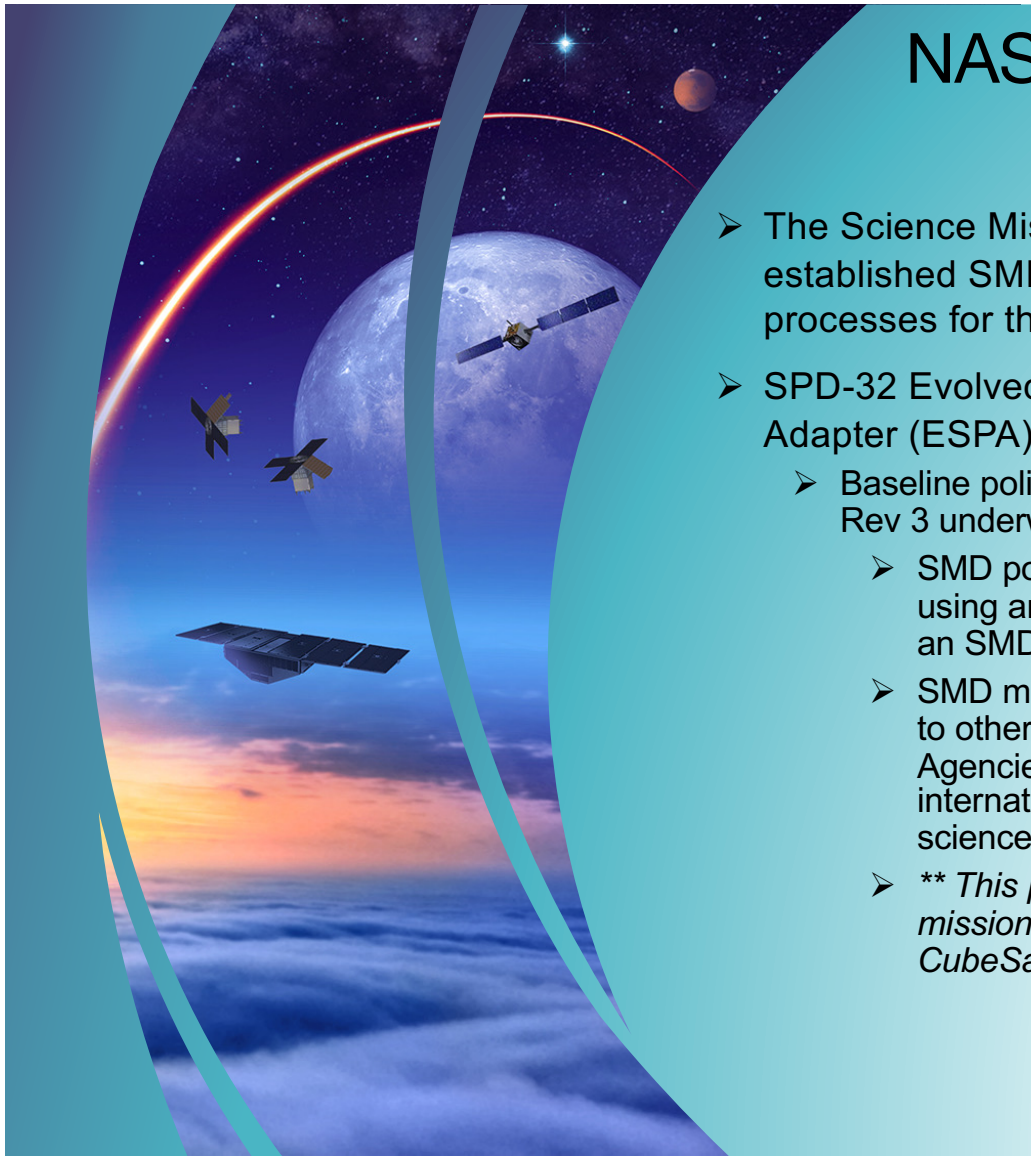
NASA SMD Rideshare Office
SPRSA
September 13-15, 2022

