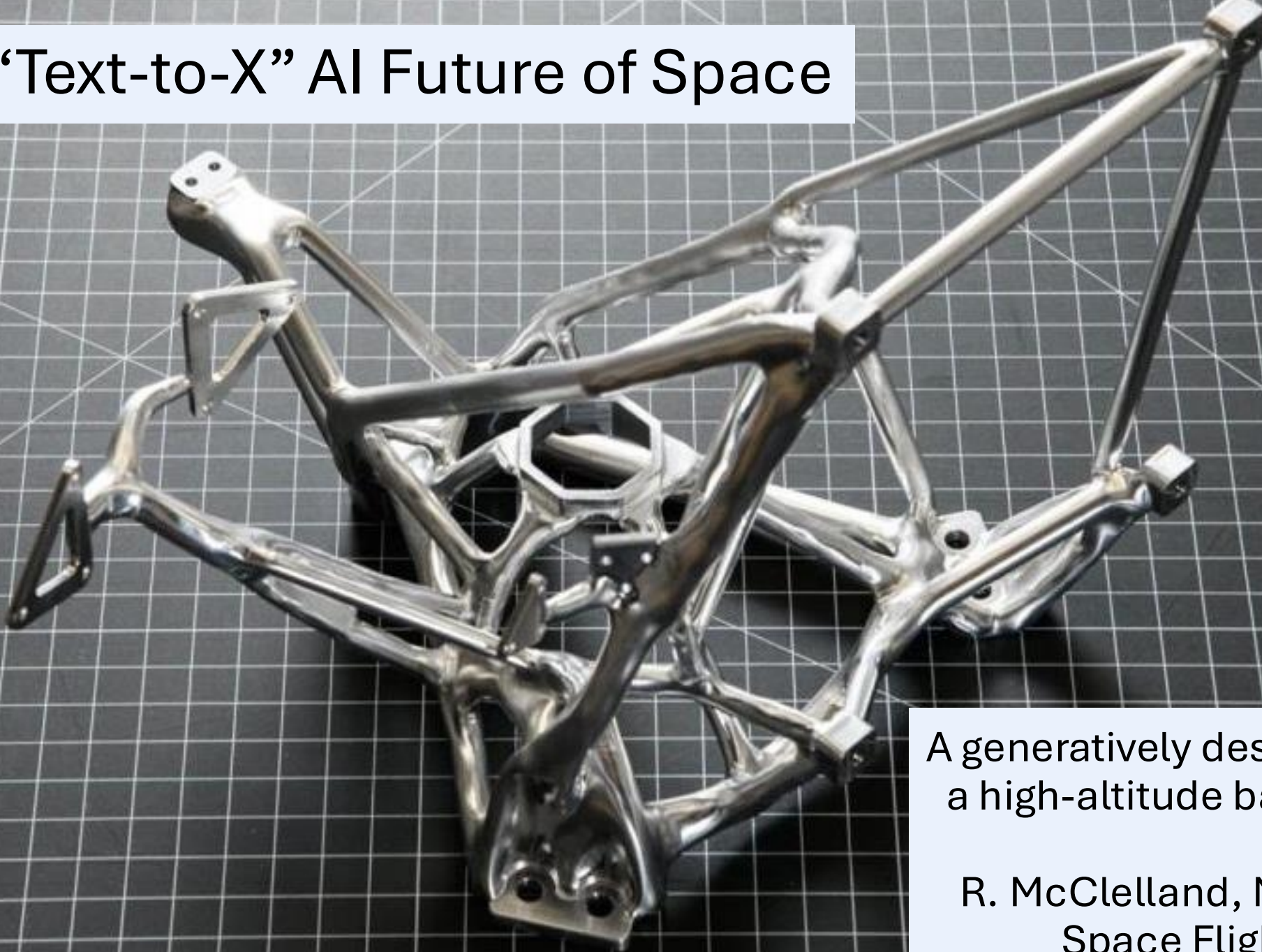
- The **Space Community is using AI** for space science and security applications and missions
- The **Genesis Mission** is a DOE-led National Initiative to transform science and national security with AI
- We are building The Platform, a unified data + HPC + manufacturing + ecosystem to **accelerate discovery and design**
- The broad **Space Community is working together** to get ready for Genesis Mission

What kind of science could you do in the era of “Text-to-X”?



Grassroots Space AI

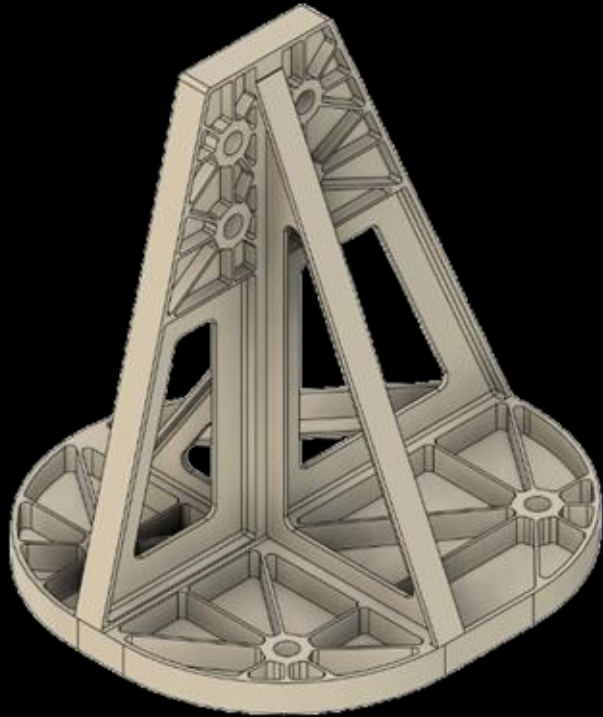
The “Text-to-X” AI Future of Space



A generatively designed mount for a high-altitude balloon payload.

R. McClelland, NASA Goddard Space Flight Center

Traditional Structure



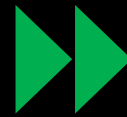
2 Engineers:

2 days

4 Iterations

Performance

Manufacturing



Evolved Structure



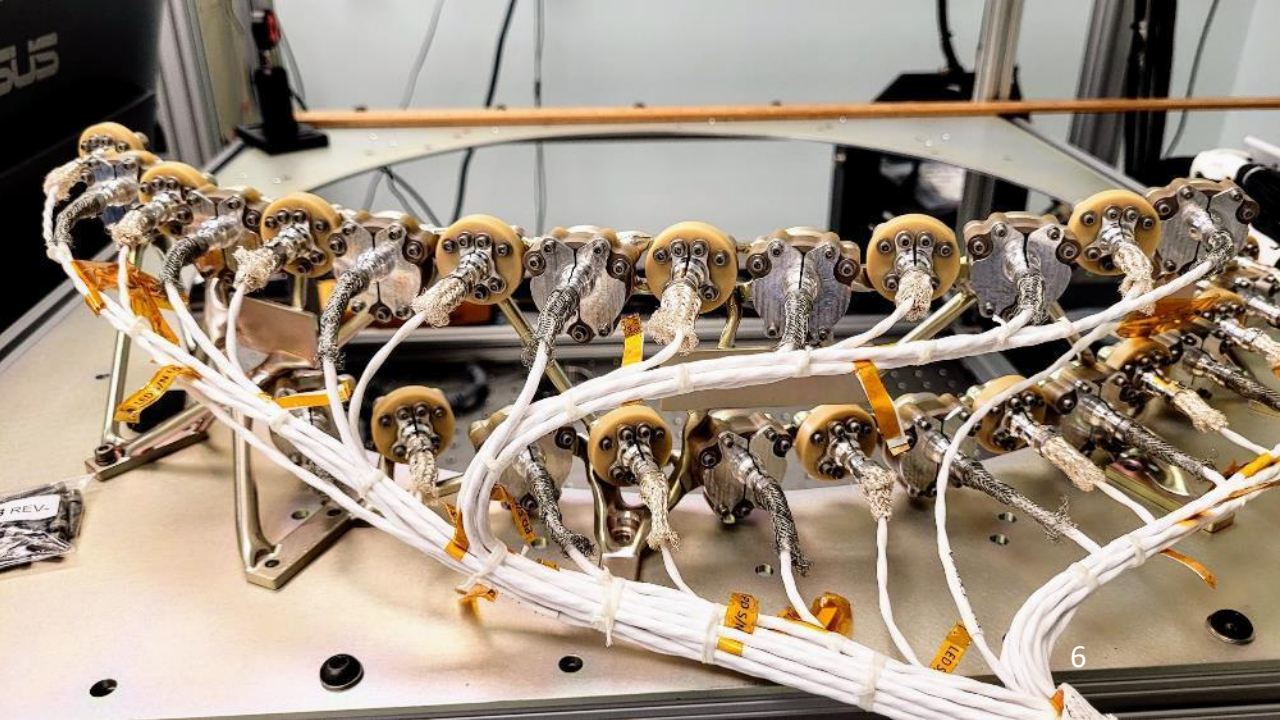
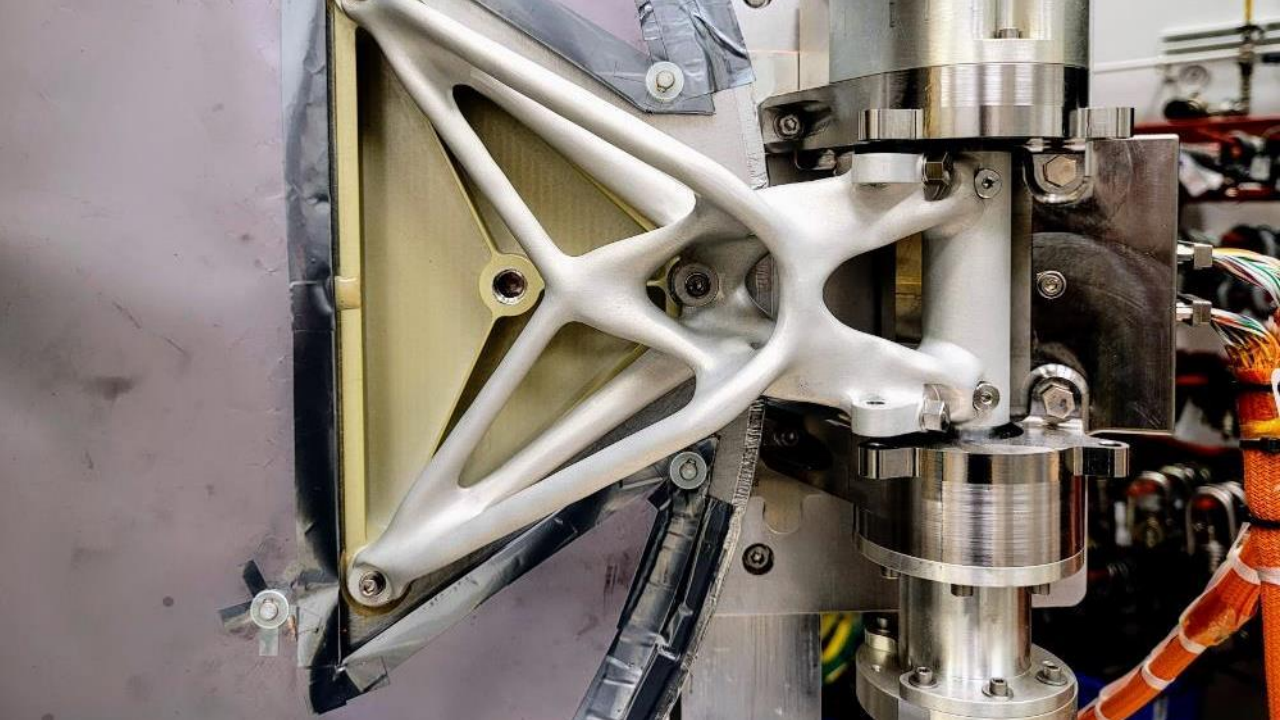
1 Engineers + AI:

