QUICK INTRO TO THE SMALL SPACECRAFT TECHNOLOGY PROGRAM

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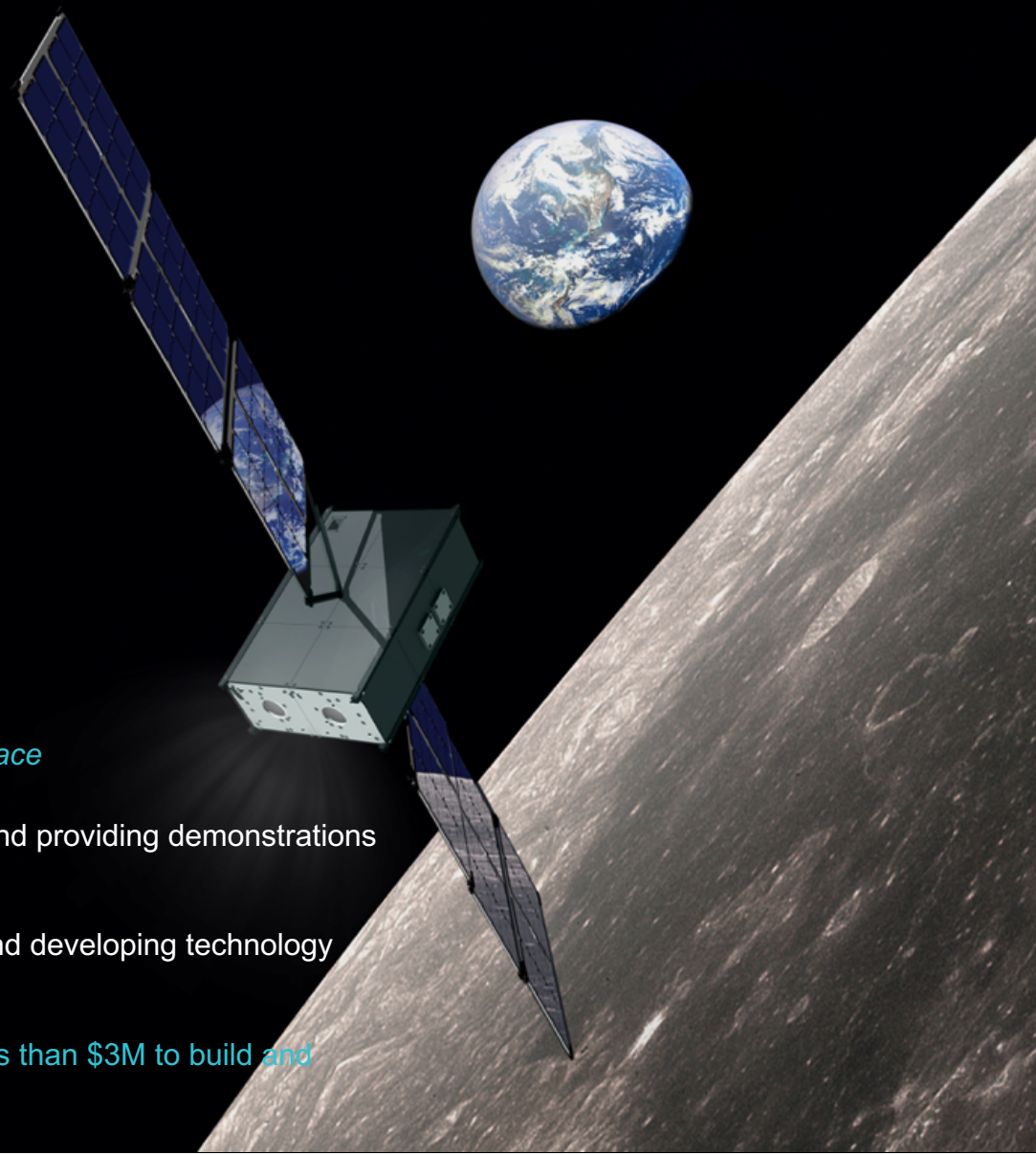
WHY Small Spacecraft Technology Program

STMD's Small Spacecraft Technology program expands the ability to execute unique missions through rapid development and demonstration of capabilities for small spacecraft applicable to exploration, science, and the commercial space sector.

