

National Aeronautics and
Space Administration




Launch Services

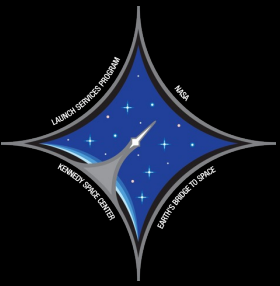
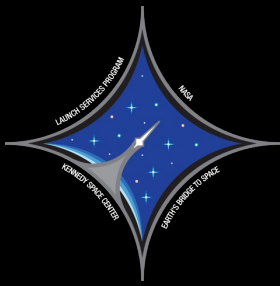
NASA Advisory Council, HEO Committee

Bradley Smith

November 20, 2023



EARTH'S BRIDGE TO SPACE



LSP Organizational Structure

LAUNCH SERVICES PROGRAM
Amanda Mitskevich
Albert Sierra

| | | |
|--|---|---|
| | LAUNCH DIRECTOR Tim Dunn | Launch Manifest Coordination |
| | TECHNICAL INTEGRATION Jorge Piquero | Risk Mgmt/Tech Policy & Business Development |
| | VSFB PROGRAM REP Mark Mertz | VSFB Resident Offices & Program Support Coord |
| | PROGRAM PLANNING Lisa Haber | Strategic Planning & Policy |
| | PROGRAM BUSINESS Brian Smith / Lety Gomez | Contracts & Budgeting |

Technical Authority

| | |
|--|---|
| | CHIEF ENGINEER James Wood |
| | ENGINEERING Bob Mott |
| | CHIEF SAFETY OFFICER Joe Dant |
| | S & MA Jessica Williams |

Center Support

Matrixed Organizations

| | |
|--|-------------------------------------|
| | PROCUREMENT Terry Crowley |
| | RESOURCES Josh Green |
| | CHIEF COUNSEL Joe Batey |

| | | | | | | | |
|-------------------------------------|--|---|---|---|--|---|---------------------------------------|
| | FLIGHT PROJECTS Diana Calero | | INFRASTRUCTURE MGMT Ralph Mikulas | | FLEET & SYSTEMS MGMT Denise Pham / Lori Ulrich | | FLIGHT ANALYSIS Mike Carney |
| Mission Management Pre Phase A E | | Ground Systems Launch Site Comm & Telemetry | | Fleet Integration Engineering Field Offices | | Flight Dynamics Flight Structures and Environments | |

The People of LSP

**TURNOVER RATE TO
DATE**

0.57%

**AVERAGE
EXPERIENCE**

16.2 Years

**YEARS AS A NASA
PROGRAM**

25

ADVANCED DEGREES

45%

RETIREMENT ELIGIBILITY

**Retirement
Eligible**

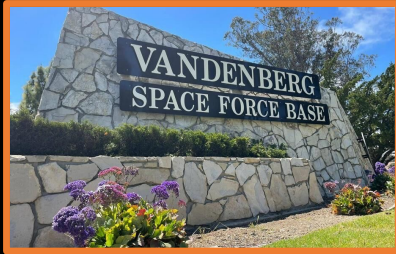
22%

**Eligible Within 5
years**

11%



Resident Offices



Vandenberg Space Force Base, California



ULA Denver, Colorado



SpaceX Hawthorne, California



ULA Decatur, Alabama



Northrop Grumman Chandler, Arizona



Launch Services Program KSC & CCSFS, Florida





Commercial Acquisition Expertise

- **NLS**
 - Insight & Approval
- **VADR**
 - Higher Risk Tolerance, Less Insight & Approval
- **SPOC**
 - Provides spacecraft processing services for both NASA-owned and NASA-Sponsored payloads
- **Advisory Services**



Formalized Government Collaboration

- Memorandum of Understanding, March 2011
- Government Launch Executive Board (GLEB), Quarterly
- Current Launch Schedule Review Board (CLSRB)
- USSF-NASA-NRO Summit








Program Management, Analysis, Engineering, Integration, & Launch Operations

- **Experience:** Technical, stable civilian workforce, mixed civil service & contractors, 20+ years average in launch
- **Consistency:** 102 primary missions + advisory + cubesats and secondaries
- **Flexibility:** Evolving expertise to meet new approaches
- **On Orbit:** Technical Assessment, Launch Mgmt. w/ "GO" for launch, 98+% Mission Success rate
- **On Time:** Mission Management, Risk Management
- **On Cost:** Success in Fixed Price Contract Management

Launch Services Program

- Current Vehicle Fleet - High Mission Assurance-

| | | | | |
|--|---|--|--|--|
|  |  |  |  |  |
| NGIS Pegasus XL | SpaceX Falcon 9 | SpaceX Falcon Heavy | ULA Vulcan | Blue Origin New Glenn |