1 hour

>100 iterations

Lighter, 3x Stiffer, 10x Stronger

Manufacturing

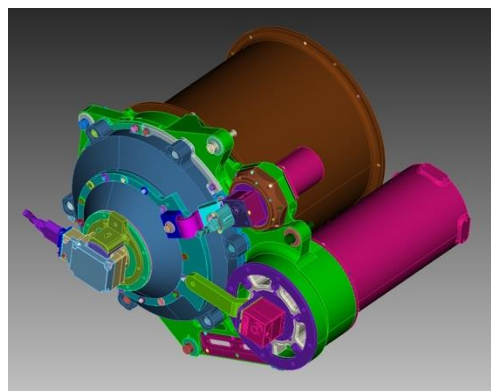




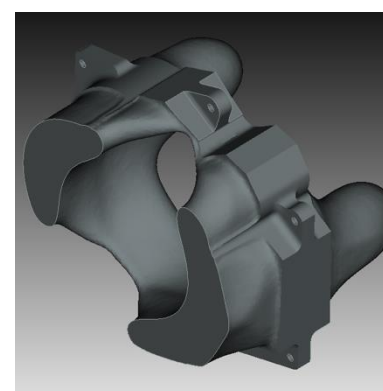
LLNL's Generative Design for NASA CAPSTONE 02 payload mass mock



Artist rendering of CAPSTONE 02 spacecraft



CAPSTONE 02 optical payload

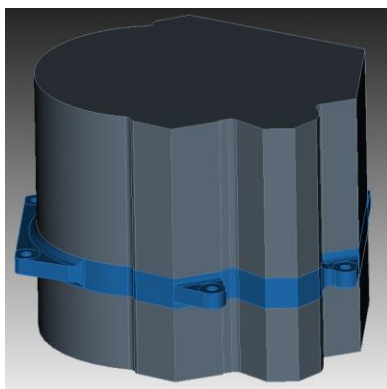


CAPSTONE 02 mass mock

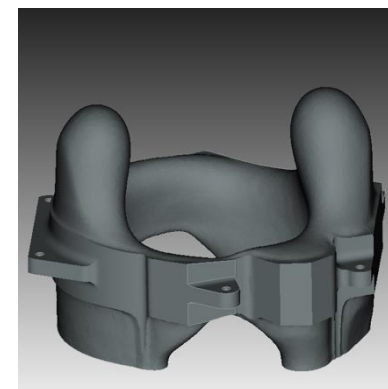
- To be printed of Ti-6Al-4V ($\rho = 4.40 \text{ g/cm}^3$)
- Mass within 1%
- CG components within 1 mm
- All inertia tensor components within 1%
- Lowest resonant mode $f_0 = 1840 \text{ Hz}$

Computational domain

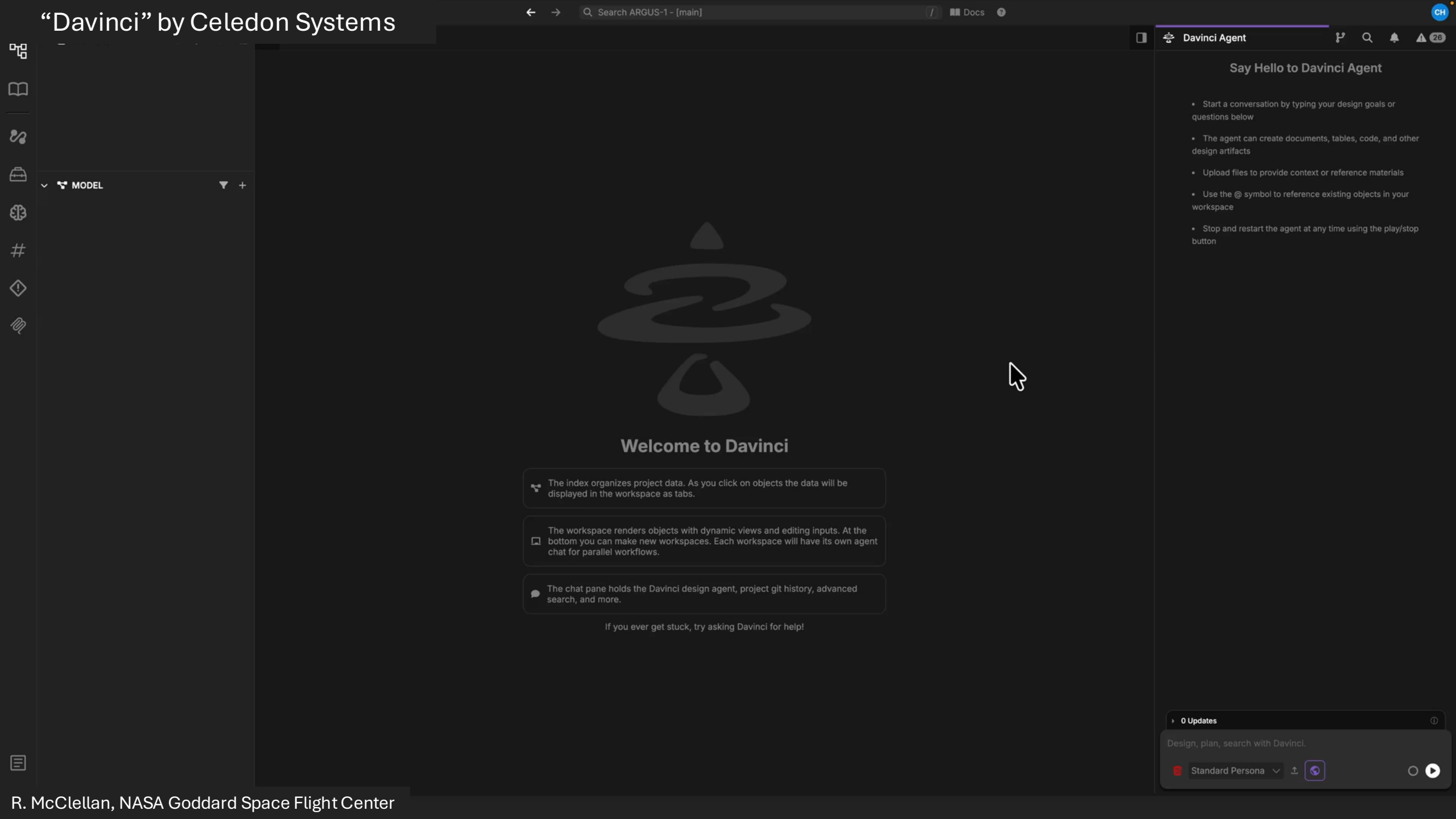
- Enforced interface
- Design volume



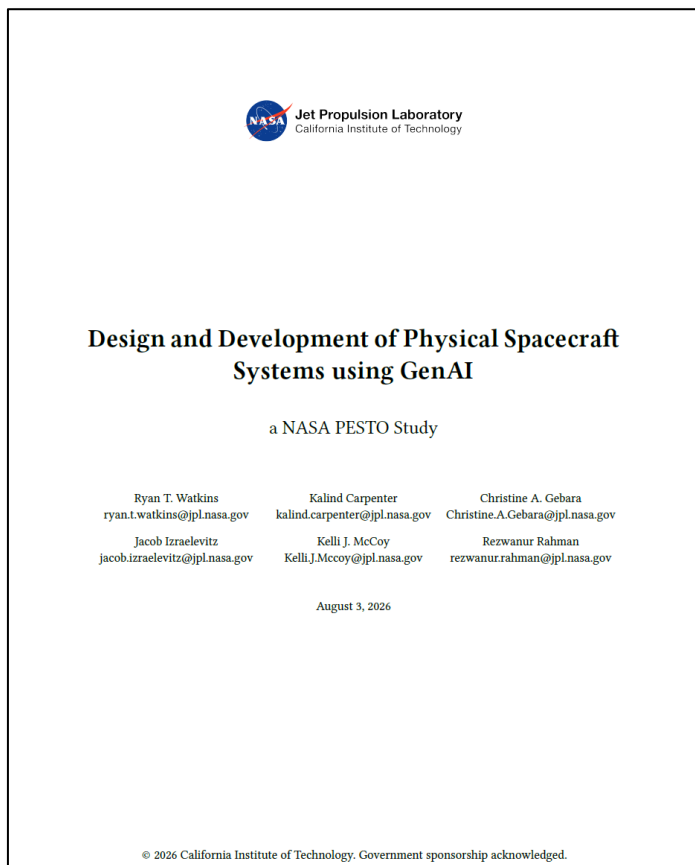
Livermore **D**esign **O**ptimization
software used to design mass mock



- All mass requirements satisfied
- Lowest resonant mode maximized
- Material overhang minimized to enable powder bed fusion additive manufacturing



Generative AI has the potential to lower costs and accelerate development, without compromising NASA's strict technical standards.



- Critical features ground AI in truth
 - Retrieval Augmented Generation (RAG)
 - Agentic Tools
- Currently technology sufficiently mature for
 - Coding
 - Systems engineering
- Technical gaps that still needed to be addressed for engineering
 - CAD integration, spatial reasoning
 - Verification
- Organizational challenges for AI adoption
 - capturing institutional knowledge (a big opportunity)
 - unifying and coordinating AI efforts

Generative AI has the potential to lower costs and accelerate development, without compromising NASA's strict technical standards.