Aly Mendoza-Hill – NASA SMD Rideshare Lead



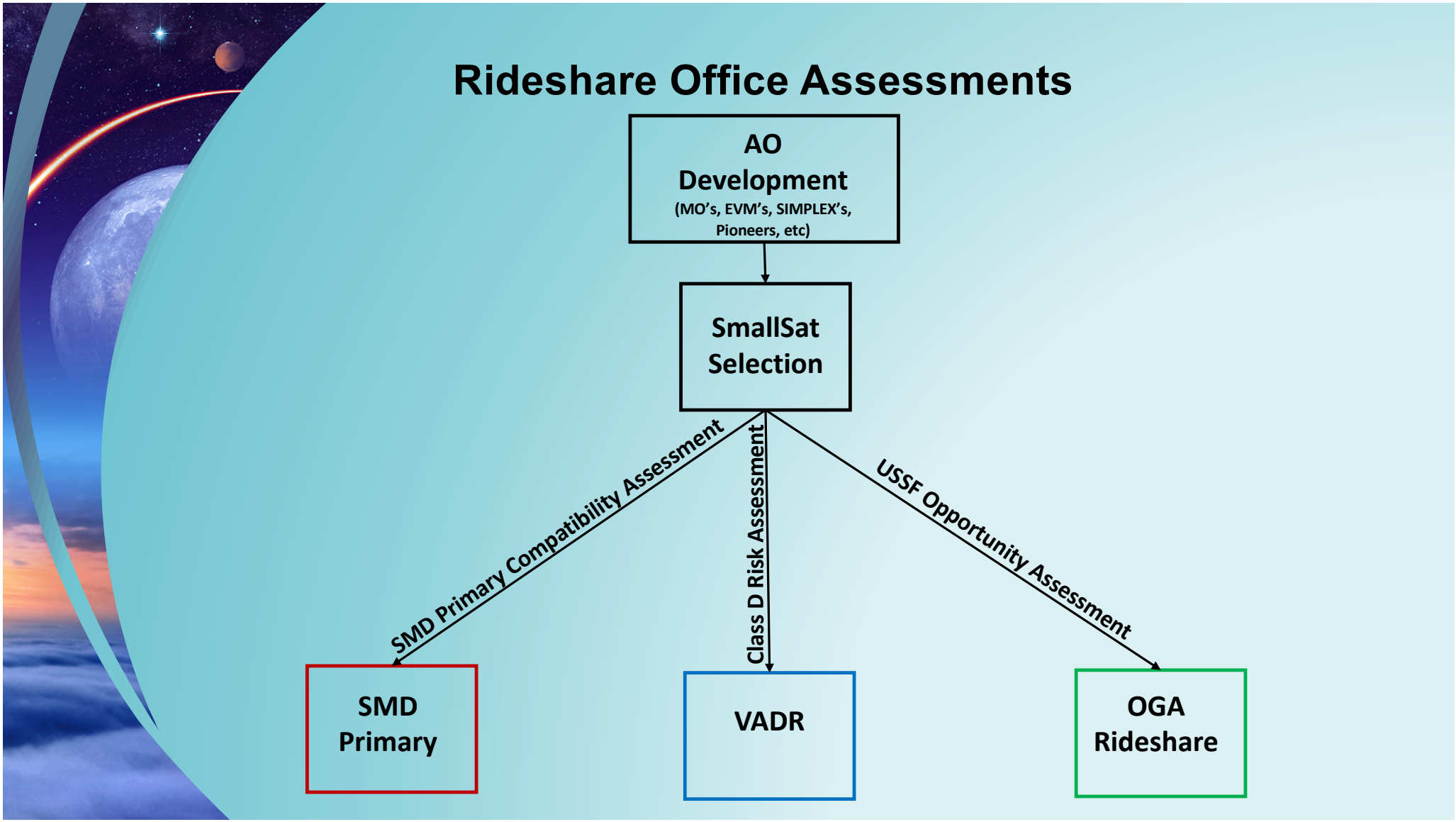
NASA Science Mission Directorate Rideshare Office

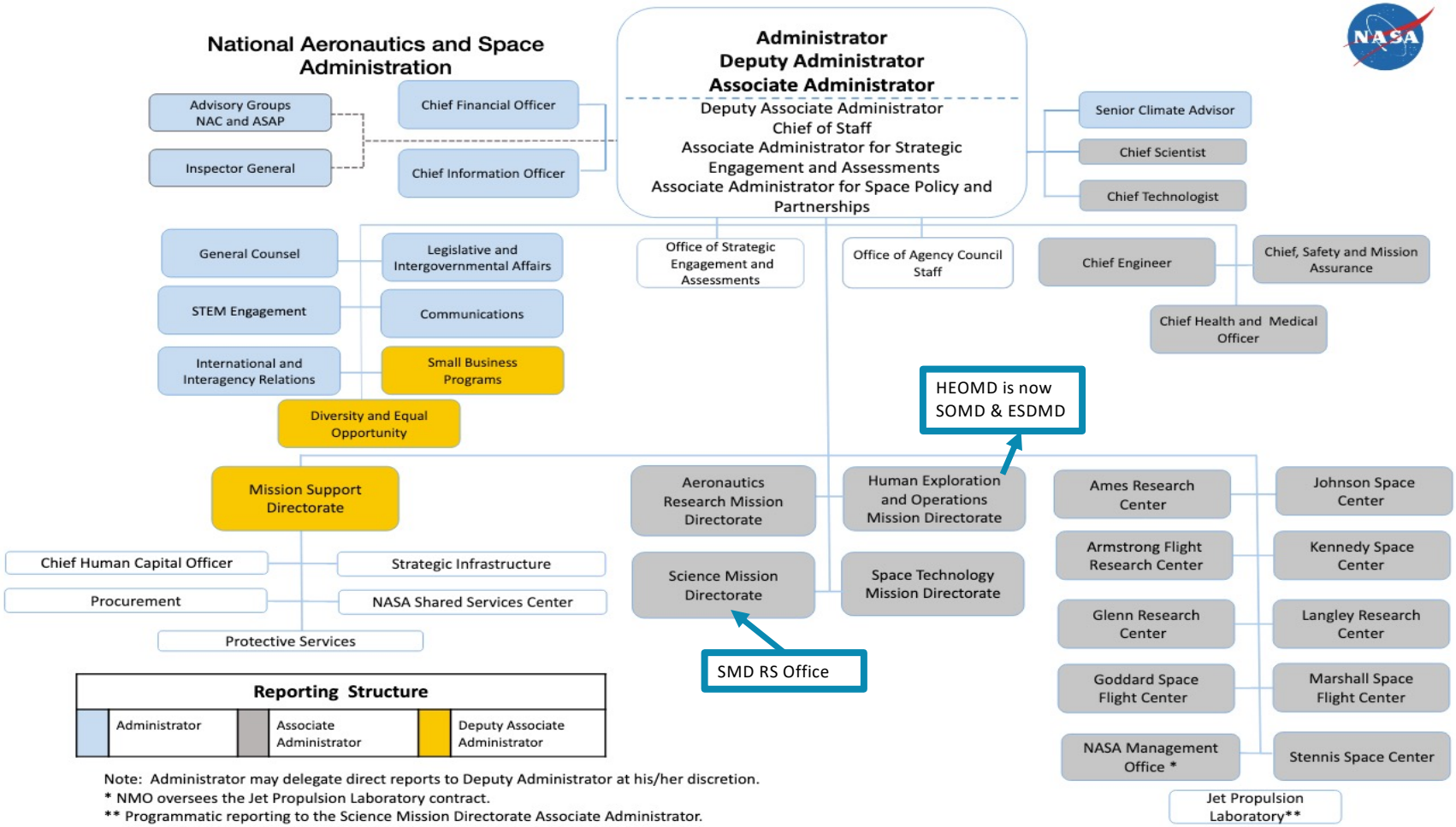
- The Science Mission Directorate has a rideshare policy and an established SMD Rideshare Office (SRO) to develop standard rideshare processes for the NASA SMD.
- SPD-32 Evolved Expendable Launch Vehicle (EELV) Secondary Payload Adapter (ESPA) Secondary Payloads Rideshare
  - Baseline policy signed Oct. 2018; Policy updated January 2021 (Rev 2); Rev 3 underway… ETA early 2023
    - SMD policy enables rideshare or launch accommodation opportunities using an ESPA-type ring integrated on the launch service procured for an SMD primary payload ***with identified excess performance***.
    - SMD may offer any excess capacity not utilized for SMD investigations to other NASA Mission Directorates (MD), other U.S. Government Agencies, or NASA's International partners in accordance with international agreements for international collaborative efforts relating to science, technology, and exploration goals.
    - *** This policy only applies to ESPA-class and independent Cubesat missions on ESPA ports (not Cubesats which are managed through the CubeSat Launch Initiative-CSLI).*