*Not shown to scale

LSP Primary Missions



102
Launches
Since 1998



Latest Mission Launched - Psyche

- Psyche was successfully launched on Oct. 13, 2023, at 10:19 a.m. EDT from Launch Pad 39A aboard a SpaceX Falcon Heavy rocket.
- The achieved orbit was well within ICD requirements, based on spacecraft tracking data

| Orbit Parameters ¹ | ICD Requirement | | Preflight Prediction ² | | Spacecraft Tracking Solution ³ | | |
|---------------------------------------|-----------------|-----------|-----------------------------------|---------|---|---------|------------------|
| | Target | Tolerance | Mean | 3 Sigma | Value | Error | Accuracy (Sigma) |
| C3 (km ² /s ²) | 34.0000 | ±0.25 | 34.0238 | ±0.0862 | 34.0024 | -0.0214 | -0.75 |
| RLA (deg) | 113.7047 | ±0.50 | 113.6918 | ±0.0474 | 113.7070 | 0.0152 | 0.96 |
| DLA (deg) | 28.0089 | ±0.25 | 28.0090 | ±0.0120 | 28.0151 | 0.0061 | 1.53 |

¹ Targets are defined conditions of the osculating departure hyperbola at the Targeting Interface Point (TIP) expressed in the EME2000 coordinate system

² Based on day and time of launch

³ Assessed by spacecraft at TIP

- All orbit parameters were less than 1.6-sigma as compared to pre-flight accuracy predictions
- Due to the spacecraft targets, upper stage disposal was compliant with orbital debris policy via Earth-escape.





JOHN F. KENNEDY SPACE CENTER

LSP Advanced Planning & Awarded Missions in Flow

Sources:

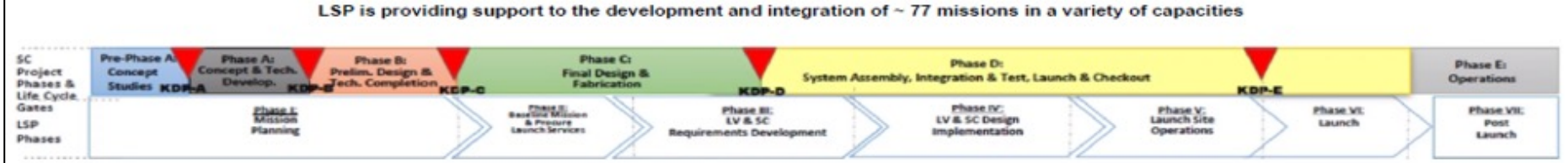
- NASA Launch Services Manifest [Release: 7/07/2023]
- Launch Manifest Waterfall [Release: 7/6/2023]
- FPO Update [Release: 7/05/2023]

VADR CLIN 2 and CSLI missions not depicted.

Version: External Release September 2023
All Pre-Award mission data is notional

LEGEND

| | | |
|--|-------------|---|
| | APL | #C: #Cubesats |
| | GSFC | CCSFS: Cape Canaveral Space Force Station |
| | JPL | AV: Atlas V |
| | LaRC | ER: Eastern Range |
| | MSFC | F9: Falcon 9 Full Thrust |
| | JSC | FH: Falcon Heavy |
| | GRC | GTO: Geostationary Transfer Orbit |
| | KSC | HEO: Highly Elliptical Orbit |
| | | LEO: Low Earth Orbit |
| | | LV: Launch Vehicle |
| | | NET: No Earlier Than |
| | | NLS: NASA Launch Service |
| | | NLT: No Later Than |
| | | SSO: Sun Synch Orbit |
| | | TBD: To Be Determined |
| | | U/R: Under Review |
| | | VADR: Venture Class Dedicated and Rideshare |
| | | VSFB: Vandenberg Space Force Base |
| | | WR: Western Range |



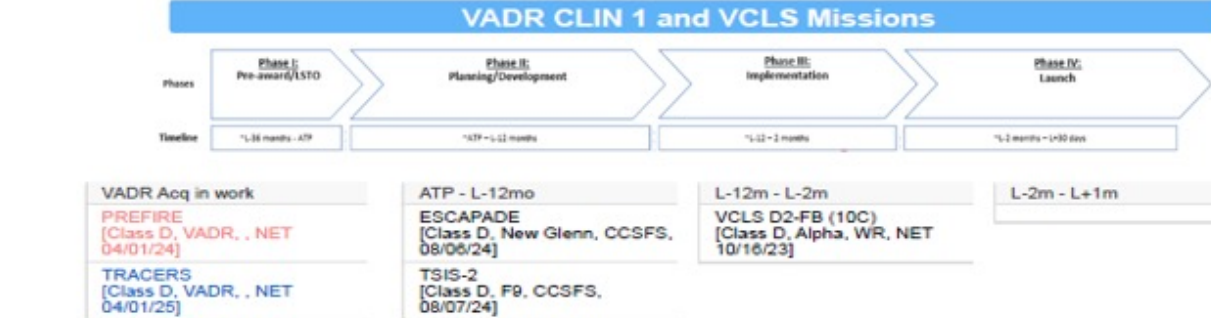
| | |
|--|--|
| AOs | Ph II (NLS II Acq in work) |
| Astro Probe AO [.] | OSAM-1 [Class C, Med/Int LV, ., 02/27/26] |
| DYNAMIC [., NET 08/01/29] | |
| Earth Science Explorer AO [.] | |
| Helio 2022 (SMEX) AO [.] | Ph II (ATP - L-30m) |
| MIDEX 2021 (Astro) AO [Med LV, NLT 12/31/28] | Roman Space Telescope [Class A, FH, Cx39A, 10/31/26] |
| MIDEX 2021 (Astro) MO [Small LV/ISS, NLT 12/31/27] | |
| New Frontiers AO [.] | |