- Critical features ground AI in truth
 - Retrieval Augmented Generation (RAG)

Finding 7

While NASA has initiated a few top-down strategic programs for GenAI in spacecraft design, **greater coordinated institutional effort and investment will be required** to achieve advanced capabilities such as automated spacecraft system design.

August 3, 2026

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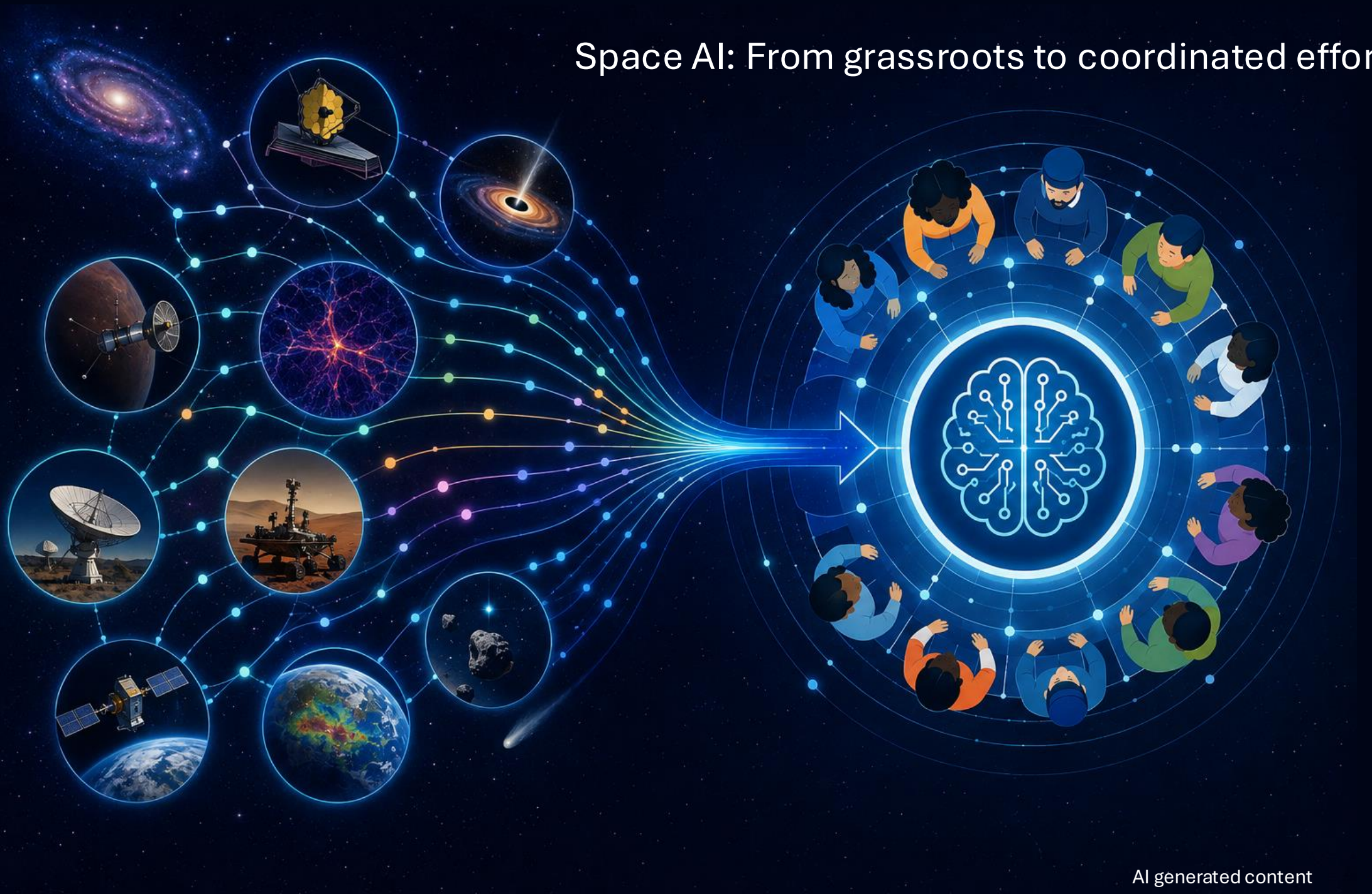
- verification
- Organizational challenges for AI adoption
 - capturing institutional knowledge (a big opportunity)
 - unifying and coordinating AI efforts



The Genesis Mission

The future of AI powered science and technology

Space AI: From grassroots to coordinated effort



An Executive Order on November 24, 2025 launched the “Genesis Mission” to transform science and technology with AI.



PRESIDENTIAL ACTIONS

LAUNCHING THE GENESIS MISSION

Executive Orders | November 24, 2025

By the authority vested in me as President by the Constitution and the laws of the United States of America, it is hereby ordered:

Section 1. Purpose. From the founding of our Republic, scientific discovery and technological innovation have driven American progress and prosperity. Today, America is in a race for global technology dominance in the development of artificial intelligence (AI), an important frontier of scientific discovery and economic growth. To that end, my Administration has taken a number of actions to win that race, including issuing multiple Executive Orders and implementing America's AI Action Plan, which recognizes the need to invest in AI-enabled science to accelerate scientific advancement. In this pivotal moment, the challenges we face require a historic national effort, comparable in urgency and ambition to the Manhattan Project that was instrumental to our victory in World War II and was a critical basis for the foundation of the Department of Energy (DOE) and its national laboratories.

This order launches the “Genesis Mission” as a dedicated, coordinated national effort to unleash a new age of AI-accelerated innovation and discovery that can solve the most challenging problems of this century. The Genesis Mission will build an integrated AI platform to harness Federal

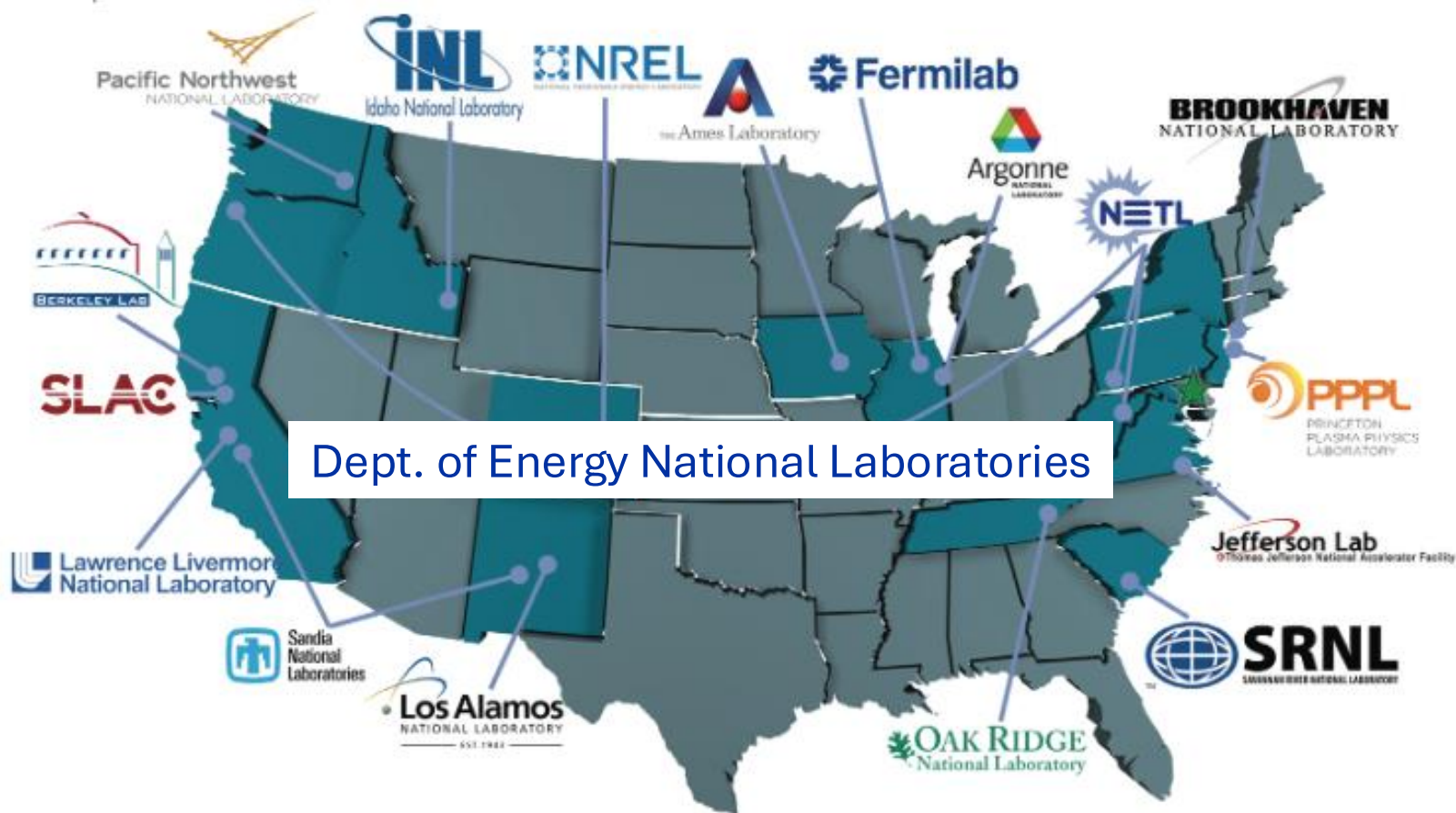
Genesis Mission is a national initiative to build the world's most powerful scientific platform to accelerate discovery science, strengthen national security, and drive energy innovation.

Goal

Genesis Mission will develop an integrated platform that connects the world's best supercomputers, experimental facilities, AI systems, and unique datasets across every major scientific domain to double the productivity and impact of American research and innovation within a decade.