SST is executed as a research and technology program, managed in accordance with **NPR 7120.8A** NASA Research and Technology Program and Project Management Requirements

SST spans the heart of the TRL spectrum with both **Technology Development** (TRL 3 to 5) and **Technology Demonstration** (TRL 6 or 7) projects. Technology Demonstration projects test technologies in relevant environments on both the ground and in space.

Project Managers execute projects at academic institutions, in private sector, NASA Centers, or as public-private cooperative agreements.



My editorial commentary:

We believe challenging how NASA explores by using Small Spacecraft to accelerate the pace of space

- We make tools for NASA's unique challenges, investing in pre-commercial technology, and providing demonstrations that can be on orbit within 24 months from Authority to Proceed.
- We focus on developing technology **FOR** small spacecraft (power, prop, system level) and developing technology **WITH** small spacecraft (NRHO demo, distributed system, comms architecture).
- SST strives to go from ATP to ILC within 24 months, with 2 new projects per year, for less than $3M to build and operate each spacecraft.

HOW do we conduct our projects

7120.8 Program Management is for Research and Technology projects:

- Technology projects attempting to solve a specific problem or address a practical need
- Research Projects performing basic research or applied research with unpredictable outcomes

Success, Failure, Risk:

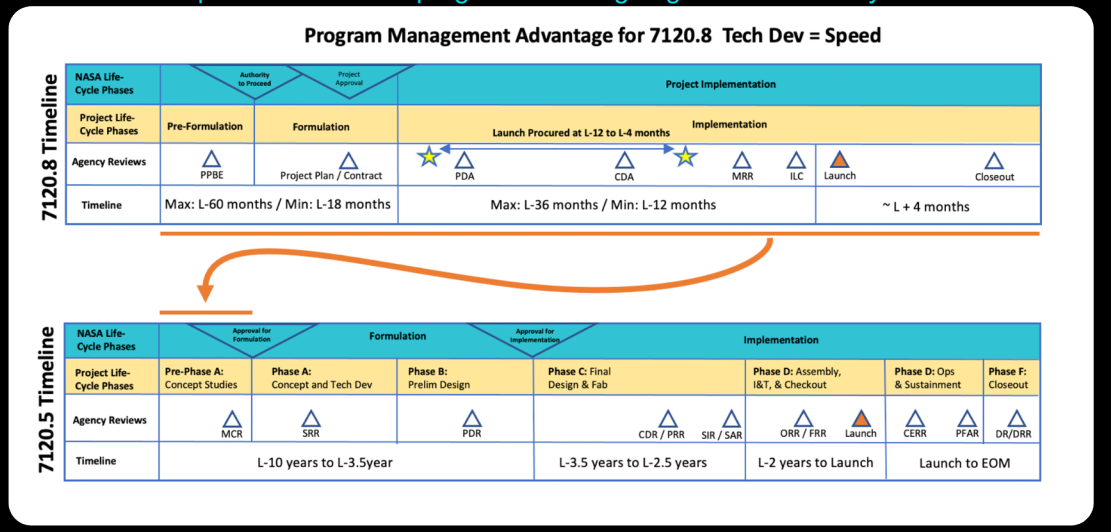
Mission Success can be defined as creating a new capability, investigating the feasibility of a new architecture, discovering capability limits, or exploring the trade space.
Mission Failure is defined as flight test data was not obtained.

