
National Aeronautics and Space Administration
NASA
NASA Flight Opportunities
Advancing Medical Technology with Suborbital Rocket-Powered Vehicles
George Pantalos, Ph.D., University of Louisville
Kathleen Karika, Virgin Galactic
Ryan Dibley, NASA's Flight Opportunities Program
Community of Practice Webinar Series – June 7, 2023
Session will start at 10 a.m. PT – Please mute your microphone and turn off your camera
www.nasa.gov

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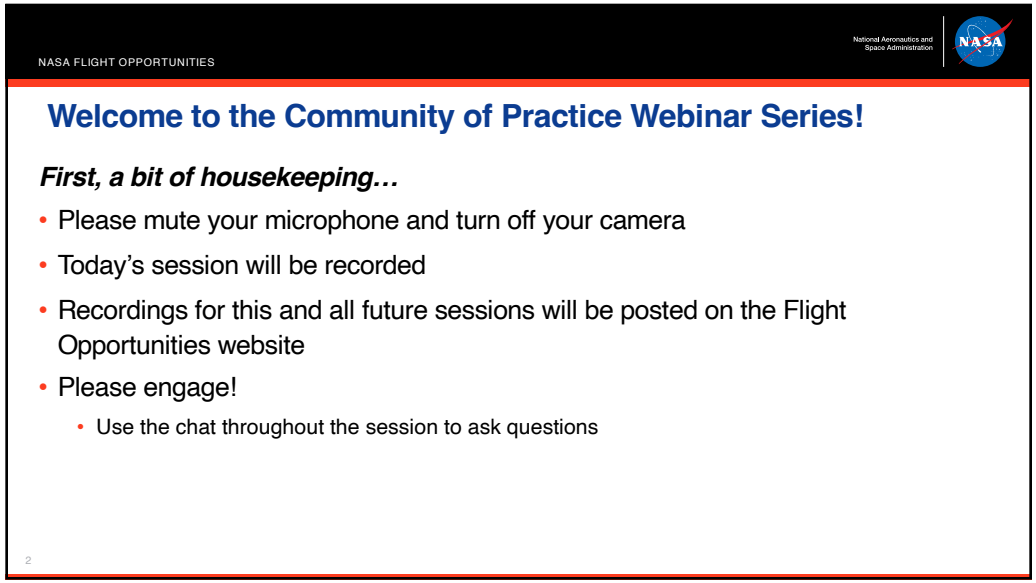
NASA FLIGHT OPPORTUNITIES
National Aeronautics and Space Administration
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Welcome to the Community of Practice Webinar Series!
First, a bit of housekeeping…
• Please mute your microphone and turn off your camera
• Today's session will be recorded
• Recordings for this and all future sessions will be posted on the Flight Opportunities website
• Please engage!
• Use the chat throughout the session to ask questions
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NASA FLIGHT OPPORTUNITIES

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Welcome to the Community of Practice Webinar Series!

Flight Opportunities hopes these webinars will enable researchers, program staff, and flight providers to connect informally and share information

- Designed to distill and share the most important lessons learned to:
  - Increase the impact of suborbital flight tests
  - Transfer best practices
  - Optimize the experience of current and prospective program participants
- Part of a broad effort to capture, organize, and communicate lessons learned by suborbital researchers
- An opportunity to hear from subject matter experts on best practices for preparing for suborbital flight tests

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Join us for future Community of Practice webinars!

Subscribe to our newsletter for updates on future webinars!

https://www.nasa.gov/directorates/spacetech/flightopportunities/newsletter

Future webinars

- Webinars are held 1st Wednesday of each month at 10 a.m. PT
- Topics will be announced in the Flight Opportunities newsletter and website
- Session recordings will be posted on the Flight Opportunities website
- Let us know session topics you would like to see covered

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Today's Speakers

George Pantalos, Ph.D.
Professor, Cardiovascular & Thoracic Surgery, Bioengineering
University of Louisville

Kathleen Karika
Director, Research Operations and Government Affairs
Virgin Galactic

Ryan Dibley
Campaign Manager
NASA's Flight Opportunities Program

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112-15:28:16.479
Boom
X
U of L & Cornell
Were Here!
George Pantalos, University of Louisville
(and a constellation of students and collaborators!)
Virgin Galactic