NASA SMD Rideshare Office (SRO)

- **Goal:** To provide a single POC for SMD Rideshare-related inquiries for both NASA Center and external partners; to maintain overall knowledge and tracking of Rideshare activities for SMD missions, and to ensure best utilization of excess LV performance to obtain maximum science on SMD missions
- Located within the Heliophysics Division
  - Supports **ALL** SMD Divisions
  - Aly Mendoza-Hill is the Rideshare Lead for SMD
    - Other key SMD Rideshare Team Members: Alan Zide, David Cheney, Pete Wilczynski, Florence Tan, & Brooke Burns
  - Works closely with the Launch Services Program
  - Works with NASA Center Rideshare POCs to create unified NASA/SMD Rideshare message; delegates tasks to appropriate Center POCs as required; does not replace Center-level Rideshare work
- Developing a robust rideshare program to utilize excess mass to orbit and enable additional launch opportunities for the science community
  - Standardizing Announcement of Opportunity (AO) language and reviewing each AO for consistency
  - Developing key documents: SMD RS101, SMD RUG & DNH requirements, & the SMD RS Implementation Plan
  - Performing top-level payload compatibility analyses of rideshare missions to identify potential impacts to the primary payload or the success of the secondaries
  - Maintaining a list of SMD launch opportunities and tracking potential external launch opportunities
    - External information is made available on the Small Spacecraft Systems Virtual Institute (S3VI) website (NASA Launch Portal - https://www.nasa.gov/smallsat-institute)