A Dept. of Energy led **National Initiative**

Robust Public-Private Partnerships will enable Genesis success

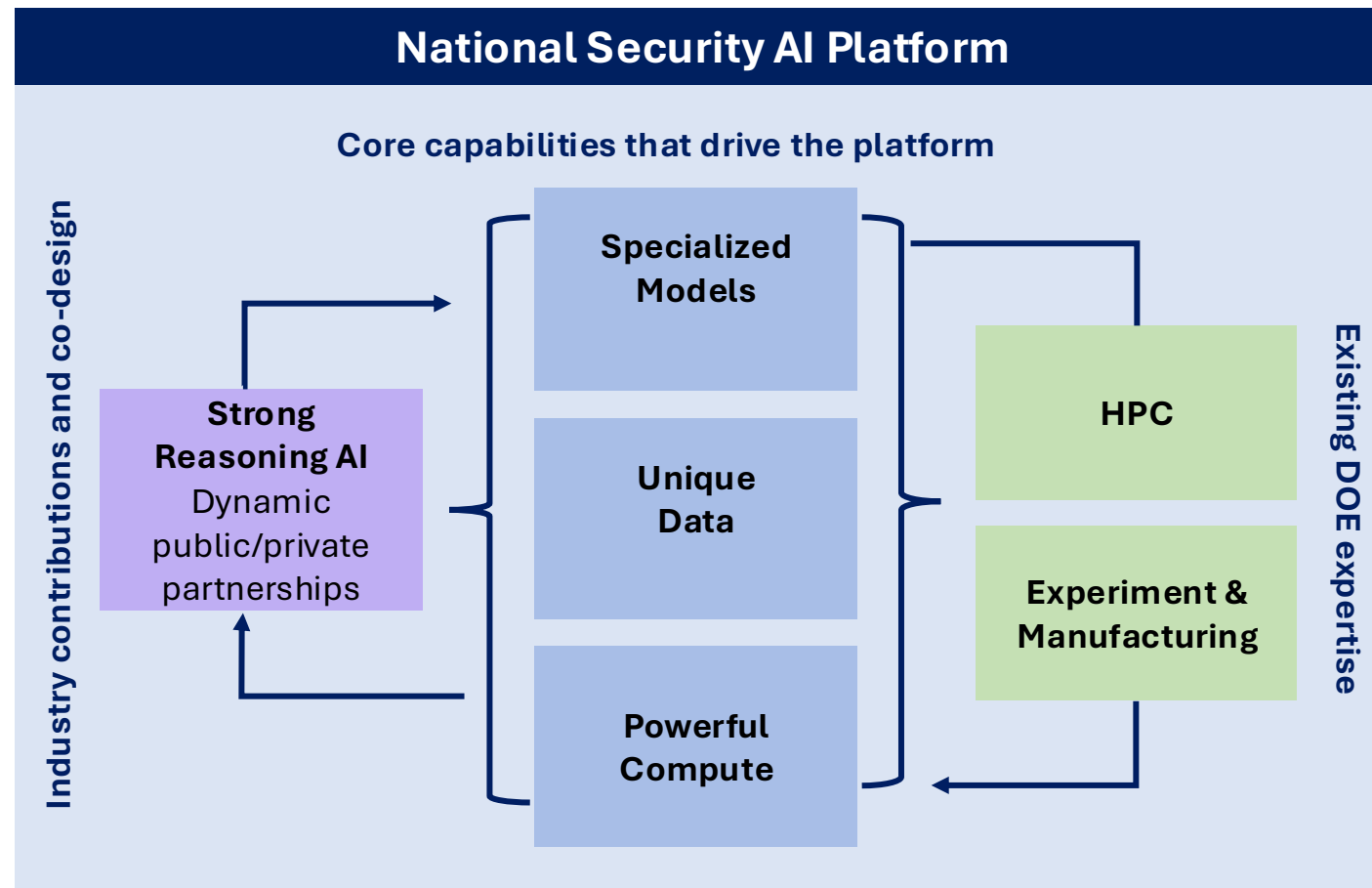


Initial Genesis Collaborators

Albemarle	Micron
Amazon Web Services	Microsoft
AMD	MP Materials
Anthropic	New York Creates
Applied Materials	Niron Magnetics
Atomic Canyon	Nokia
AVEVA	Nusano
Cerebras	NVIDIA
Chemspeed	OLI Systems
Collins Aerospace	OpenAI for Government
ComEd	Oracle
Cornelis Networks	Phoenix Tailings
Critical Materials	PMT Critical Metals
Recycling	Quantinuum
Dell Technologies	Qubit
Emerald Cloud Lab	RadiaSoft
EPRI	Ramaco
Esri	RTX
FutureHouse	Sambanova
GE Aerospace	Scale AI
Google	Semiconductor Industry Association
HPE	Siemens
Hugging Face	Synopsys
IBM	TdVib
ISO New England	Tennessee Valley Authority
Kitware	xLight
LILA	

A National Security Scientific AI Platform will accelerate innovation and production across missions

- Industry brings ...
 - AI models, expertise & Cloud Infrastructure
- DOE brings ...
 - High Performance Computing (top 3 systems in the world)
 - Experimental and Manufacturing capabilities
 - Real truth data
 - High-consequence missions and applications



From executive order to national scale-up

Key milestones and forward-looking RFA implementation dates



WHAT HAPPENS NEXT RFA implementation windows

Planning dates in DE-FOA-0003612

PHASE I PLANNED BUDGET PERIOD

JUL 1, 2026 → MAR 31, 2027

9 months • go/no-go after month 6 • follow-on Phase II apps due Dec. 17, 2026

PHASE II BUDGET ASSUMPTION

SEP 1, 2026 → AUG 31, 2029*

3-year project period • applies to direct FY26 Phase II awards

* Phase II end date is the three-year endpoint implied by DOE's Sep. 1, 2026 budget-start assumption.

From executive order to national scale-up

Key milestones and forward-looking RFA implementation dates

NOV 24, 2025

Mission launched

Executive Order 14363 launches the Mission and assigns DOE the lead.

FEB 9 – 12, 2026

Consortium + 26 DOE challenges

Consortium launches Feb. 9; initial DOE S&T challenges announced Feb. 12.

JAN 16 – MAR 4, 2026

Partnership + workforce RFI

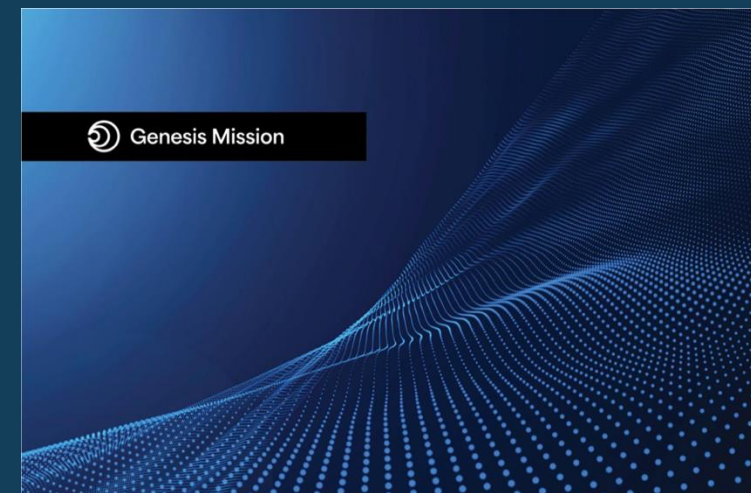
MAR 17 – MAY 19, 2026

\$293M funding round

- Unifying **Physics** from Quarks to the Cosmos
- Realizing **Quantum** Systems for Discovery
- **Designing Materials** with Predictable Functionality
- Achieving AI-Driven **Autonomous Laboratories**
- ... plus 22 others ...

* Phase II end date is the three-year endpoint implied by DOE's Sep. 1, 2026 budget-start assumption.

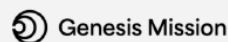
Kickstarted with 26 initial DOE-focused challenges



U.S. DEPARTMENT OF ENERGY Genesis Mission National Science and Technology Challenges



33 New National S&T Challenges set Strategic AI Priorities



GENESIS MISSION: NATIONAL SCIENCE & TECHNOLOGY CHALLENGES



GENESIS MISSION: NATIONAL SCIENCE & TECHNOLOGY CHALLENGES

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JUL 22, 2026

First project selections + national expansion

SELECTED FOR AWARD NEGOTIATIONS

278 projects selected
for award
negotiations

342 participating institutions

All 50 states

15+ federal agencies

\$5B+ federal commitments

New cross-agency national
S&T challenge portfolio

Planning dates in DE-FOA-0003612

* Phase II end date is the three-year endpoint implied by DOE's Sep. 1, 2026 budget-start assumption.

Aires Tide: An AI-Designed Flight Test Vehicle

NNSA's First Genesis Mission Demonstration

AI-driven design optimization

Multiphysics simulation

Additive manufacturing

Test

Concept to build in under five months

15x cheaper

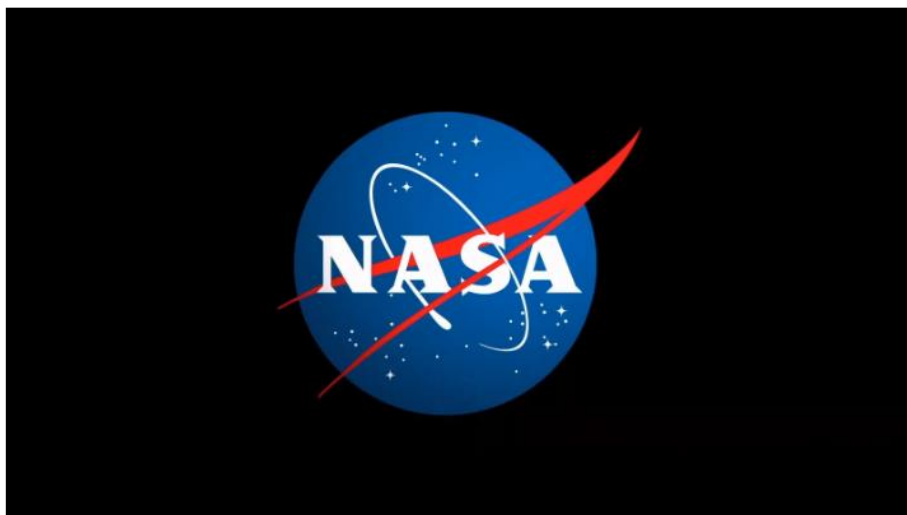
7x faster



A collaboration between LLNL, LANL, SNL, Kansas City National Security Campus
Photo: Aires Tide test, May 2026, Craig Fritz/Sandia

The space community is teaming on Genesis

NASA Joins Genesis Mission to Accelerate AI-Driven Discovery



Credit: NASA

“ America has invested for generations in the data, missions, and technical expertise that make NASA one of the world’s greatest engines of discovery. **The Genesis Mission is an opportunity** to turn that foundation into **faster science, stronger engineering,** and **better mission outcomes.** Leveraging our relationships with interagency counterparts, NASA can advance AI tools that accelerate exploration, strengthen American leadership in space, and open new paths to understanding our planet and the universe. ”

NASA Administrator Jared Issacman
July 22, 2026

July 22 2026. <https://www.nasa.gov/news-release/nasa-joins-genesis-mission-to-accelerate-ai-driven-discovery/>

Two major strategic space priorities for Genesis

Mining Decades of Space Mission Data for Discovery

Challenge: For over seventy years, NASA's telescopes, orbiters, landers, and satellites have returned more data about our planet and the cosmos than any institution in history. Only a fraction has been truly examined. These holdings now exceed a scale and complexity that traditional computational analysis methods cannot fully exploit; scientists have found planets, transient events, and physical phenomena in data previously thought fully analyzed. By processing and integrating more than 150 petabytes of heterogeneous data, scientists will connect observations, simulations, and models across disciplines, time scales, and physical regimes in ways that accelerate discovery.