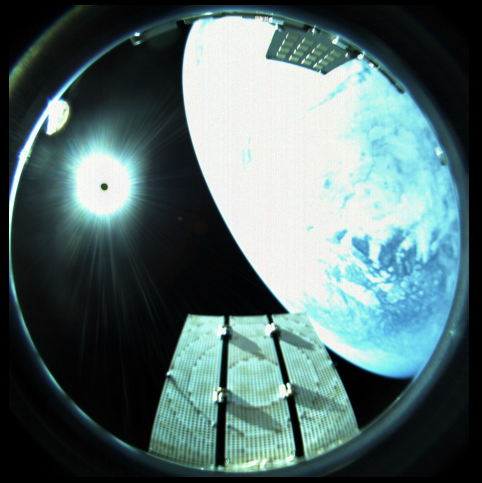
Independent assessments at key decision points replace reviews in accordance with a risk-tolerance approach. Economically appropriate efforts are made to understand risks, but cost and schedule are not used to eliminate all uncertainty in technical risks. SST invests in projects that have high-risk/high-reward, acknowledging only a minority will be transformative.

SST invests in Technology Gaps:

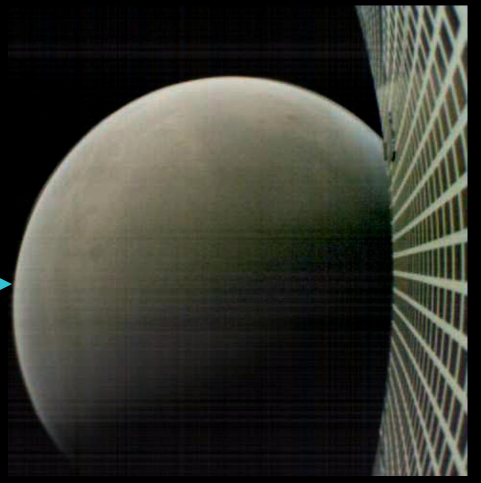
Supports NASA's strategic efforts to identify future investment. Most recently, "2020 RFI on Technology Gaps to desired future states" as part of the STAR process.

7120.8 Project Life-Cycle allows for a risk reduction mission to be flown within the formulation phase of a 7120.5 program. Allowing larger mission to buy down technical risk.





ISARA Reflectarray



MarCO Reflectarray at Mars

Early Investment in ISARA to lead to MarCO capability

WHAT we are doing currently at SSTP 2021

nasa.gov/directorates/spacetech/small_spacecraft

EXPLORE SPACE TECH
WITH SMALL SPACECRAFT

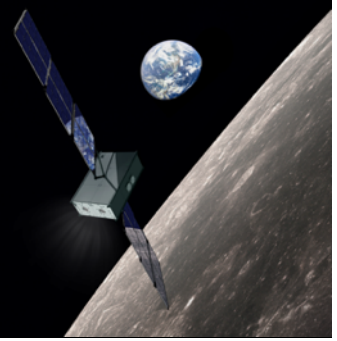
FUTURE MISSIONS IN PLANNING FOR 2022+
Enabling technologies for small missions that support the Sustained Lunar Presence and Next Generation Mission Architectures for Scientific Discovery and Space Commerce

Including:

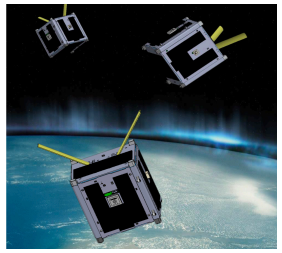
- Systems for Distributed Missions and Sensor Webs
- High dV Propulsion for Small Spacecraft
- On Orbit Maneuvering Vehicles & Transfer Stages
- Modular and Interoperable Small Spacecraft Platforms

SSTP PM's in the special sessions:

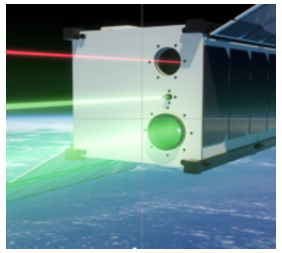
- V-R3X/ PACE (Anh Nguyen)
- BioSentinel & EDSN/Nodes (Rudy De Rosee)
- CAPSTONE (Elwood Agasid)
- PTD (David Mayer)
- Public-Private (Ali Guarneros Luna)
- University Partnership (Jim Cockrell)