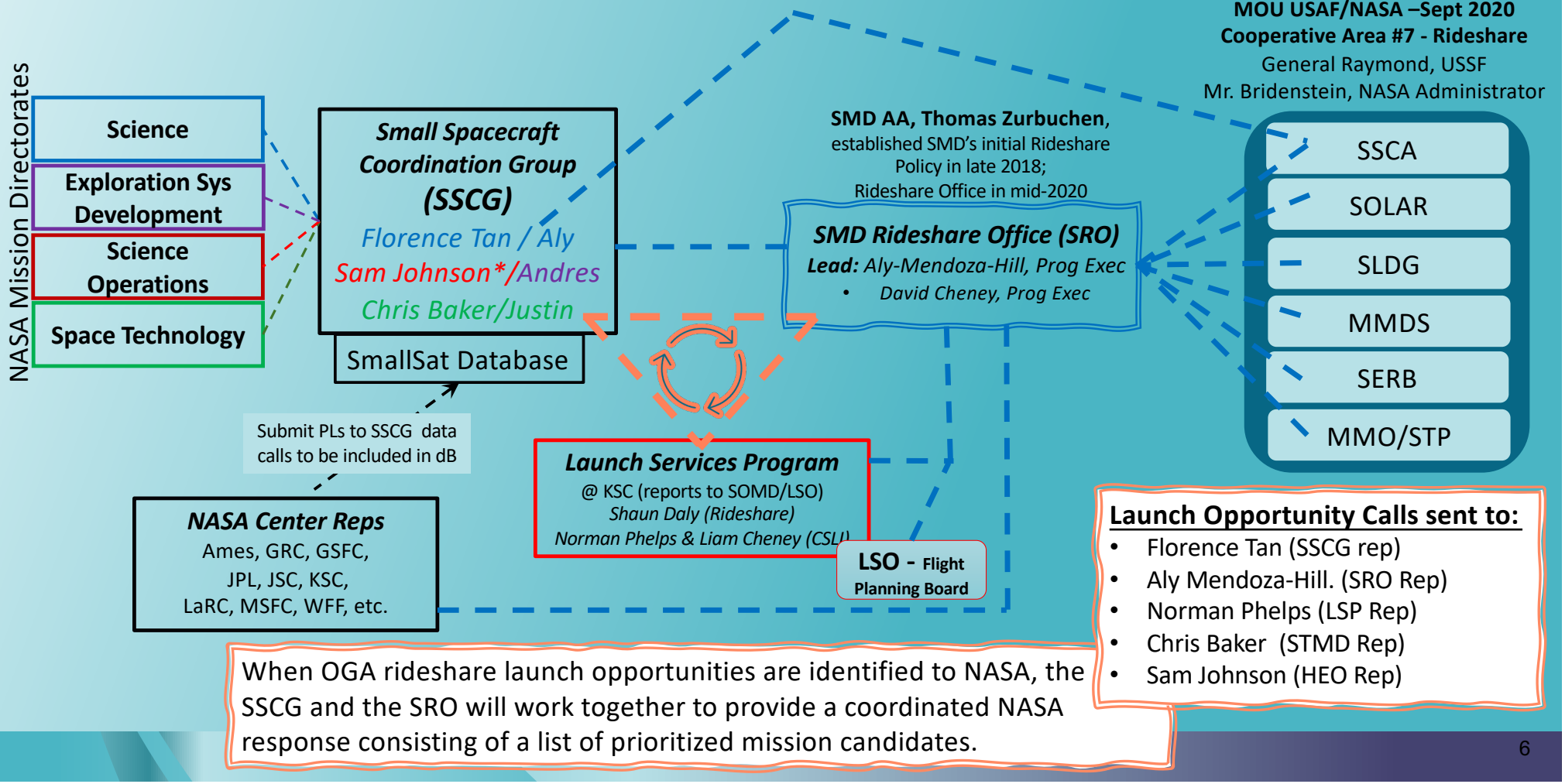
Rideshare Office Assessments





Note: Administrator may delegate direct reports to Deputy Administrator at his/her discretion.
* NMO oversees the Jet Propulsion Laboratory contract.
** Programmatic reporting to the Science Mission Directorate Associate Administrator.
JPL will participate in Agency-level functions, such as APMC.
JPL is a Federally Funded Research and Development Center (FFRDC).

Rideshare Launch Opportunity Primary POC's



Launch Opportunity Calls sent to:

- Florence Tan (SSCG rep)
- Aly Mendoza-Hill. (SRO Rep)
- Norman Phelps (LSP Rep)
- Chris Baker (STMD Rep)
- Sam Johnson (HEO Rep)

When OGA rideshare launch opportunities are identified to NASA, the SSCG and the SRO will work together to provide a coordinated NASA response consisting of a list of prioritized mission candidates.

NASA HQ Rideshare

Andres Martinez
Advanced Exploration Sys

Sam Johnson*
Launch Service Office

Aly Mendoza-Hill – SMD RS Lead
& Florence Tan – SMD Deputy Chief Technologist

Chris Baker
STMD

To implement NASA's Mission, NASA Headquarters is organized into five principal organizations called Mission Directorates:

- Aeronautics: Pioneers and proves new flight technologies that improve our ability to explore and which have practical applications on Earth.
- Exploration Systems Development: Development programs for deep space exploration, including Artemis missions.
- Space Operations: Space operations in low-Earth orbit.
- Science: Explores the Earth, moon, Mars, and beyond; charts the best route of discovery; and reaps the benefits of Earth and space exploration for society.
- Space Technology: A catalyst for the creation of technologies and innovation needed to maintain NASA leadership in space while also benefiting America's economy.
- Mission Support: Oversees the management of the institutional functional areas that support the Agency mission.

Access to Space Process for NASA SMD Launches

SMD procures launch services for Primary missions, including rideshare integration, services from LSP

SMD Rideshare Office (SRO) works with LSP to determine excess performance

Nominally..
~33 months B4 LRD

Per SMD Policy: If excess perf is avail, it will be made available, if possible, for rideshare missions

Priority:
- Primary division paying for the launch
- Other SMD Divisions
- Other Mission Directorates
- OGA's

Timeline
Ideally at 3-4 years prior to launch… NLT than 27 months B4 LRD

SRO & LSP, together, work compatibility assessments for potential RS missions

SRO brings compatible configs to the SMD DAAP

DAAP requests FPB approval to add RS missions to the Primary's launch service

LSP adds RS to the Primary's contract

Memo/Agreement would be needed between NASA SMD & OGA's

Timeline
- Ideally at 36 months prior to launch (include early in primary initial buy)
- **No later than 24 months before launch**

The above SMD process is specifically for the Science Mission Directorate launches. The other NASA mission directorates may have a rideshare opportunity to offer OGA's on a specific occasion. Those opportunities will be handled on a case-by-case basis, and therefore, an established documented process does not exist at this time. (ex. future Artemis mission opportunities)

NOTIONAL MILESTONES FOR SECONDARY PAYLOAD INTEGRATION

SPs: SECONDARY PAYLOADS
SPA: SECONDARY PAYLOAD ADAPTER
CLA: COUPLED LOADS ANALYSIS
FDLC: FINAL DESIGN LOADS CYCLE
FEM: FINITE ELEMENT MODEL

FPB: FLIGHT PLANNING BOARD
LSIRD: LAUNCH SERVICE IRD
LSTO: LAUCH SERVICE TASK ORDER
PER: PRE-ENVIRONMENTAL TEST REVIEW

APRIL 2025 — LRD

SP Mass Simulators ready for contingency

TBD — Primary Mission PER

~7 MONTHS PRIOR TO PER — SECONDARY FEM'S FOR FDLC **(supports Primary PER)**

FPB FOR FINAL LV CONFIGURATION — ***NLT L – 24 (APRIL 2023)***

IF NO SPs BY L-24 MONTHS, THE PRIMARY MISSION GOES TO FPB TO DECIDE EITHER TO REMOVE THE SPA OR KEEP IT (ASSESS IMPACTS: COST, SCHEDULE, TECHNICAL)