NLS II Advanced Planning

| |
|---|
| AOS-Sky w/ HAWCsat (2nd) [Class C, SSO, Med/Int LV, 12/01/30] |
| AOS-Storm [Class C, SSO, Med/Int LV, 07/01/28] |
| COSI [Class D, LEO, Sm/Med LV, 04/01/27] |
| DAVINCI [Class B, Interplanetary, Med/Int LV, U/R 08/01/29] |
| Dragonfly [Class B, Interplanetary, Int/Hvy LV, NET 06/20/27] |
| ExoMars/RPM [., Interplanetary, Int LV, 09/24/26] |
| GDC [Class C, Multiple, Med LV, 09/01/29] |
| GeoXO [Class B, Orbit TBD, Med/Int LV, 01/01/30] |
| HelloSwarm [Class C, Lunar, Med LV, 01/01/29] |
| JPSS-3 [Class B, LEO, Med/Int LV, 09/01/32] |
| JPSS-4 [Class B, LEO, Med/Int LV, 09/01/27] |
| LandSat Next [., SSO, Med/Int LV, 12/01/30] |
| MAIA [Class C, SSO, TBD LV Class, NET 01/01/26] |
| Mars SRL [Class A, Interplanetary, Int/Hvy LV, NET 06/29/28] |
| MUSE [Class C, LEO, Sm/Med LV, 01/01/27] |
| NEO Surveyor [Class C, HEO, Med/Int LV, 09/13/27] |
| SBG [Class C, SSO, Med LV, 04/30/28] |
| SWFO L1-A [Class C, ., Med/Int LV, 12/15/28] |
| SWFO L1-B [Class C, ., Med/Int LV, 07/15/30] |
| USDV [Class A, LEO, Hvy LV, NLT 01/01/29] |
| VERITAS [Class B, Interplanetary, Heavy LV, NET 05/01/31] |

Awarded NLS II, One Offs, and LSP Advisory Missions

| | | | | |
|--|--|---------------------|-------------------|---------------|
| Ph III (L-30m - L-18m) | Ph IV (L-18m - L-3m) | Ph V (L-3m - L-10d) | Ph VI (L-10d - L) | Ph VII (L+3m) |
| HALO [., FH, ER, NET 10/01/25] IMAP w/ SWFO (2nd) +Carruthers (2nd) [Class C, F9, ER, 02/01/25] Sentinel 6-B [Class B, F9, WR, 11/24/25] SPHEREx/PUNCH(2nd) [Class C, F9, WR, 02/28/25] | Europa Clipper [Class A, FH, Cx39A, 10/10/24] GOES-U [Class B, FH, ER, 04/30/24] NISAR [Class C, GSLV, India, U/R 01/28/24] PACE [Class C, F9, ER, 01/09/24] Psyche [Class B, FH, Cx39A, 10/05/23] | | | |



Supporting Programs

| |
|--|
| Artemis/Gateway |
| Artemis-2 [., SLS, Cx39B, 11/23/24] |
| Artemis-3 (HLS) [Hvy LV, SLS, Cx39B, 12/01/25] |
| ESPRIT [Hvy LV, ., 01/01/27] |
| Gateway (IHAB/US-HAB) [Hvy LV, SLS, ., NET 01/01/27] |
| Gateway (Log Mod) [SpX Heavy LV, ., 11/01/27] |
| Gateway GERS [SpX Heavy LV, ., NET 11/01/28] |
| HLS [Hvy LV, Starship, ., NET 01/01/25] |

VADR Adv. Planning

| |
|--|
| ULTRASat [Class D, GTO, VADR, NET 08/01/26] |
| StarBurst [Class D, LEO, VADR, NET 01/01/25] |
| QuickSounder [Class D, LEO, VADR, 12/01/25] |
| PANDORA [Class D, SSO, VADR, NET 10/01/24] |
| INCUS [Class D, ., VADR, 08/02/26] |
| CFM [Class D, LEO, VADR, NET 01/01/30] |
| ASPERA [Class D, SSO, VADR, NET 05/01/25] |

Emerging Launch Services Strategy

VADR Overview

- Lower level of mission assurance and more commercial practices to achieve lower launch costs through FAA licensed launches (only applicable to Class D & higher risk tolerant missions. Not applicable for Class A-C)
- Includes capability to procure streamlined commercial CubeSat launch services
- Category 1 certification of launch vehicle available, not baseline
- First flight not required to bid
- Spacecraft (SC) readiness go/no-go for launch (only for Dedicated & Primary Rideshare)