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Disclosure: Certain members of this panel
have been caught partying in the desert!
Virgin Galactic

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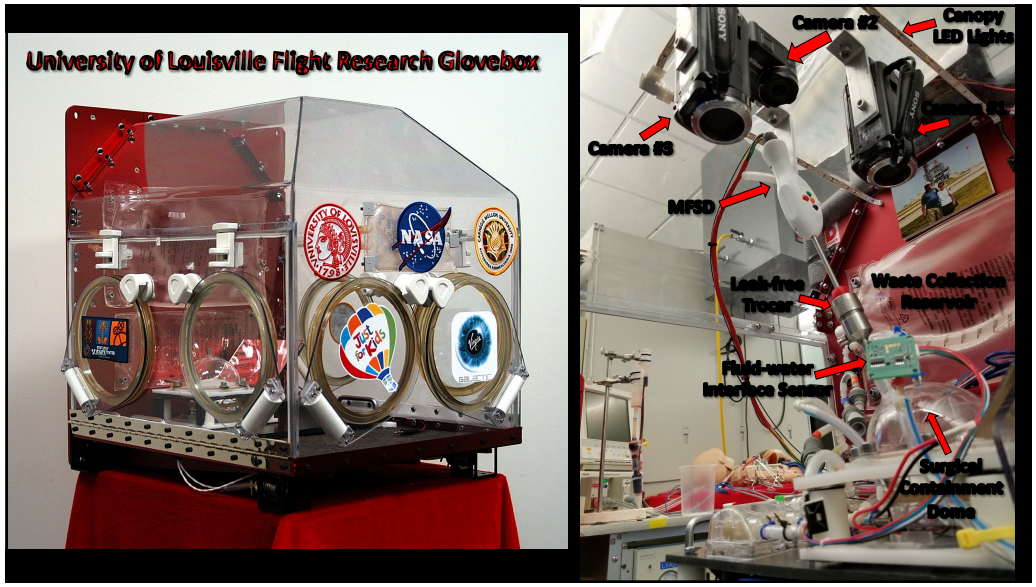
University of Louisville Flight Research Glovebox
Camera #2
Canopy LED Lights
Camera #3
MFSD
Leak-free Trocar
Waste Collection Reservoir
Fluid-water Interface Sensor
Surgical Containment Dome

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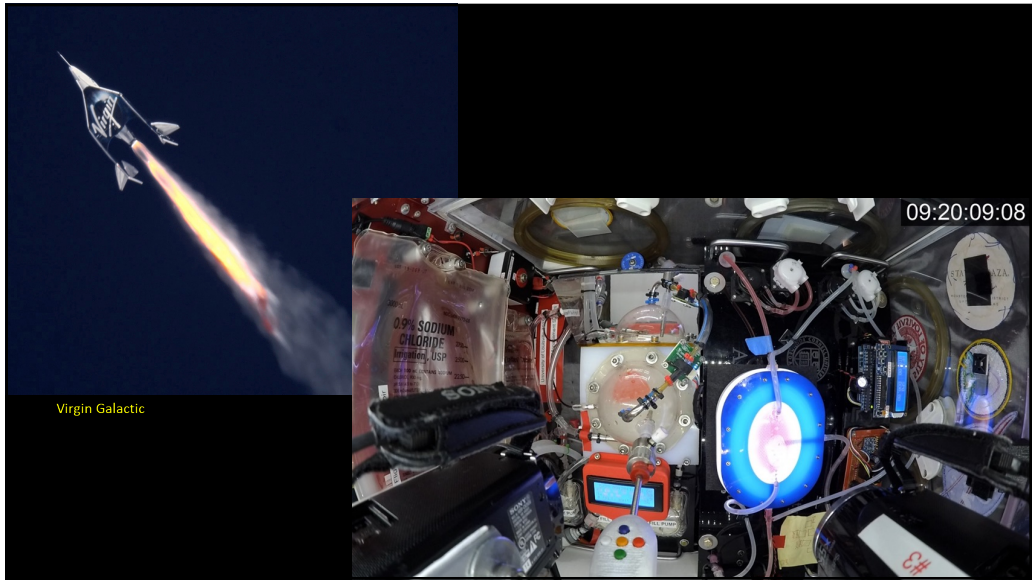
Virgin Galactic
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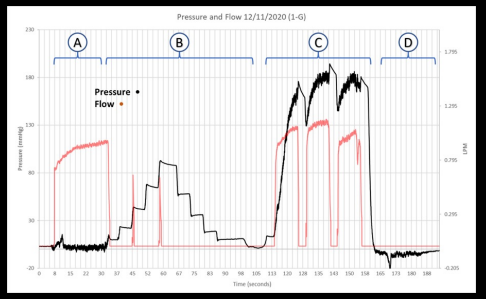
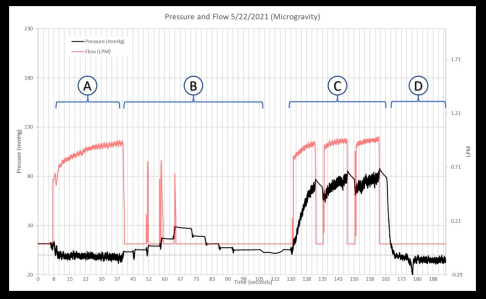
U of L SFMS In-Flight Protocol: 1-G and µ-G Data