TBD — Primary Mission CDR

CONTINUE SP SEARCH, IF NEEDED

CONTINUAL COMPATIBILITY AND DI/H ASSESSMENTS FOR POTENTIAL SPs

~6 MONTHS PRIOR TO CDR — SECONDARY FEM'S FOR PRELIMINARY CLA **(supports Primary CDR)**

PRIMARY MISSION COUPLED LOADS IS SCHEDULE DRIVER FOR IDENTIFYING SECONDARY PAYLOAD CONFIGURATION

LV SELECTION | SELECTED LV EXCESS PERFORMANCE KNOWN — **~L – 33 (~JULY 2022)**

TBD — Primary Mission KDP-C

FPB DIRECTION TO LSP — **~L – 40 (~DEC 2021)**

SECONDARY LSIRD'S TO LSP — **~L – 41 (~NOV 2021)**

SPs PRELIMINARY DETAILS TO BE INCLUDED IN THE LAUNCH SERVICE REQUIREMENTS FOR THE LSTO PROCUREMENT PROCESS

INITIAL ID OF POTENTIAL SPs

TBD — Primary Mission PDR

PRIMARY MISSION REQUESTS POTENTIAL EXCESS PERFORMANCE FROM LSP — **~SEPTEMBER 2020**

~June 2020 — Primary Mission SELECTED/DIRECTED

JPSS-2

-Joint Agency Satellite Division

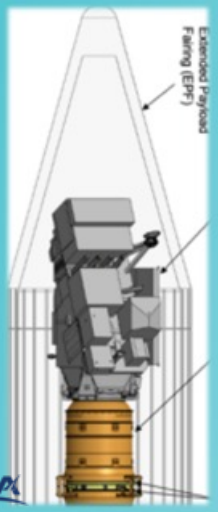
-LV: AtlasV-401

-ULA C-Adapters

-Rideshare Payloads:

-LOFTID

LRD 11/1/2022



Landsat-9

-Earth Science Division

-LV: AtlasV-401

-ESPA Standard

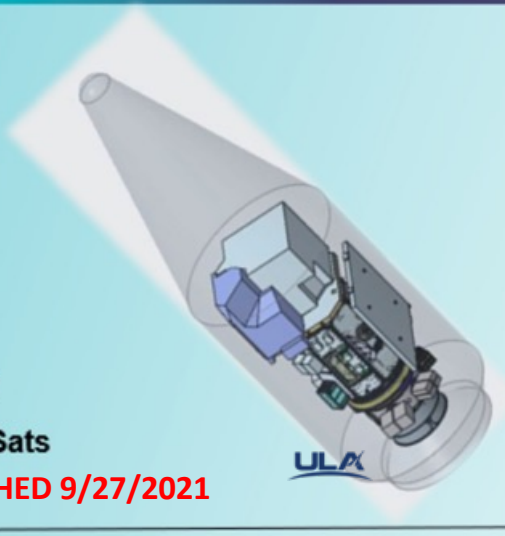
-Rideshare Payloads:

~~1~~ USSF and

4 Cubesats launched!

NASA CubeSats

LAUNCHED 9/27/2021



Majority of excess performance utilized

PSYCHE

-Planetary Science Division

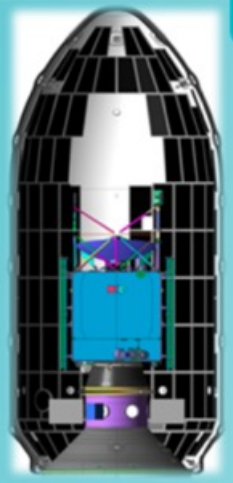
-LV: Falcon Heavy

-ESPA Standard

-Rideshare Payloads:

-JANUS

LRD 9/2~~0~~TBD22



IMAP

-Heliophysics Division

-LV: Falcon

-ESPA Grande

-Rideshare Payloads:

-SWFO L1

~~-PSP LTB~~

-HPD GLIDE

~~-HPD Solar Cruiser~~

LRD 2/1/2025

Images not to exact scale

SMD Rideshare Office – Mission Overview

Pre-2018 SMD RS Policy

Post-2018 SMD RS Policy (manifested)

Post-2018 SMD RS Policy –potential excess

Upcoming Launches

11/01/2022 (tbd)

JPSS-2
JASD
LV & RS Details
-AtlasV-401 (SSO)
-ULA C-Adapters
-RS Payload:
LOFTID

TBD

PSYCHE
PSD
LV & RS Details
-Falcon Heavy (Asteroid)
-ESPA Standard
-RS Payload:
JANUS

02/01/2025

IMAP
HPD
LV & RS Details
-Falcon (L1)
-ESPA Grande
-RS Payloads:
NOAA SWFO
L1, HPD GLIDE

02/28/2025

SPHEREx
APD
LV Details
-Falcon (SSO)
-ESPA Grande
-RS Payloads:
PUNCH

04/30/24

GOES-U
JASD
LV Details
-TBD
-[illegible]0 deg

Sept 2025

COSI
[illegible]SD
LV & RS Details
- TBD

Nov 2025

Sentinel-6B
APD
LV & RS Details
- TBD

2026

Neo Surveyor
PSD
LV & RS Details
- TBD
- L1

2027

MUSE
HPD
LV & RS Details
-LV: TBD

2028/29

Helioswarm
HPD
LV & RS Details
-LV: TBD

2028

AOS
ESD
LV & RS Details
-LV: TBD (GPM 65 deg)