- Fully leverage existing data
- Connect observations, simulations, models
- Enable new discoveries through federated access
- Future data born “AI Ready”

Ensuring American Space Superiority

Challenge: Superiority in space begins with the ability to see, predict, and safely maneuver within a domain that is growing more crowded, more contested, and more dynamic by the year. As American operations extend from low Earth orbit and out into cislunar space, the United States must develop, field, and sustain increasingly complex space capabilities on timelines that push beyond what traditional engineering and mission operations methods were designed to support. Across spacecraft, surface systems, communications, logistics, environmental forecasting, autonomous operations, and supporting infrastructure, NASA must be able to design, simulate, test, qualify, integrate, and operate tightly coupled systems at a speed, scale, and level of concurrency that was previously impractical. AI-enabled engineering capabilities will compress the path from concept to trusted operational readiness while preserving safety, performance, and mission assurance.

- Significantly accelerate engineering
- Enhance the full design, simulate, test, qualify, integrate and operate life cycle
- Preserve safety, performance and mission assurance

The Space Community is working together to prepare for Genesis Mission Applications

- **“Space Genesis Mission Workshop”**
 - USSF (host), NASA, USSPACECOM, NRO, NOAA, AFRL, OSTP, DOE
 - November 2026, Washington DC Area
- Goal: Create a unified list of **“Space AI Focus Problems”**
 - Distill strategic “National S&T Challenges” into tactical focus areas
 - Search for commonalities
 - Drive coordinated development
- **A cross-gov’t collaboration** on space+AI challenges



The Genesis Mission will change science, technology, and engineering

- **Engineering processes will become quicker** and more cost-effective, spanning systems, structures, instruments, and materials.
- The pace of **scientific discovery will increase** and improve through the integration of modeling, simulation, and experimentation.
- Collaborative platforms will support design, simulation, manufacturing, testing, and data analysis within **shared ecosystems**.

What science might be possible in the era of “Text-to-X”?

Thank you!

Contact Info:



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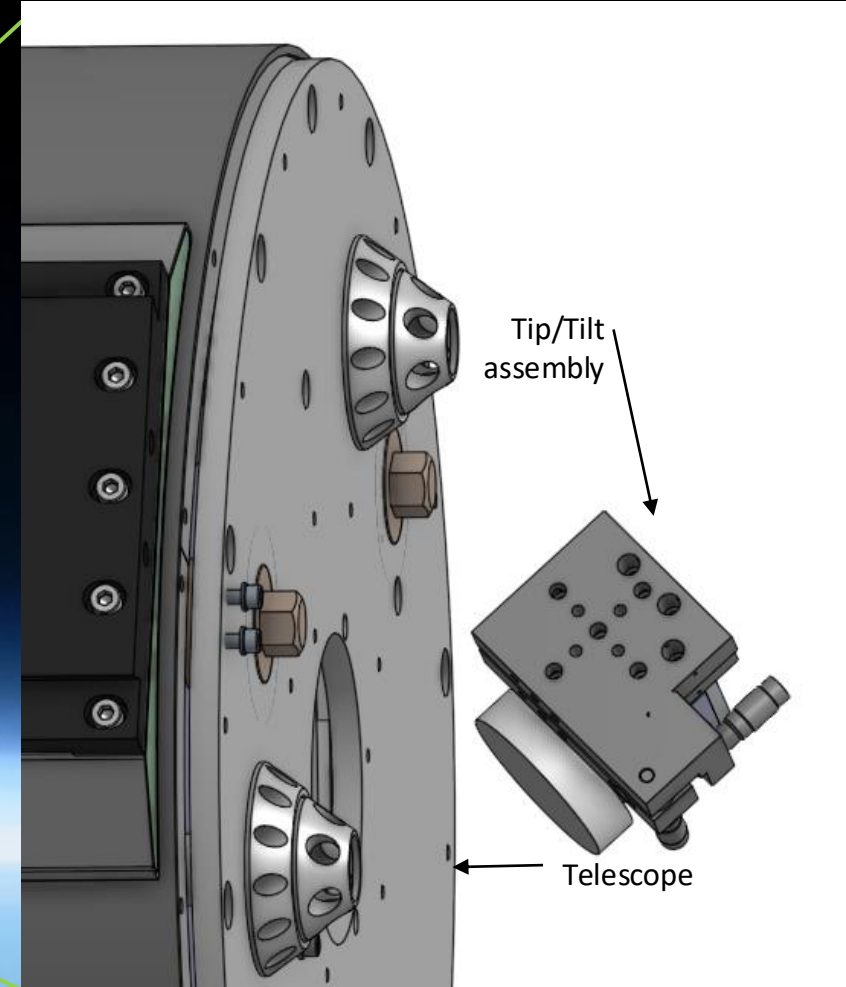
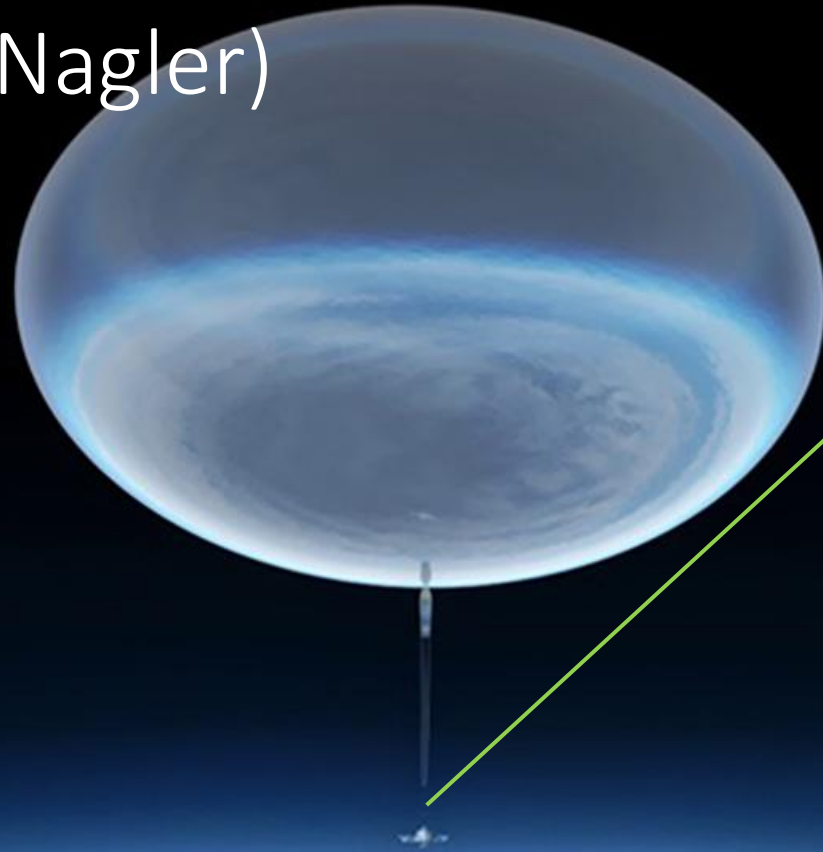
Acknowledgements:

Brian Spears, Ryan Fellini, Seth Watts, Shawn Higbee, John Ganino, Timm Wulff, Aaron Peer, Trier Mortlock, Phillip Rittmuller, Nate Golovich, Wim de Vries, Ryan McClelland, Ryan Watkins

NASA EXoplanet Climate Infrared Telescope (EXCITE, Peter Nagler)