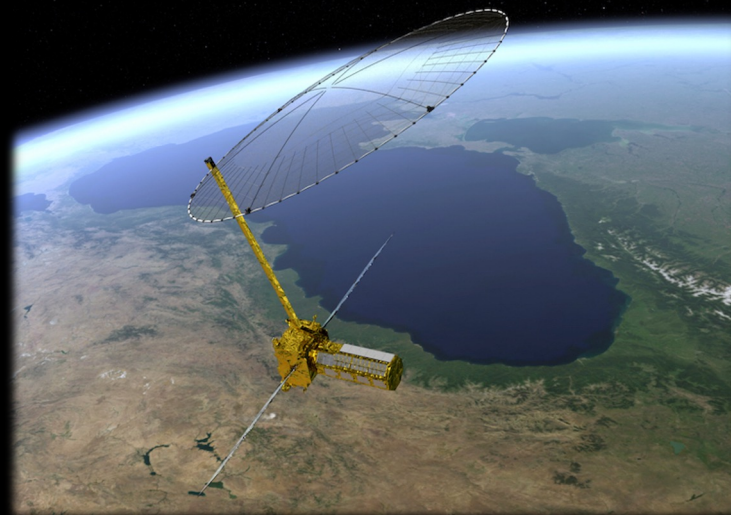
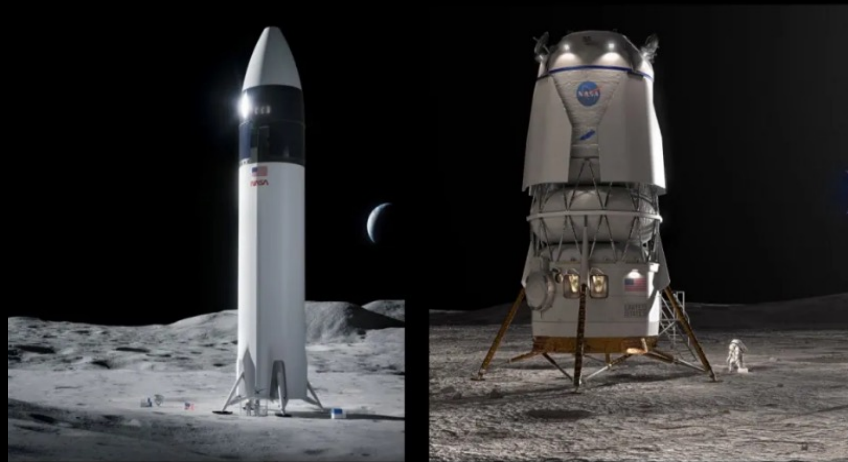
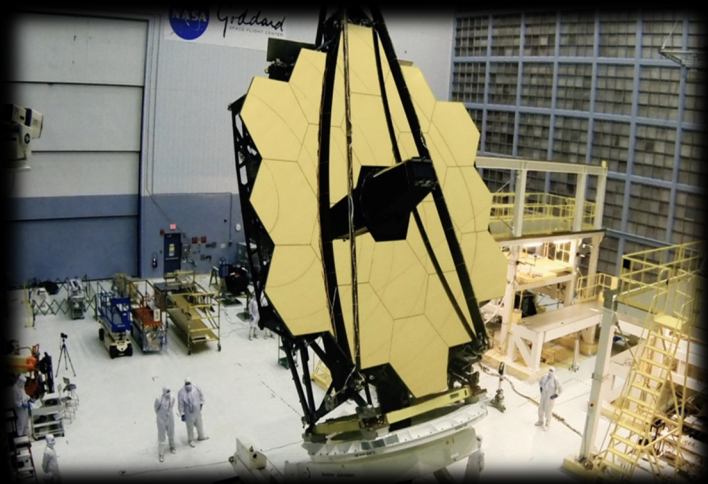
| | |
|-----------|--|
| 2015 | VCLS (Venture Class Launch Service) |
| 2020 | CAPSTONE (Cislunar Autonomous Positioning System Technology Operations and Navigation Experiment) |
| 2020 | VCLS Demo 2 (Venture Class Launch Service Demonstration 2) |
| 2021 | TROPICS (Time-Resolved Observations of Precipitation structure and storm Intensity with a Constellation of Smallsats) |
| 2021 | VADR (Venture Class Acquisitions of Dedicated & Rideshare) |
| 2022-2023 | <ul style="list-style-type: none"> • 2022 <ul style="list-style-type: none"> • TROPICS - Rocket lab • TSIS-2 - SpaceX • 2023 <ul style="list-style-type: none"> • PREFIRE– Rocket Lab • ESCAPEDE – Blue Origin • TRACERS – SpaceX • Streamlined CubeSat Launch Services awarded for multiple CubeSat missions |

Launch Services Program

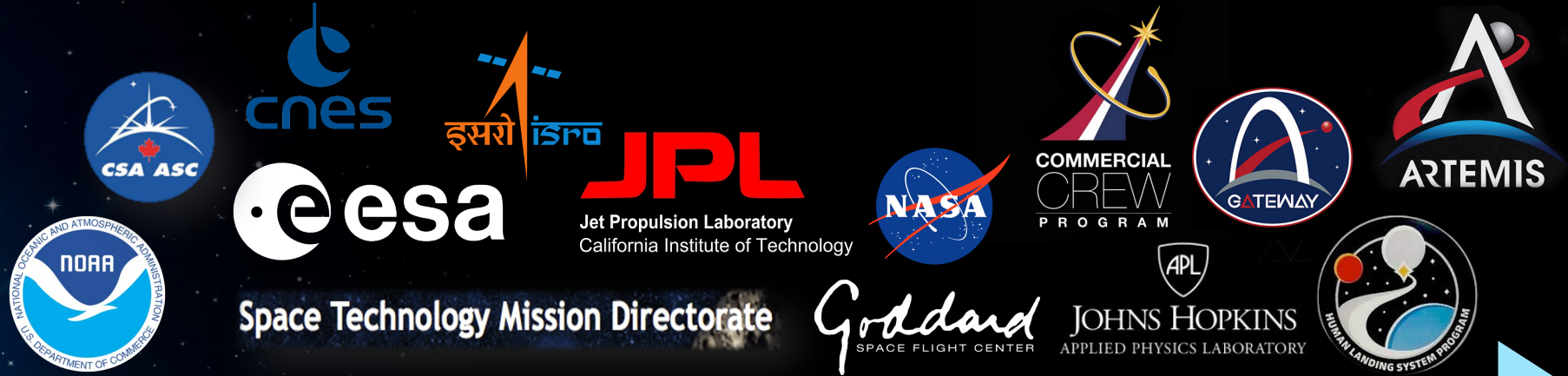
- Venture Class Launch Service Providers -