2028-2030

VERITAS & DAVINCI+
PSD
LV & RS Details
- TBD
- C3=17/18

2025/27

JPSS-3
JASD
LV & RS Details
- TBD
- LEO SSO 13:30 MLTAN

05/2028

GDC
HPD
LV & RS Details
-LV: TBD (LEO 400KM)
-Six SC Constellation
-Potential RS Slots

2028

SBG
ESD
LV & RS Details
-LV: TBD (SSO 623km)

Potential RS Missions

GeoCarb
-ESD/ESSP
-LV: TBD (GTO/GEO)
-200kg instrument
LRD: 2024

ESCAPADE
-HPD
-LV: TBD (Mars)
-ESPA Standard
-2 SC to Mars
LRD: May 2024

TRACERS
-HPD
-LV: TBD (SSO)
-ESPA Standard
-2 200kg SC to SSO
LRD: 07/2024

ULTRASAT
-APD
-LV: TBD (G[illegible]O
-1200kg SC
LRD: [illegible]025

IN[illegible]JS
[illegible]SD/ESSP
LV: TBD
(500km 28.5deg)
-three 150kg SC
LRD: Oct 2026

PANDORA
-APD
-LV: TBD
LEO 500-600 SSO
6pm LTAN
-115kg SC
LRD: 11/2024

ASPERA
-APD
-LV: TBD
LEO 600-900 SSO
-21kg SC
LRD: 11/2024

StarBurst
-APD
-LV: TBD
LEO 500km
20-60 deg
-230kg SC
LRD: 01/2025

EVM-3 AO (INCUS)
-ESD/ESSP
-LV: TBD
LEO 500km 28.5 deg
3 SC (150kg each)
LRD: 2027

Future Primaries and Secondaries

AO/MOs

2027

EVI-6 & APD Pioneers20

2027-2028

APD MIDEX & MO AO

2028

HPD SMEX AO & MO

2028

APD Pioneers21

2028

HPD DYNAMIC AO
2 SC to 600km

SMD Missions: *Potential* Rideshare Opportunities

Note: Dates are estimates and subject to change, excess launch capacity on most flights still TBD

Mission	Org	LV Class	Trajectory	LRD	Rideshare Adapter	RPLs
GOES-U	JASD	Falcon-Hvy	GTO (8000x35000) ~10 deg	04/30/24	TBD	TBD - excess performance being evaluated
COSI	APD	TBD	LEO 550km 5deg	September 2025	TBD	TBD
Sentinel 6B	ESD	Intermed/Large (tbd)	LEO (1336km; 66deg (tbd)	Nov 2025	TBD	TBD
NEO Surveyor	PSD/PDCO	Intermed/Large (tbd)	L1 (C3 tbd)	May 2026	TBD	TBD
JPSS-3	JASD	Intermed/Large (tbd)	LEO SSO 13:30 MLTAN	2025 or 2027	TBD	TBD
INCUS	ESD	Small/Intermediate	500km 28.5 deg	Oct 2026	TBD	TBD
MUSE	HPD	Intermed/Large (tbd)	SSO 620km 97.9 deg 6am MLTAN	June 2027	TBD	TBD
GDC	HPD	Intermed/Large (tbd)	400km, 81-82 deg	May 2028	TBD	TBD
2021 MIDEX AO	APD	Intermed	TBD	NLT Dec 2028	TBD	TBD
HelioSwarm	HPD	Intermed	C3 = 2.75 km2/s2	2028/2029	TBD	TBD
DAVINCI+	PSD	Intermed/Large (tbd)	Venus (C3=18)	06/01/29	TBD	TBD
VERITAS	PSD	Intermed/Large (tbd)	Venus (C3=17)	tbd (2028/2030)	TBD	TBD

Public Mission List location: Small Spacecraft Virtual Institute – NASA Launch Portal https://www.nasa.gov/smallsat-institute
For NASA Internal ONLY

NASA SMD RS & SmallSat – Top 5 technical challenges

SC flexibility to meet Primary Launch Parameters

Minimized Launch Costs

- Early coupled loads analyses
  - 50-75Hz fundamental frequencies
  - Random Vibe – High frequencies from SX
- DSN coverage post SC separations – L1 vs LEO
- Contamination Control - every SC has a different set of requirements. (Instrument GN2 flowrate & humidity, **magnetic cleanliness**, silicone sensitivity, hydrocarbon, surface cleanliness, etc)
- Rideshare payload power-on for extended coast phases (thermal)
- On-board propulsion for NASA 'unique' orbits
  - vs relying on LV delta-v
  - Reliability and TRL of propulsion systems for deep space

Rideshare Challenges & Lessons Learned:

National Aeronautics and Space Administration

Challenges & Lessons Learned:

- •Utilize excess performance on NASA SMD Primary launches => RS Policy
- •NASA Science-unique orbits => VADR
  - •Promote expansion of commercial launch options for SmallSats with higher risk tolerance
- •Partnering with government and commercial providers for increased opportunities
- •Compatibility and DNH for reducing risks to all payloads
- •Mission flexibility for increasing launch opportunities and reducing costs