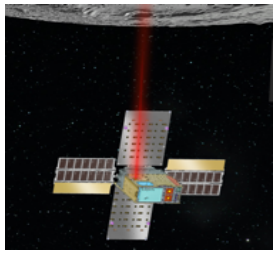
Distributed Mission



Optical / Solar Sail

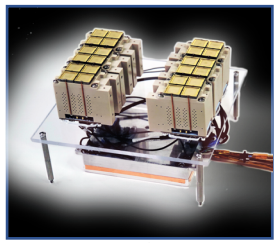


Lunar Mission



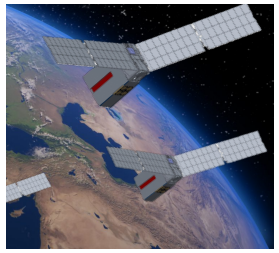
Demo Mission

Public / Private



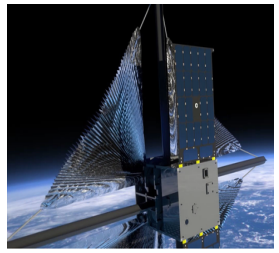
V-R3x / PACE (Series)
Demonstrate new small spacecraft subsystems with suborbital and orbital flights 6 months later. V-R3x (3x1U) launched 1/2021, PACE-1 (1x6U) Launch NET 6/2021
*V-R3x will post process topology on the ground,

Starling Distributed Spacecraft Missions
Low-power spacecraft ranging, formation topology recovery*, and coordinated autonomous operations. Starling (4x6U) launch NET 4/2022
*Starling will do so onboard and include propulsive formation flight



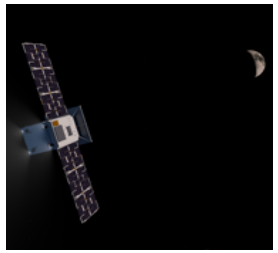
CubeSat Laser Intersatellite Crosslink (CLICK)
Demonstrate optical crosslink and timing exchange between two small spacecraft at a data rate of 20 Mbps and range of 580 km. CLICK A downlink demonstration launch NET 7/2021, CLICK B/C crosslink launch NET 5/2022

Advanced Composites Based Solar Sail (ACS3)
Demonstrate new composite booms to enable mission capable solar sails.
Launch NET 10/2021



Lunar Flashlight
Characterize lunar in-situ resource utilization potential. Measure quantity and distribution of surface ice deposits in lunar south pole cold traps with a compact laser spectrometer. Artemis-1 launch NET 9/2021

CAPSTONE
Demonstrate how to enter into and function in a near rectilinear halo orbit around the Moon and demonstrate spacecraft-to-spacecraft navigation. Dedicated small launch vehicle NET 9/2021



Pathfinder Technology Demonstrator (PTD) Series
Demonstrate new small spacecraft subsystems. Leverages public-private partnerships, commercial spacecraft and services. PTD-1 launched 1/2021
(PTD-1) HYDROS water-based thruster (-2) HyperXACT attitude determination and control (-3) TBIRD High bandwidth laser communications (-4) LISA-T high-power low-volume solar array.

CubeSat Proximity Operations Demonstration (CPOD)
Demonstration of rendezvous, proximity operations and docking using two 3U CubeSats.
Delayed Launch NET 12/2021

Propulsion and Auto-Navigation Public-Private Partnerships
Micro-Hall effect Courier Solar Electric Propulsion with ExoTerra Resource. Fiber-fueled Dual Propulsion Experiment (DUPLEX) with CU Aerospace. Tiled Ionic Liquid Electrospray (TILE) propulsion with Accion. X-NAV Autonomous Navigation Demonstration with Blue Canyon.