Advisory



LSP's Evolving Future



1998 - LAUNCH SERVICES PROGRAM CUSTOMERS - 2023

SCIENCE MISSION DIRECTORATE



Langley Research Center



Commercial Resupply



Marshall Space Flight Center



JOHNSON SPACE CENTER

Exploration Systems Development Mission Directorate



LAUNCH SERVICES PROGRAM

KENNEDY SPACE CENTER

EARTH'S BRIDGE TO SPACE

CubeSat Launch Initiative

Mission

NASA's CubeSat Launch Initiative (CSLI) is intended to expand U.S. interest in Science, Technology, Engineering, and Mathematics (STEM).

CSLI emphasizes education and provides launch opportunities to a variety of U.S. CubeSat developers and encourages participation by Minority Serving Institutions.

Accomplishments to Date

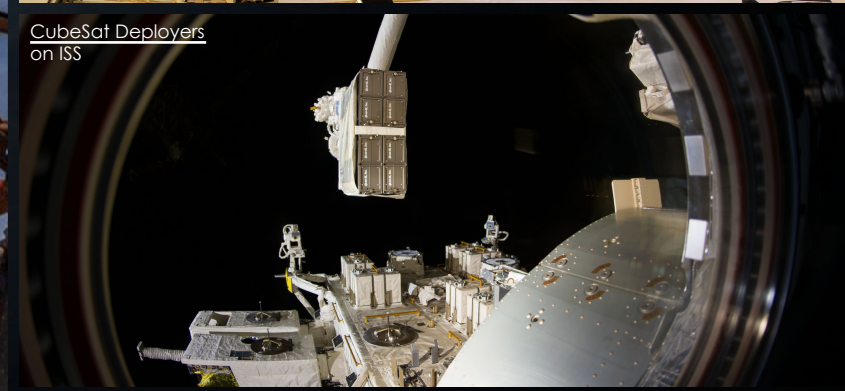
- 200+ CubeSat Projects selected from 100+ organizations from 40+ states, Washington DC and Puerto Rico
- 150+ CubeSats launched to date

Looking forward to 2024

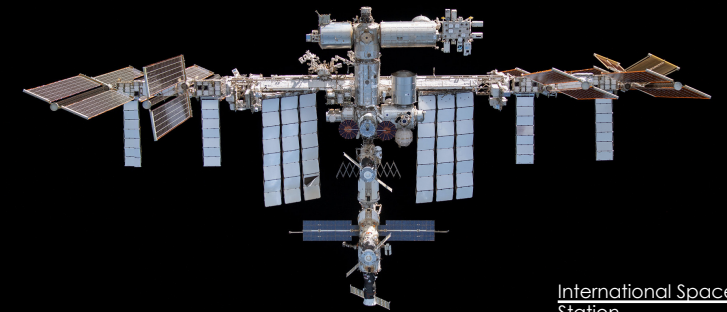
- 45+ Missions scheduled to launch in the next Calendar Year
- 20+ missions awaiting procurement



LightSail, Credit: The Planetary Society

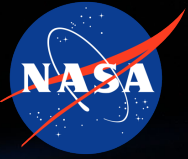


CubeSat Deployers on ISS



International Space Station

Image: ELaNu 19 Launch, Credit: Rocket Lab/Trevor Mahlmann



Benefits to Education Orgs



1

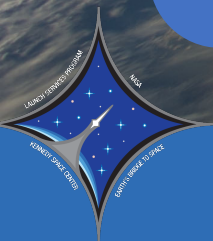
CSLI provides up to \$300k to cover launch and integration costs, thereby removing the financial barriers associated with launch.