NASA SmallSat Launch Options

- •SMD Rideshare opportunities
- •LSP Commercial VADR launch contract for SmallSats for Dedicated Launch & Rideshare
  - *•VADR = Venture-Class Acquisition for Dedicated and Rideshare Launch Service contract*

Current Opportunities & S3VI Resources:

- NASA Launch Portal. (https://www.nasa.gov/smallsat-institute/launchportal)
- Upcoming SmallSat Mission solicitations. (https://www.nasa.gov/smallsat-institute/nasa-smallsat-opportunities)
- NASA SMD Rideshare Guide (https://www.nasa.gov/sites/default/files/atoms/files/smd_spa_rug_with_dnh_generic_2021dec15.pdf)

For questions about NASA launch opportunities or other potential rideshare opportunities, email:

hq-smd-rideshare@mail.nasa.gov

Backup

- NEW NASA LSP Launch Service Contract for higher risk tolerant missions – VADR
  - **V**enture-class **A**cquisition for **D**edicated & **R**ideshare
- Example SmallSat Rideshares – Pioneers & TRACERS
- GeoCarb Info (Large SC to GTO/GEO)

VADR - **V**enture-class **A**cquisition for **D**edicated & **R**ideshare

- NEW NASA LSP Launch Service Contract for higher risk tolerant missions
  - IDIQ to procure FAA licensed commercial launch services for Class D/high risk tolerant payload and streamlined CubeSat launch services
    - Less technical oversight (insight & approval) over the launch service than on nominal NLS-II launch services for less risk-tolerant SMD primary missions… i.e. limited LSP mission assurance
  - Launch providers bid either a dedicated or rideshare solution based on the particular mission's requirements.
    - Rideshare solutions can either be "Primary RS" or "Traditional RS"
      - Primary RS controls the orbit and the launch date; Traditional does not
  - Multiple Providers/Launch Vehicles
  - First flight not required to bid

VADR Contracts Awarded Initially

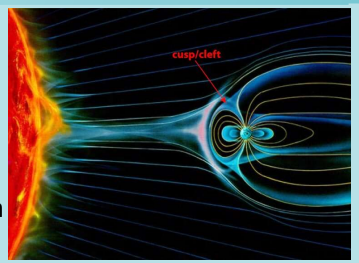
- ABL Space Systems
- Astra Space, Inc.
- Blue Origin Florida, LLC
- L2 Solutions, LLC
- Northrop Grumman System Corp.
- Phantom Space Corp.
- Relativity Space, Inc.
- Rocket Lab USA, Inc.
- Spaceflight, Inc.
- Space Exploration Technologies Corp.
- United Launch Services, LLC
- Virgin Orbit, LLC

Example SmallSat Rideshares - 2020 APD Pioneers

PANDORA	ESPA Mass: 115 kg Volume: 1.26m x 0.98m x 0.90m	Orbit: LEO SSO Altitude: 500-600km (preferred) / 450-600km (acceptable) Inclination: SSO (97.4-97.79 preferred; 97.03-98 acceptable) LTAN: 6pm (preferred) / 5am-7am and 5pm-7pm (acceptable) Launch date: October 2024	• ISO 8 • GN2 purge only thru mate/encapsulation • No propulsion
ASPERA	ESPA Mass: 59.2 kg Volume: 0.55m x 0.44m x 0.42m	Orbit: LEO SSO Altitude: 700-900km (preferred) / 530-850km (acceptable) Propulsion system will be used for orbit insertion and de-orbit. Inclination: 98.2-99.0deg SSO(preferred) / Any SSO (acceptable) LTAN: 6am/6pm dawn/dusk (preferred) /Any SSO (acceptable) Launch date: May 2025	• ISO 7 • GN2 Purge thru T-0: Grade 5 GN2 @ 0.02scfm • Indium propulsion. Solid state metal and inert at room temp.
StarBurst	ESPA Grande Mass: 299.7 kg Volume: 0.90m x 0.80m x 0.92m	Orbit: LEO Altitude: 363-536km (preferred) / 300-600km (acceptable) Inclination: 0deg (preferred) / 0-60 degrees (acceptable) Launch date: November 2024	• IEST-STD-CC1246E: Visibly clean; highly sensitive + UV (VCHS+UBV) level of cleanliness. • No propulsion

SMD Rideshare Office – Class D Launch Options Assessment - TRACERS

TRACERS Mission Information



Helio SMEX
Date of Selection: Nov 5, 2021

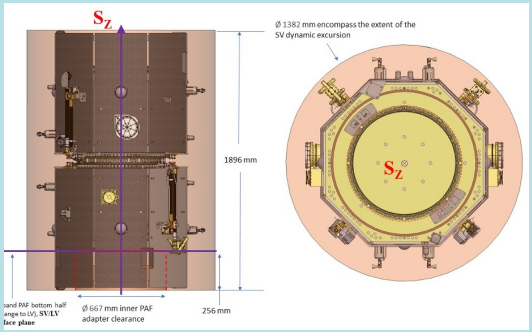
Two(2) Spinning SmallSats flying in formation
Mass: 131-200 kg each
Volume: .948m x 1.382m diam

Orbit: Polar SSO
Altitude: 500km circular
Inclination: 97.5
MLTDN 10:30 (preferred)… 02:30 (secondary)… can do 06:00 with additional TRACERS