1-G



µ-G



A = Dome Filling B = Pressure Ramp C= Dome Purging D = Dome Emptying

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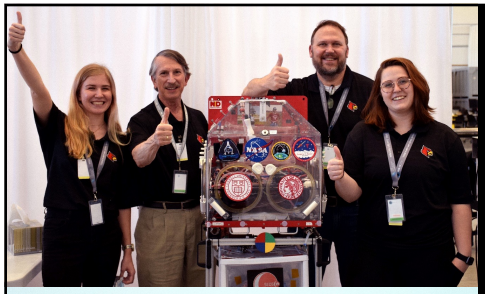

Next Steps

-Add vision and cautery to the functional capabilities of the multifunction surgical device

-Add a bleeding wound model for the containment dome to cover

-Regulate dome pressure ramp to desired pressure, not by volume added increments

-Evaluate device and operator function during parabolic flight

-Evaluate suborbital spacecraft cabin and glovebox for compatibility to conduct a human-tended evaluation

-Conduct a human-tended evaluation during suborbital flight

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Lessons Learned From Our SubO Experience

- Your NASA FO payload manager and the VG payload engineers can provide lots of good guidance
- Prior to flight preparations, 4 visits to Virgin Galactic at Mojave Air and Space Port/16 parabolic fights
- Payload Information Packet page numbers = 344 (Beaucoup Revisions)
- Number of weekly telecons with payload engineers = 2 years worth
- Number of flight re-schedules = not enough fingers and toes
- Number of trips to Spaceport America = 2
- Was the flight successful and was useful data obtained = **YES!!!!!**
- Would you do it again = **YES!!!!!** (Next flight with a different experiment is already in the works!)

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Suborbital Flight Assessment of Preserved Red Blood Cells for Transfusion Therapy in Reduced Gravity

Technology Need

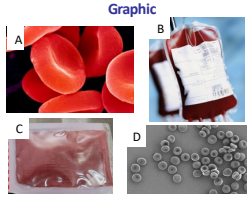
Technology Need: Radiation induced anemia is a hazard to all astronauts who travel to the Moon and spend extended periods of time involved in lunar surface operations. Blood transfusion is an essential component in the treatment of anemia. Currently, there are no whole blood or red blood cell (RBC) storage and transfusion capabilities appropriate for exploration spaceflight due to biological limits on storage duration and the power and mass required for storage.

Technology Relevance: The proposed use of dehydrated red blood cells prepared pre-flight offers the advantage of long-term (years) blood storage at ambient spacecraft temperature and rehydration with sterile saline, making storage, handling, and restoration of the red blood cell source a reasonable and appropriate option for extended exploration spaceflight and lunar surface operations.

Test Apparatus

The test apparatus contains four units (2x2 above) that can automatically rehydrate dehydrated red blood cells, assess oxygen transport status, and preserve cells for post-flight analysis during the period of reduced gravity. A glovebox will contain the test units, cameras, and automation controller needed for the red blood cell rehydration evaluation.