40 km

above Earth's surface



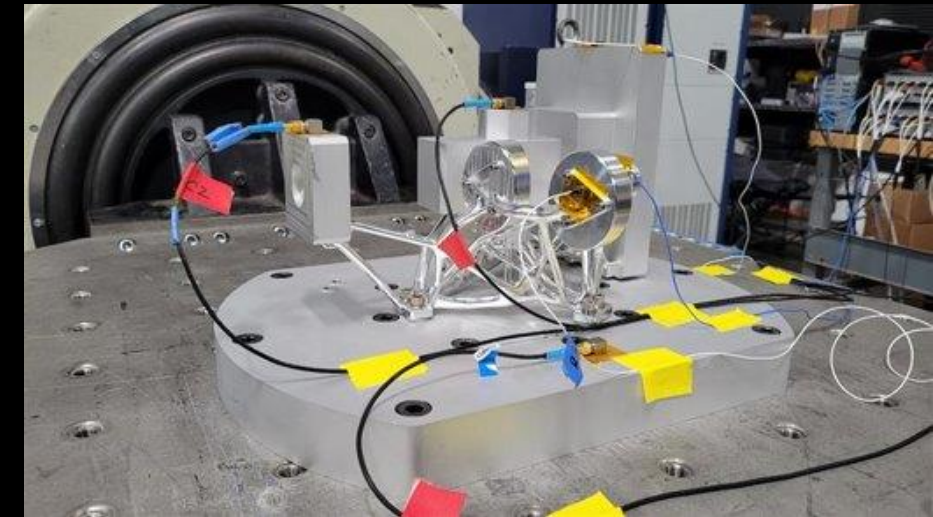
Illustration

R. McClellan, NASA Goddard Space Flight Center

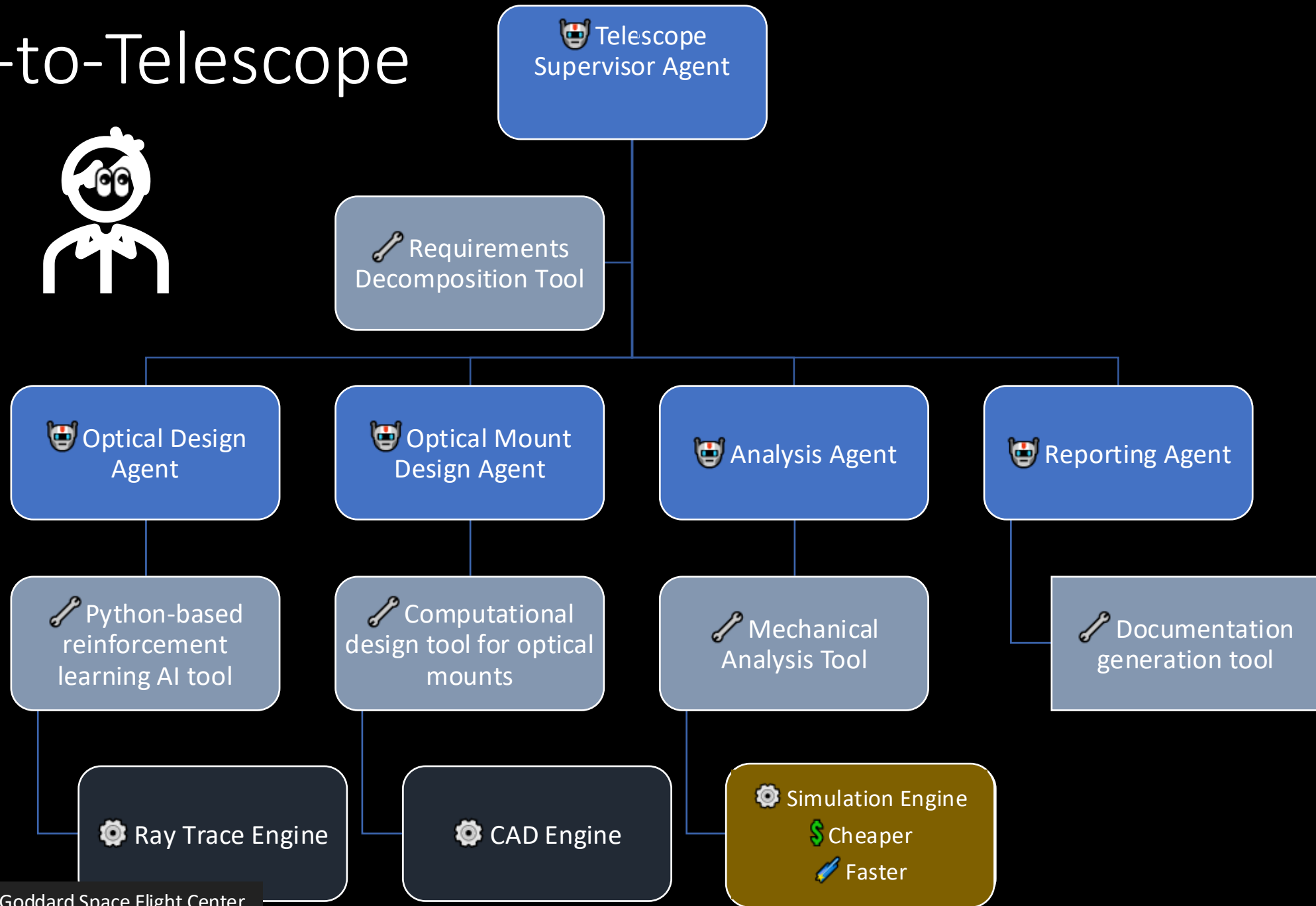
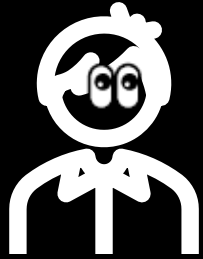
Image Source: <https://www.jpl.nasa.gov/news/nasa-mission-will-study-the-cosmos-with-a-stratospheric-balloon>

ALICE Application: Virtuous Cycle

- 3.6 kg ►► 610 gm **lower cost**
 - Lighter support structures **lower cost**
 - Thinner flexures **better performance**
 - Smaller surface area **better performance**
 - Smaller radiators **lower cost**
- 10 parts consolidated to 1 part
 - Simplified integration **lower cost**
 - Fewer interfaces for distortion **better performance**
 - Better temperature uniformity **better performance**



Text-to-Telescope



Synera

FileEditToolsHelp

Search (Ctrl+Shift+F)

Log in

NASA Telescop...+

Browse

NodesTemplates

Control

Dat...Dat...Mat...Ref...Cur...Sur...Sol...Mes...Vox...Geo...FEAAMMLCon...MASUti...HxG...Fac...Rap...Rap...Rap...Sim...Cog...Cog...Cog...Moc...Raf...Den...IMDev...

ImportExportExcel

19,3ms

Large Language Model

Modelanthropic.clau...

LLM

LLM

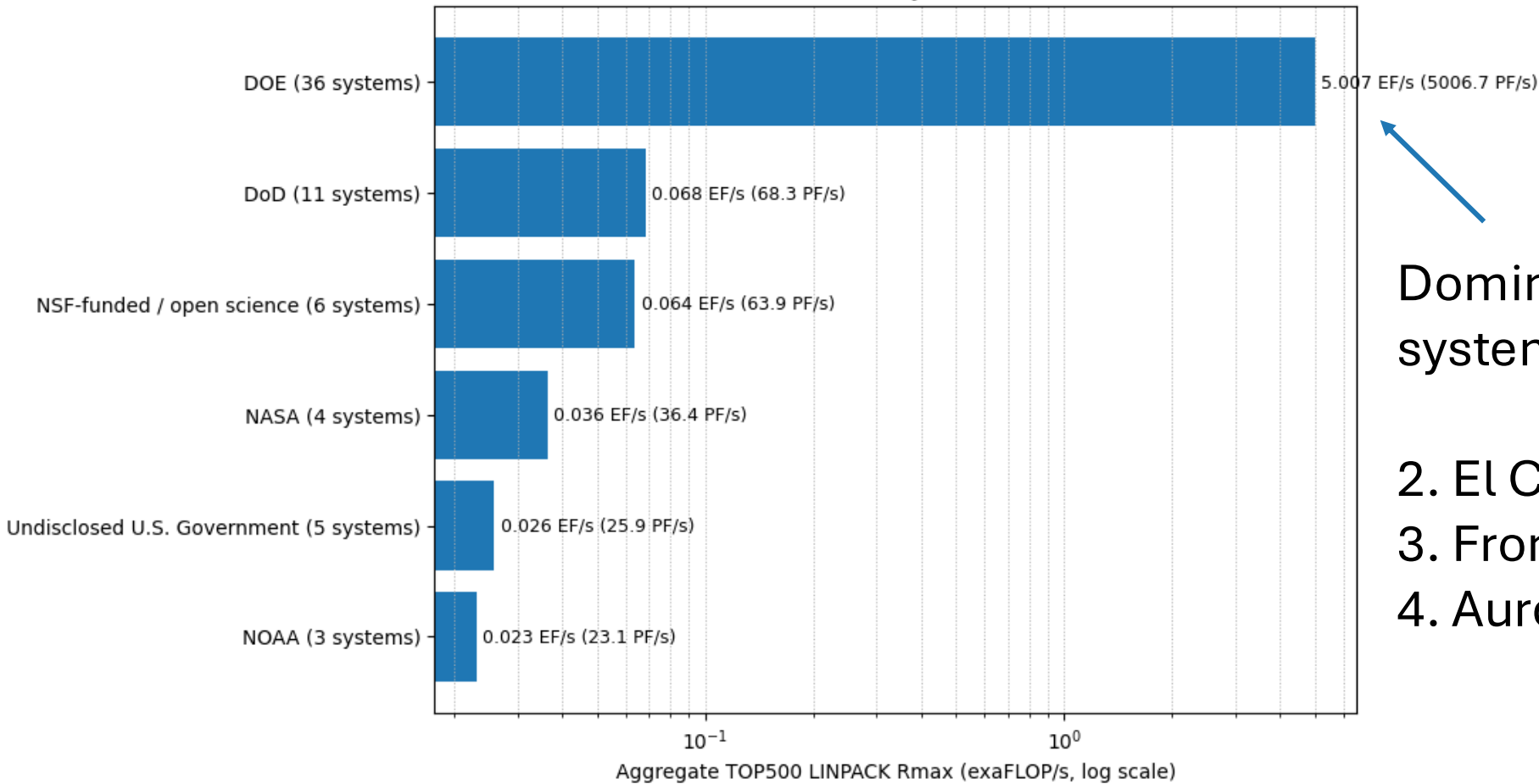
Solution

View

Zoom100

DOE HPC will power the Genesis Mission Platform

U.S. Government HPC Capability by Agency / Program
TOP500 November 2025 systems; summed Rmax



Dominated by 3 of the top systems in the world

- 2. El Capitan 1.8 EF/s (LLNL)
- 3. Frontier 1.3 EF/s (ORNL)
- 4. Aurora 1.0 EF/s (ANL)

Notes: Rmax is measured LINPACK performance. NSF category includes selected NSF-funded/open-science systems hosted outside federal agencies. Undisclosed category covers TOP500 entries listed only as U.S. 'Government'.

The LLNL Space Program is preparing for Genesis

Accelerate mission-ready hardware

Rapidly iterate and deliver space hardware that meets national science and security objectives