Mission Classification & Timelines

7120.5 Mission
~$115 PI Cost Cap (not including NASA provided launch)

PDR: Oct 2021
KDP-C: March 31
CDR: July 2022
Launch date: NET July 2024

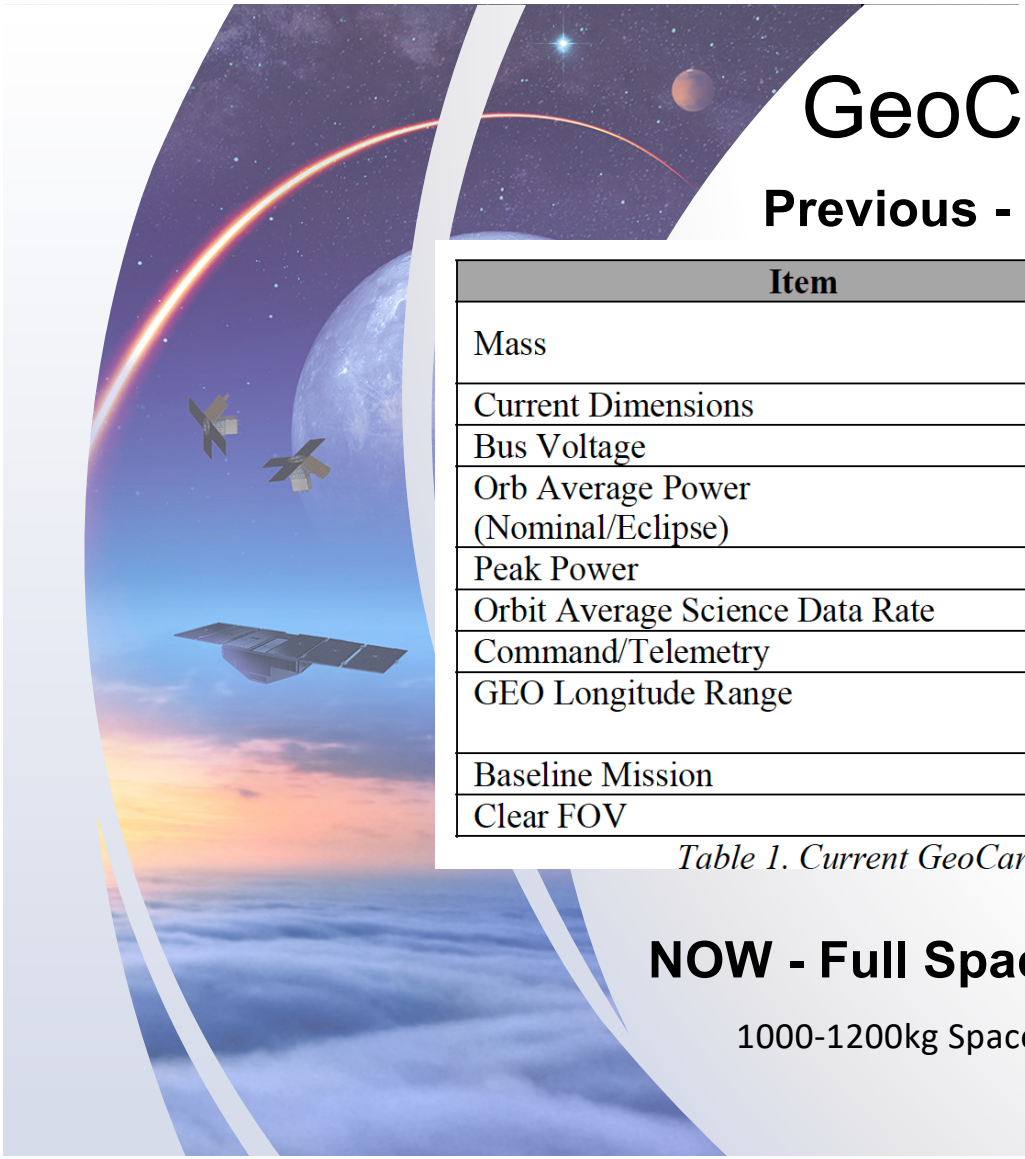


Mission Uniques:

- Powered-on at launch and during ascent
- GN2 Purge
- Spin separation & thermal roll requirements
- Free molecular Heating requirement
- Contamination monitoring inside the fairing
- Spare EGSE and umbilical connectors
- Hydrazine Fueling
- Dedicated PPF
- MLTDN preference

OGA Rideshare Options

☐ USSF : nothing yet



GeoCarb – late 2024

Previous - Hosted Instrument Option

Item	Requirements/Parameters
Mass	Current Best Estimate (CBE): 155 kg Maximum Expected Value (MEV): 179.5 kg
Current Dimensions	70 in (TBD) x 50.2 in x 44.3 in (door deployed)
Bus Voltage	100 Vdc
Orb Average Power (Nominal/Eclipse)	CBE: 393/402W MEV: 518/565W
Peak Power	CBE: 600W
Orbit Average Science Data Rate	10 Mbps (fixed rate; redundant LVDS channels)
Command/Telemetry	MIL-STD-1553B
GEO Longitude Range	Desired: 85°W +/-10° Allowable: 65°W to 105°W
Baseline Mission	3 years + 60 days commissioning
Clear FOV	+/- 10.18 degrees E-W by +/- 9.42 degrees N-S

Table 1. Current GeoCarb Mission Hosting Requirements/Parameters

NOW - Full Spacecraft Rideshare Opportunity

1000-1200kg Spacecraft Bus (“Caketopper” or “Side-by-Side)
GTO launch

NASA HQ
Science Mission Directorate
Rideshare Office (SRO)

For SMD Rideshare inquiries, contact us at:
HQ-SMD-Rideshare@mail.nasa.gov

Aly Mendoza-Hill

Alan Zide

David Cheney

Brooke Burns