Graphic



(A) Healthy red blood cells (RBCs). (B) Transfusion unit of RBCs. (C) Freeze dried RBC powder (100 ml). (D) Scanning electron microscopy images of RBCs that were rehydrated after 6 weeks of dry storage at ambient temperature.

Flight Requirements/Objectives

Flight Requirements: One suborbital flight campaign to an altitude of at least 80 Km will provide sufficient time to conduct the automated assessment of red blood cell rehydration and physiological status in reduce gravity. Flight readiness by March, 2024.

Flight Technical Objectives:

(1) Evaluation of the ability to acceptably rehydrate the dehydrated red blood cells in a relevant reduced gravity environment
(2) Evaluation of the anatomic morphology (shape) and physiologic function of rehydrated red blood cells during reduced gravity

Technology Advancement

The current state of the dehydrated red blood cells is at a TRL of 5-6. Successful completion of the proposed flight evaluation program will advance the preserved red blood cells for transfusion therapy to a TRL of 7.

Technology Concept

We have developed a process to preserve red blood cells (RBCs) for long-term storage in a dried state. We us sonoporation to load RBCs with the protective compound trehalose that is used by animals that naturally survive complete desiccation at room temperature. Our biomimetic approach allows for the preservation of RBCs without cooling after loading and dehydrating. Rehydration is achieved by simply adding sterile saline to the dried RBCs.

Technology End Users

Technology End Users for Spaceflight and Earth-bound Applications: Crew Medical Officers would be the end users for the preserved red blood cells when treating radiation-induced anemia or an in-flight trauma; physicians on Earth (particularly in extreme and remote conditions) needing blood for transfusion therapy for trauma and other illnesses.

Technology Applicability: Technology that enables long-term survival in the extreme Lunar Environment

May 2022

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GALACTIC
Introduction and Overview
Kathleen Karika
June 2023