Integrate multiphysics AI/ML

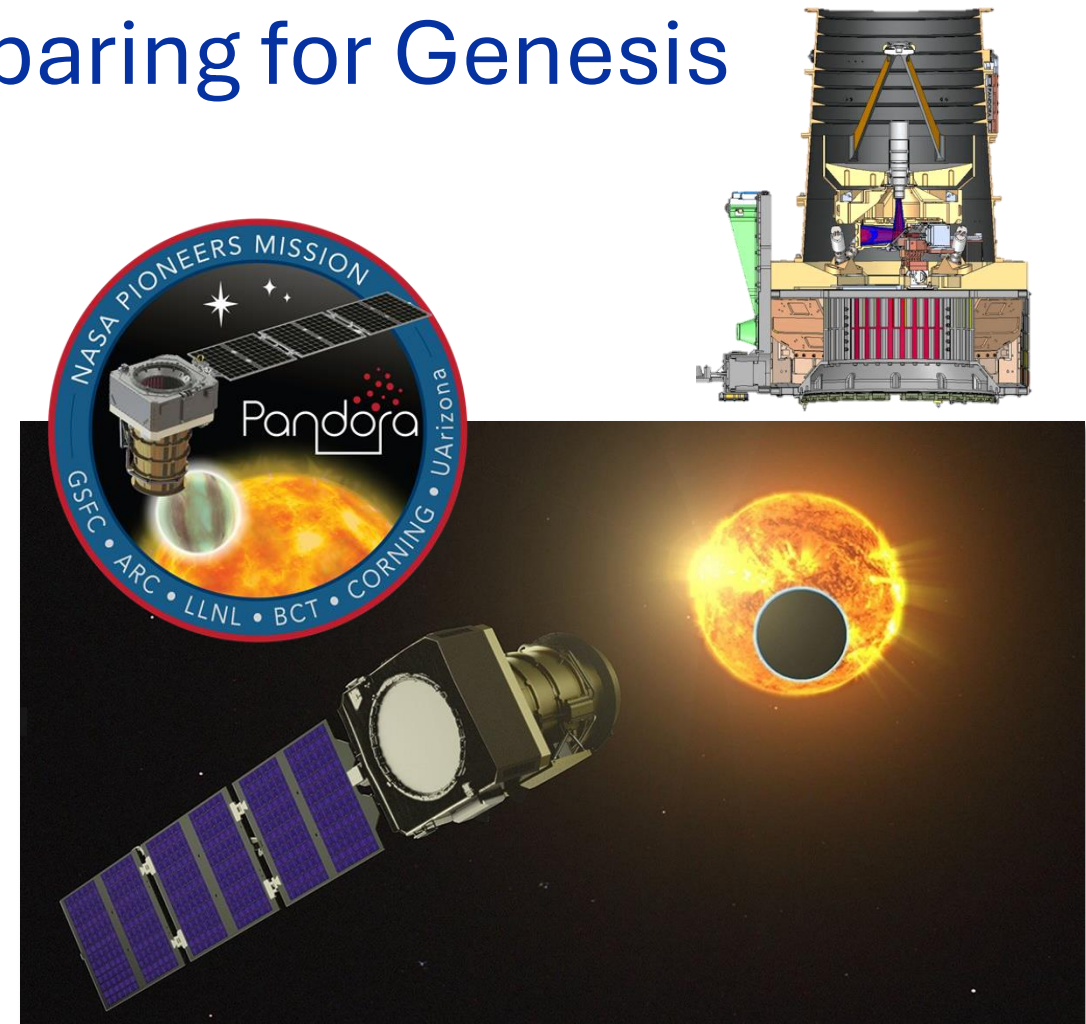
Use multiphysics-based AI/ML capabilities to break down traditional disciplinary silos and converge more quickly on effective designs that achieve multidisciplinary targets

Optimize components computationally

Apply in-house topology and shape optimization codes to quickly design high performance mechanical subcomponents and assemblies

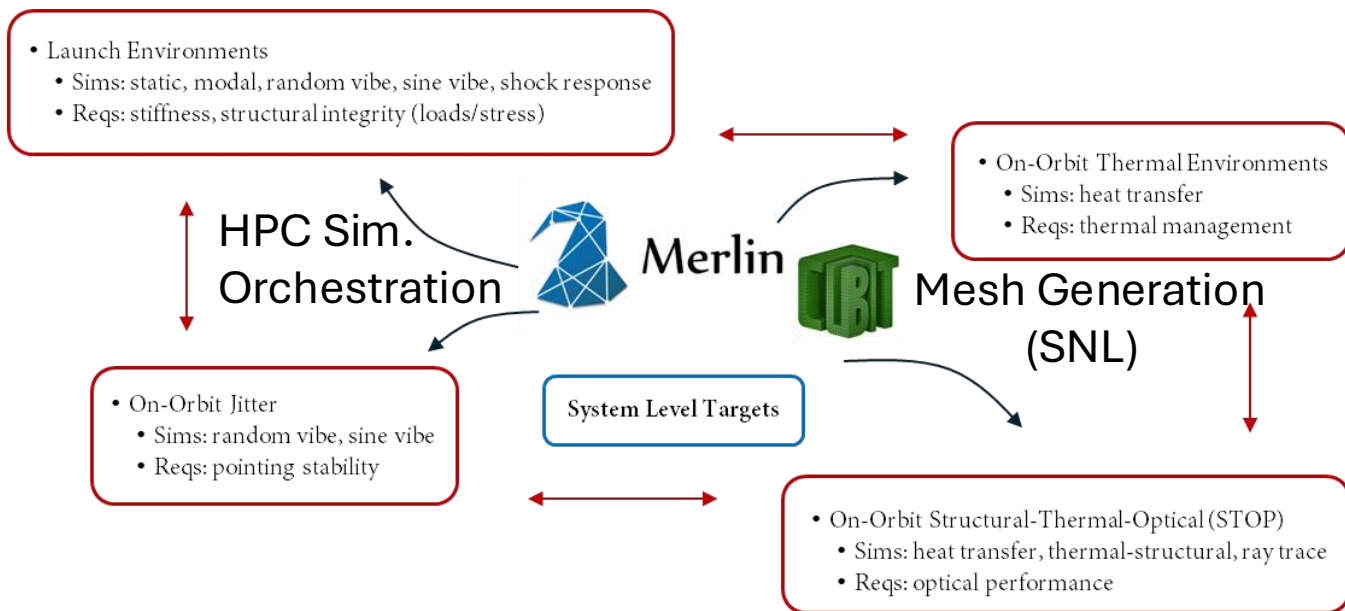
Exploit world-class HPC capabilities

Leverage national lab High Performance Computing (HPC) and HPC-optimized lab codes to explore larger design spaces and reduce design risk

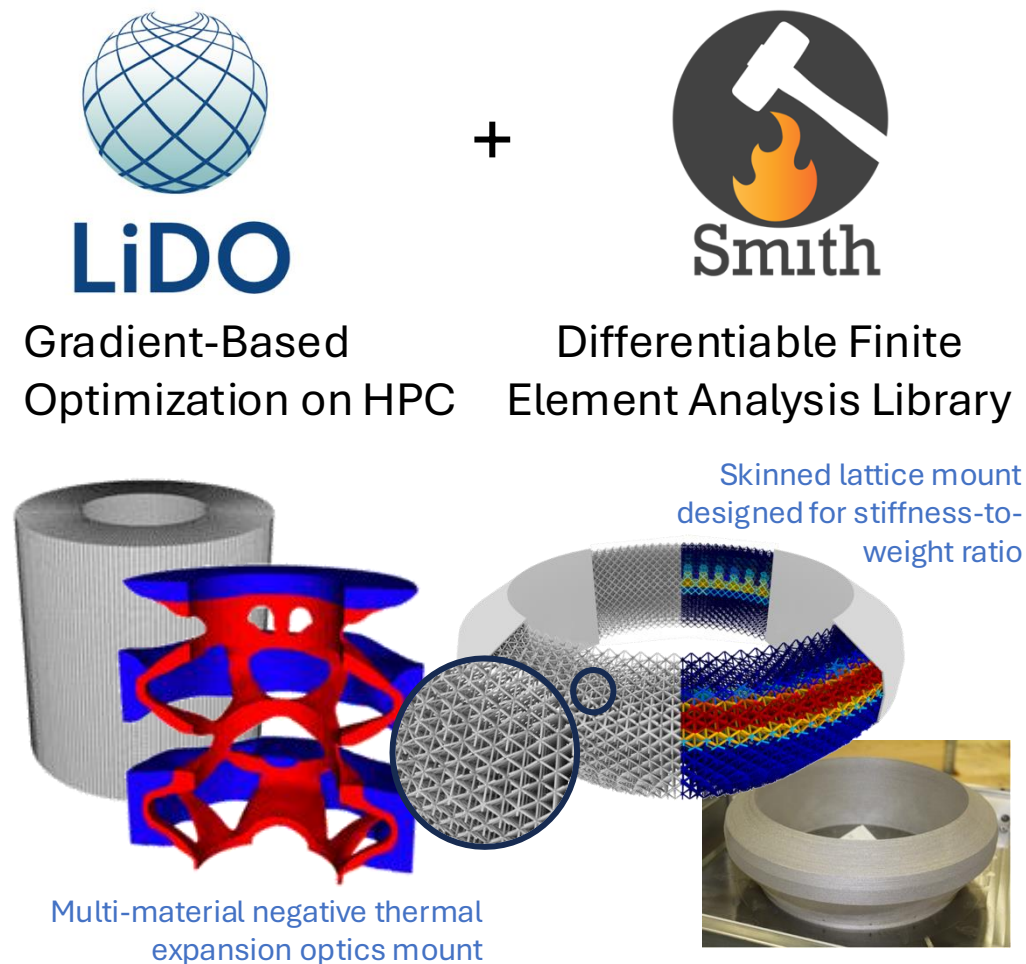


Pandora Pioneers Mission, a Lawrence Livermore National Laboratory and NASA Goddard Space Flight Center collaboration to develop a \$20m small satellite space observatory for exoplanet science

We are building an AI+HPC ecosystem for fast digital optical payload design & optimization

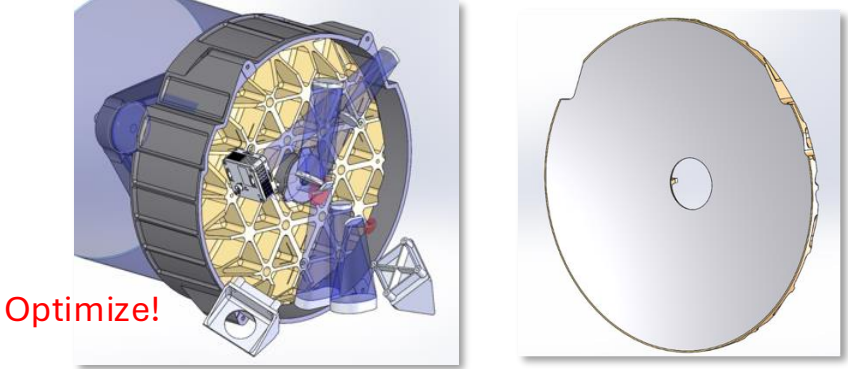


- Modular system design for physics engine flexibility
- Leverages open source and in-house (US gov't) software