2

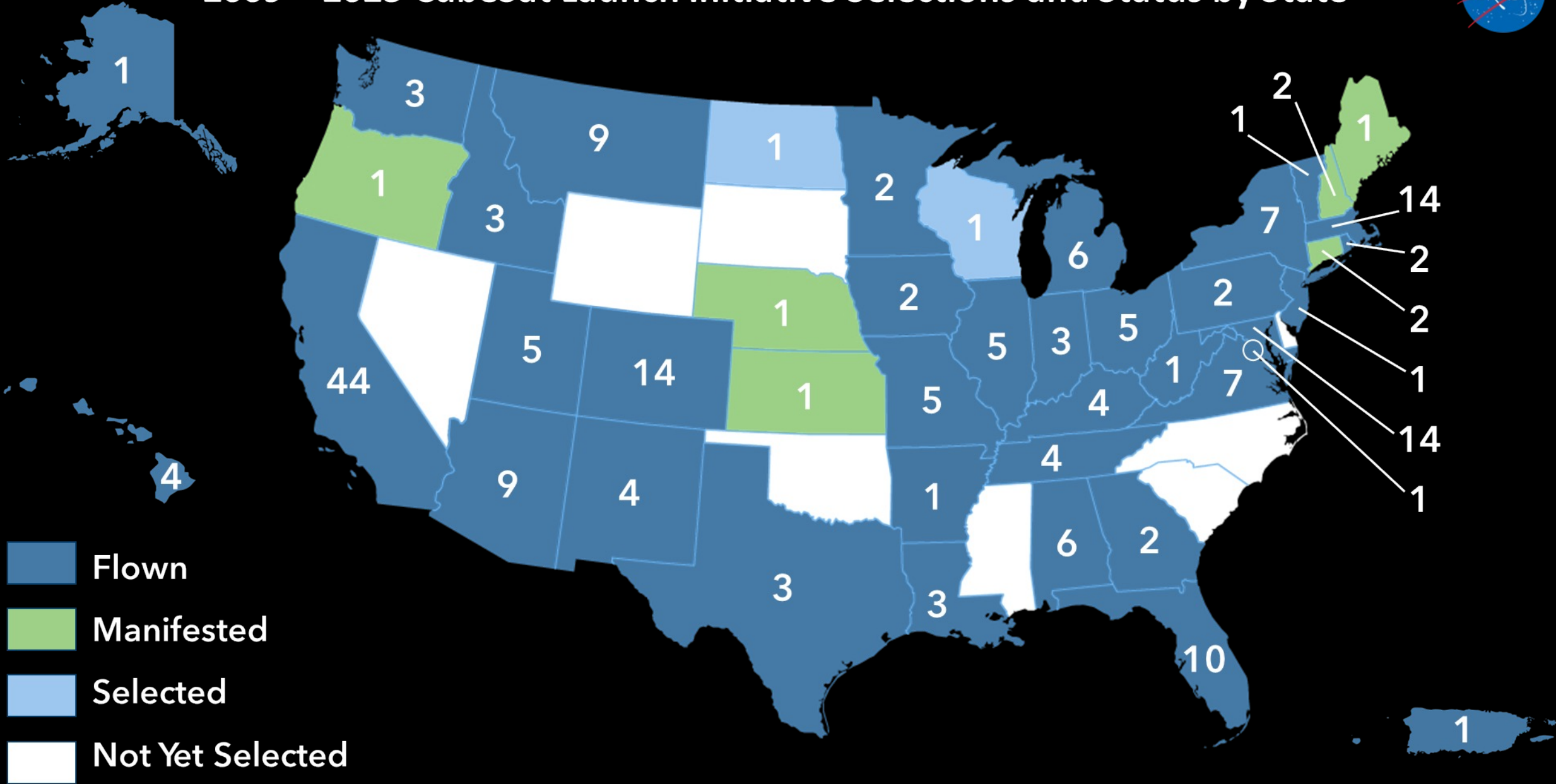
Enables students, teachers and faculty to obtain hands-on flight hardware development and operational experience

3

Provides mechanism to conduct scientific research and develop technologies in outer space



2009 – 2023 CubeSat Launch Initiative Selections and Status by State





CSLI Inspires the Next Generation of Explorers

R. Pierce Smith, CACTUS-1 "For me the most rewarding part was building the payload - that's when I really started to get that sense of doing something really incredible."

"StangSat gave me early insight into the engineering process, confirming my interest in an engineering career. It also gave me the luxury of working a project to completion."

Ryan Izant, EQUISat "Brown Space Engineering played an extremely large role in my career development and is the main contributor to getting me to where I am today."



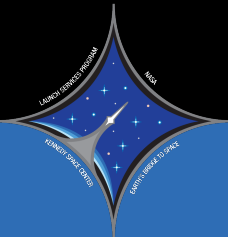
University of Hawaii -
Neutron-1



Robertsville Middle
School - RamSat



Brown University - EQUISat





2024 - What's Next?



- Launch : Jan 2024
- SpaceX Falcon 9
- Spacecraft shipment targeted for mid November
- LSP review of launch vehicle booster in work
- Launch campaign preparations in work

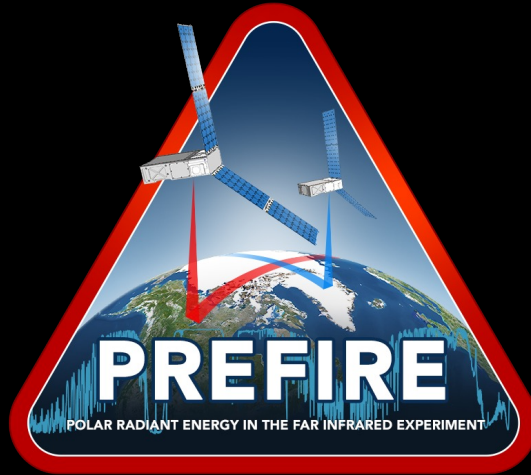


- Launch Date: April 2024
- SpaceX Falcon Heavy
- Spacecraft shipment currently targeted for early 2024
- Launch services analyses progressing



- Launch Date: Oct 2024
- SpaceX Falcon Heavy
- Pad and ground support facility readiness in work
- Launch services analyses progressing

2024 - What's Next (VADR)?



- Launch Date:
 - PREFIRE 1 May 2024
 - PREFIRE 2 May 2024
- Rocket Lab Electron
- Launch services analyses progressing
- Spacecrafts targeted for transport to New Zealand in spring 2024



- Launch Date: Aug 2024
- Blue Origin New Glenn
- Launch services analyses progressing



JWST

MAP

Kepler

SIRTF

STEREO-B

GOES-N GOES-O GOES-P IBEX

TDRS-I TDRS-J ST-5 THEMIS SDO

GOES-M

TDRS-H

GOES-L

IMAGE

Aqua
TIMED HESSI STSS Demo
Jason-1 STSS ATRR GRACE
Kodiak Star NOAA-N Prime SAOCOM 1A
Munin OSTM Jason-2 TROPICS GRACE-FO
SAC-C GLAST SWOT SAOCOM 1B
EO-1 AIM JPSS-2 / LOFTID GPM CRS
HETE-2 CloudSat IXPE CCP
NOAA-L CALIPSO Terra NOAA-N Landsat 9
FUSE DART Sentinel 6-MF
QuikSCAT Swift ICON
MUBLCOM Aura ICESat-2
TERRIERS GP-B JPSS-1
Landsat 7 SCISAT-1 CYGNSS GRAIL-A
WIRE GALEX Jason-3
SWAS SORCE SMAP
CHIPSat OCO-2
ICESat IRIS
NOAA-M LDCM
NuSTAR Artemis 1 LADEE
NPP CAPSTONE LRO
Aquarius/SAC-D GRAIL-B
WISE LCROSS

MESSENGER

CONTOUR

Solar Orbiter

Parker Solar Probe

STEREO-A

Genesis

DSCOVR

OSIRIS-REX

RBSP

TDRS-K

TDRS-L

MMS

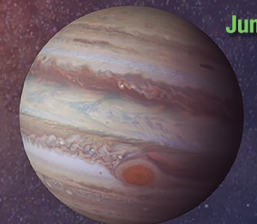
GOES-R

TDRS-M

GOES-S

TESS

GOES-T



Green: Primary
Pink: Advisory
Orange: Venture-Class

NASA'S LAUNCH SERVICES PROGRAM WHERE WE'VE GONE



Roman Space Telescope

VERITAS

DAVINCI

GOES-U

ULTRASat

Dragonfly

MAIA

QuickSounder

IMAP

NEO Surveyor

Sentinel 6-B

Landsat Next

ASPERA

AOS-Sky

SWFO-L1

GeoXO

JPSS-3

TRACERS

GDC

EscaPADE

StarBurst

USDV

HelioSwarm

Europa Clipper

PUNCH

SPHEREx

HALO+PPE

ExoMars RFM

Mars Sample Return

PANDORA

AOS-Storm

HLS

TSIS-2

SBG

Logistics Mod

PREFIRE

JPSS-4

I-HAB

PACE

COSI

ESPRIT

SLS/Artemis II

MUSE

GERS

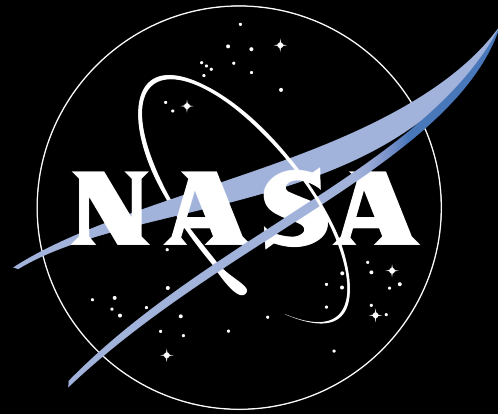
INCUS

OSAM-1

Green: Primary
Pink: Advisory
Orange: Venture-Class

NASA'S LAUNCH SERVICES PROGRAM

WHERE WE'RE GOING



Follow us on X
[@NASASpaceOps](#)



Back-Up

1960

1970

1980

1990

2000

2010

2020

Beyond



NASA Science via Government



DoD via Government



NASA Science and DoD via Commercial



NASA Human via Government



NASA Cargo via Commercial

Evolution of Spaceflight



NASA Human via Commercial



MISSION

Uniting customers, capabilities, and culture to explore space through unparalleled launch services

VISION

Science and discovery through unlimited access to the universe

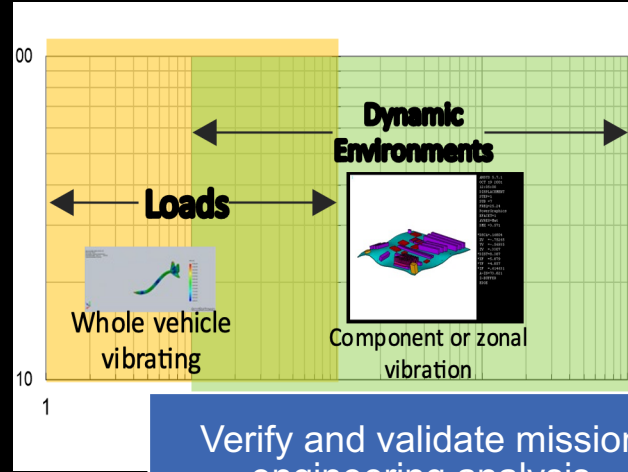
GOALS

Maximize mission success, Assure long-term launch services, Promote evolution of a US Commercial Space Launch Market, Continually enhance LSP's core capabilities