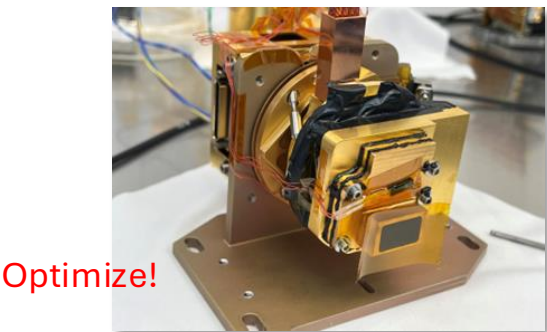


Space Hardware Case Studies are driving the design of our ecosystem

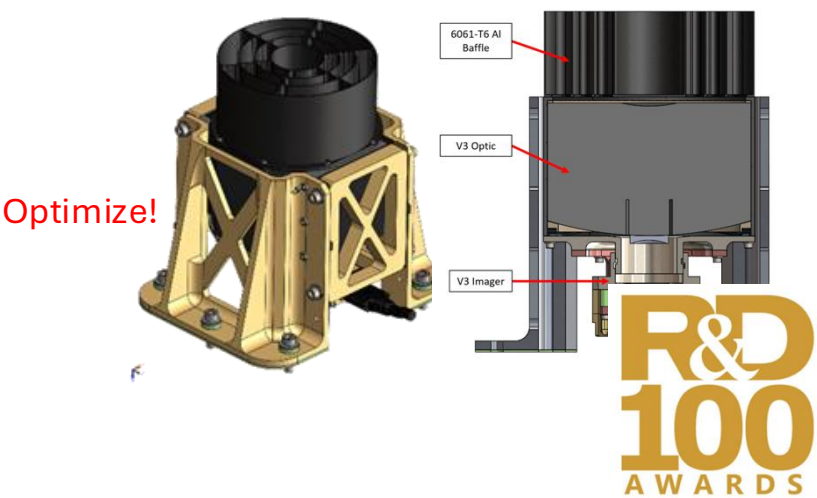
LLNL's CODA all-aluminum
Cassegrain telescope
(like on Pandora)



Pandora's Near-Infrared Detector
Assembly (NIRDA)
(uses a backup sensor from JWST)



LLNL Monolithic Telescope



R&D Plan

Mechanical Vibration → Thermal Isolation → Optical Figures of Merit

Exascale computing will allow us to design for manufacturability and performance

Improved accuracy, higher order algorithms, better physics, UQ-aware design optimization

El Capitan: 2.79 exaFLOPS (2.79e18 FLOPS)

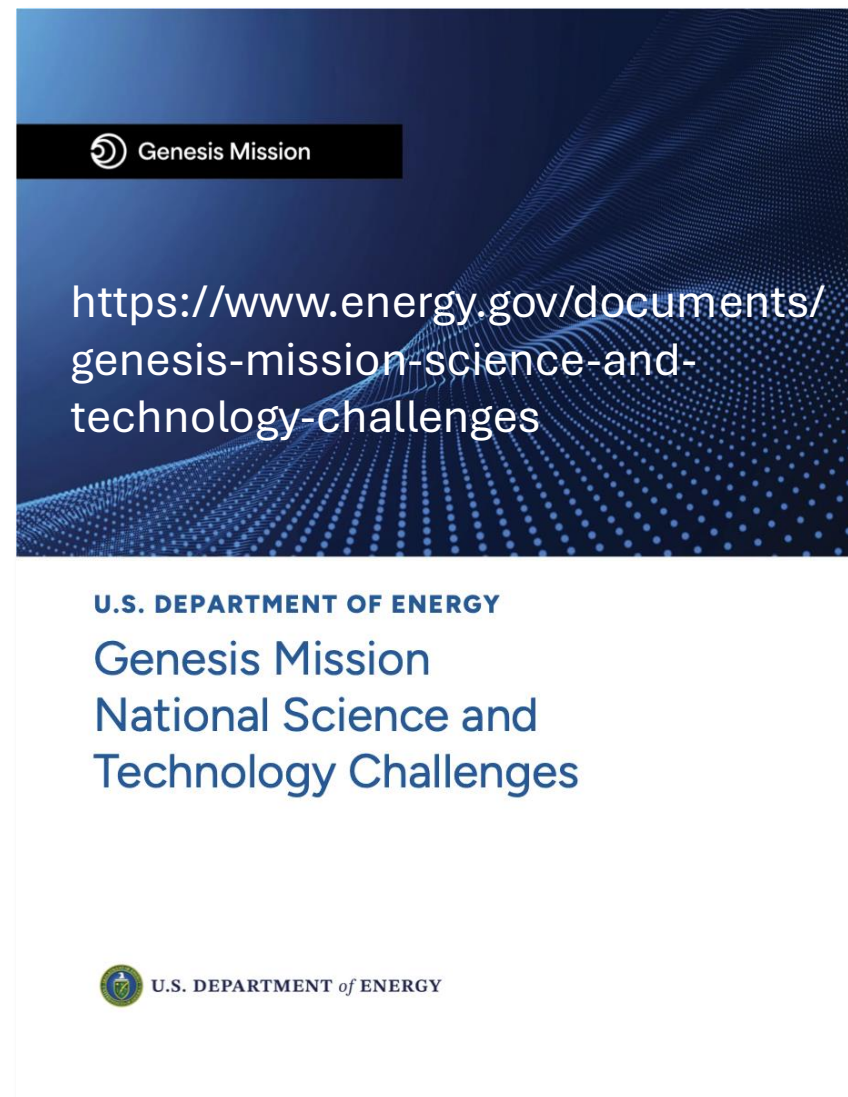


Tuolumne: 288 petaFLOPS (2.88e17 FLOPS)



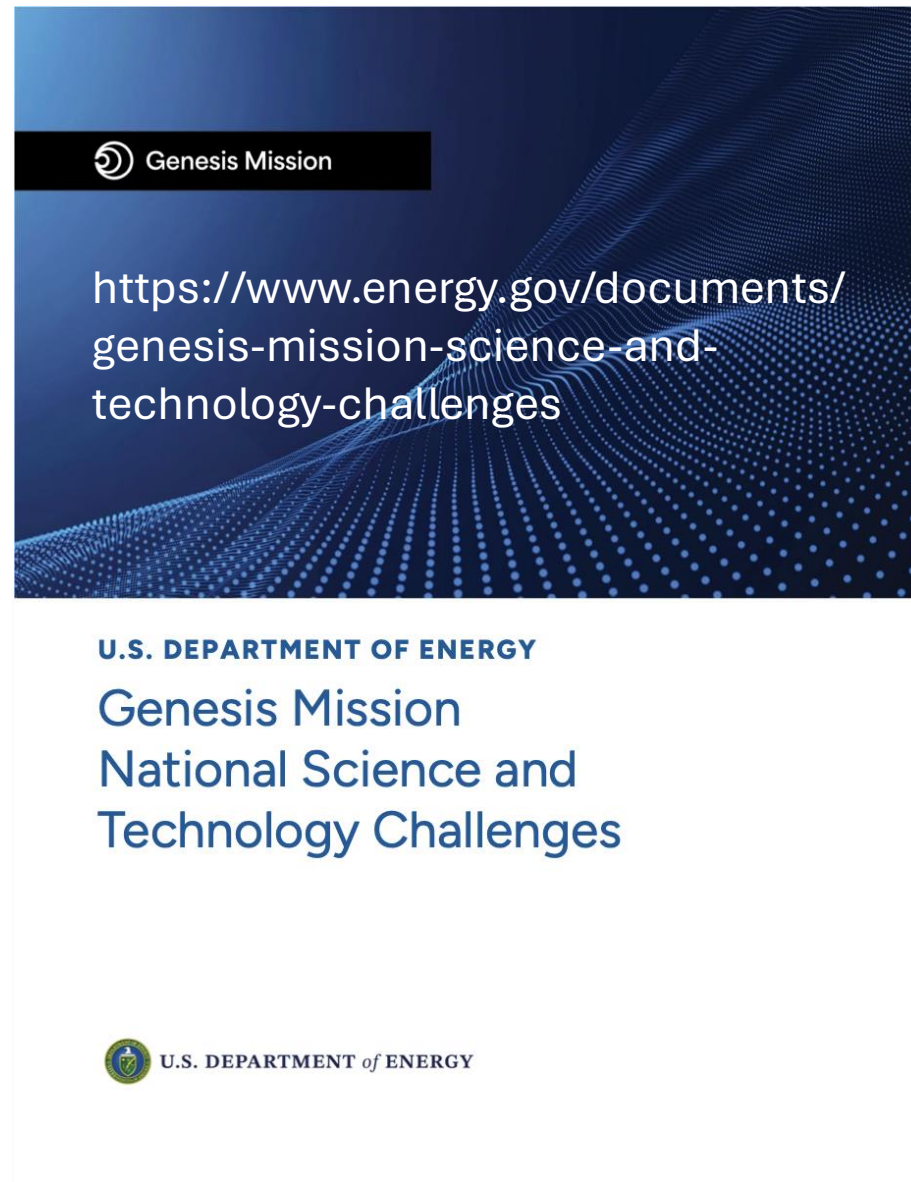
DOE targeted a broad set of initial **challenge problems**

- Reenvisioning **Advanced Manufacturing** and Industrial Productivity
- Reimagining **Construction** and Operation of Buildings
- Scaling the **Biotechnology** Revolution
- Securing America's **Critical Minerals** Supply
- Delivering **Nuclear Energy** that is Faster, Safer, Cheaper
- Accelerating Delivery of **Fusion Energy**
- Realizing **Quantum** Systems for Discovery
- **Designing Materials** with Predictable Functionality
- Achieving AI-Driven **Autonomous Laboratories** ... and 15 more ...



Genesis is targeting a broad set of initial **challenge problems**

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- Securing America's **Critical Minerals** Supply
- Delivering **Nuclear Energy** that is Faster, Safer, Cheaper
- Accelerating Delivery of **Fusion** Energy
- Transforming Nuclear Cleanup and Restoration
- Discovering Quantum Algorithms with AI
- Realizing **Quantum** Systems for Discovery
- Recentering **Microelectronics** in America
- Securing U.S. Leadership in **Data Centers**
- Accelerating **Materials Discovery**, Production, and Qualification for Strategic Deterrence
- Achieving AI-Driven **Autonomous Laboratories**
- Designing Materials with Predictable Functionality



Genesis is targeting a broad set of initial **challenge problems**

- Enhancing **Particle Accelerators** for Discovery
- Increasing Experimental Capacity at Nuclear Research Facilities
- Unifying **Physics** from Quarks to the Cosmos
- Integrating Design and Production Operations for Nuclear Deterrence
- Predicting U.S. **Water** for Energy
- **Safeguarding Nuclear Materials** from Proliferation Threats
- Scaling the **Grid** to Power the American Economy
- Streamlining **Production**, Removing Red Tape, and Ensuring Safety in the Nuclear Enterprise
- Unleashing Subsurface Strategic Energy Assets
- Strengthening **Deterrence** Through Attribution of Nuclear and Radiological Signatures
- Accelerating Nuclear Threat Assessment, **Preparedness, and Response**
- Harnessing America's Historic Nuclear Data and Research