Traditional LSP Roles and Responsibilities



Acquire Launch Services



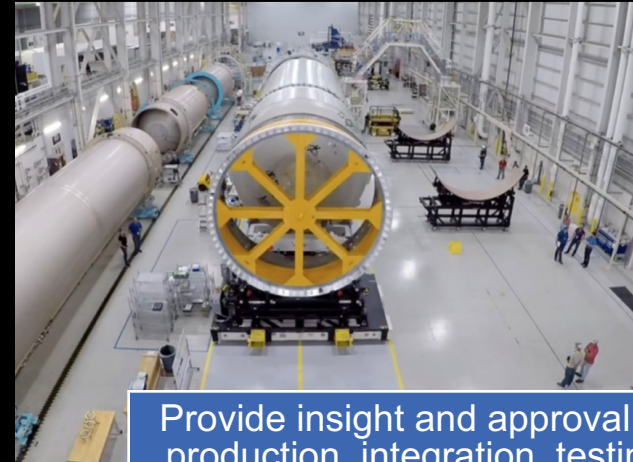
Verify and validate mission engineering analysis



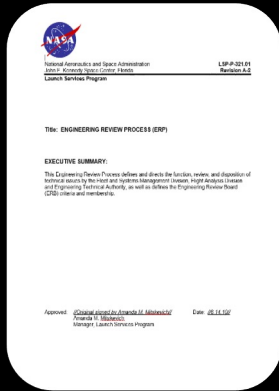
Manage launch vehicle to spacecraft integration



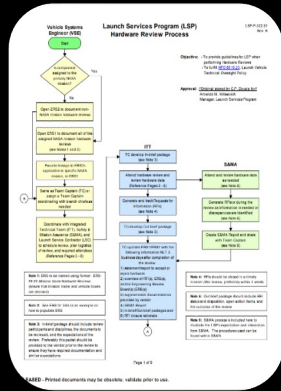
Certify launch systems for NASA use



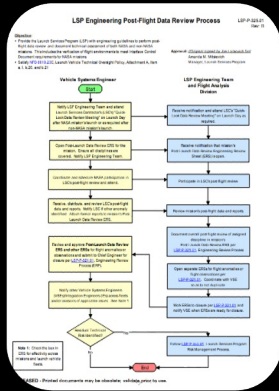
Provide insight and approval of production, integration, testing and processing



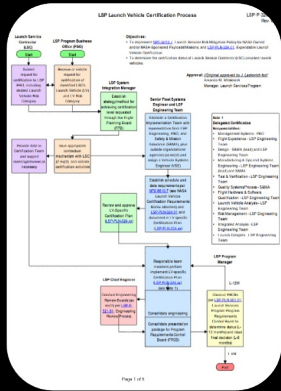
Engineering Review Process



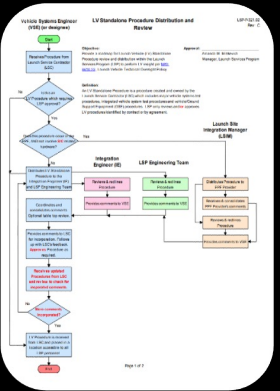
LSP Hardware Review Process



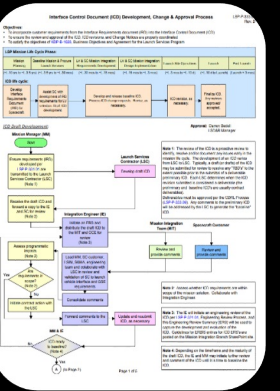
Post-Flight Data Review Process



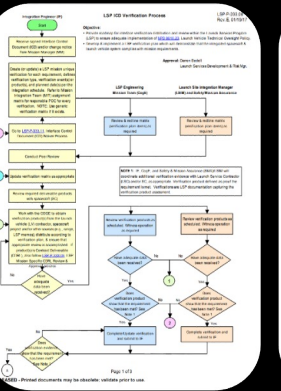
Launch Vehicle Certification Process



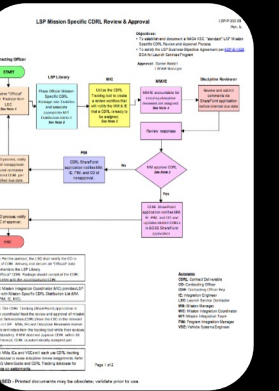
LV Standalone Procedure Review Process



LSP ICD Process



LSP ICD Verification Process



LSP Mission Specific CDRL Review & Approval

Mission First

- Over 20 years of heritage of launch vehicle mission assurance in the “non-government-owned” launch vehicle world
- Adaptable to changing environments
 - New providers
 - Heritage customers with new requirements
 - New Agency customers using commercial launch vehicles, with different procurement approaches
- Full manifest of missions to execute “traditionally” and in advisory capacity