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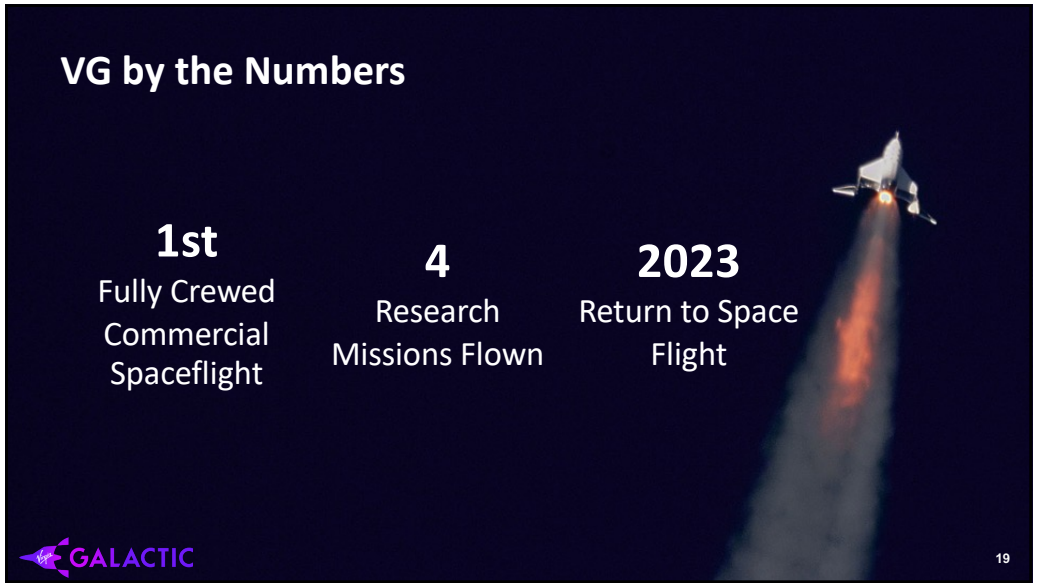
VG by the Numbers
1st
Fully Crewed Commercial Spaceflight
4
Research Missions Flown
2023
Return to Space Flight
GALACTIC
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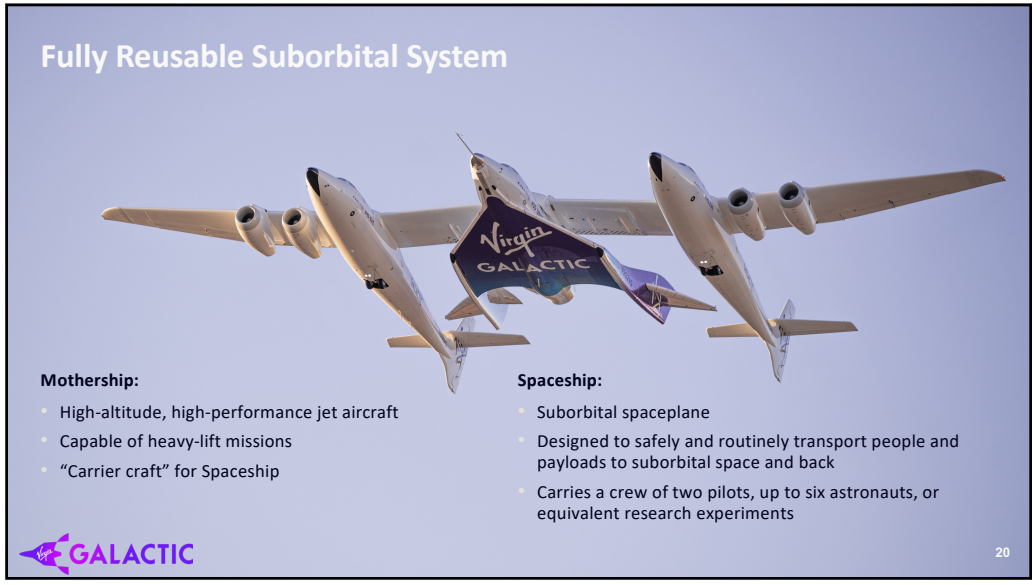
Fully Reusable Suborbital System
Virgin GALACTIC
Mothership:
High-altitude, high-performance jet aircraft
Capable of heavy-lift missions
"Carrier craft" for Spaceship
Spaceship:
Suborbital spaceplane
Designed to safely and routinely transport people and payloads to suborbital space and back
Carries a crew of two pilots, up to six astronauts, or equivalent research experiments
GALACTIC
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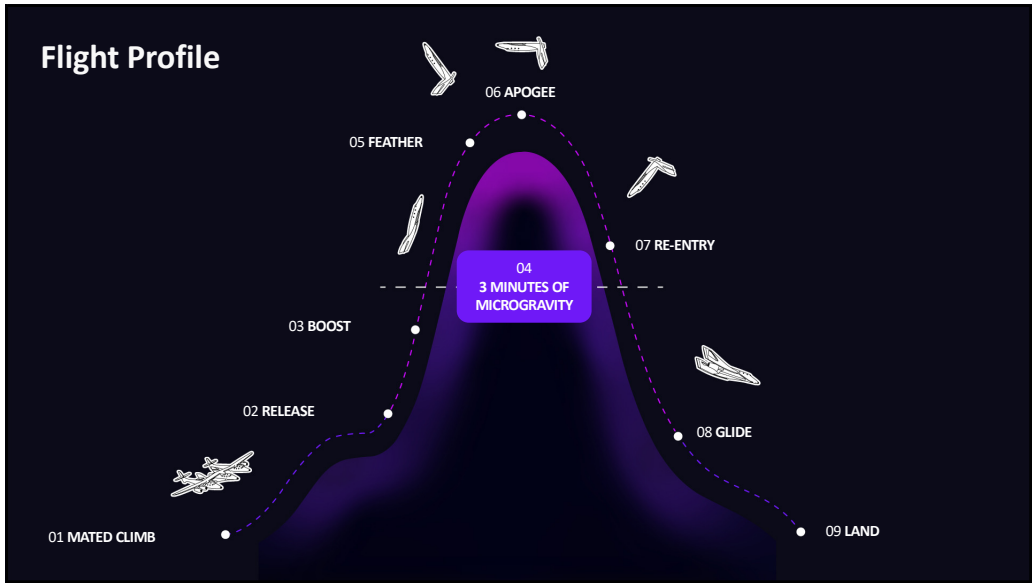

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Operations

- Training, preparation, and payload integration at Spaceport America
- Timely payload access with late load and early unload options
- Full-size cabin mockup for testing and training

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Research Offerings

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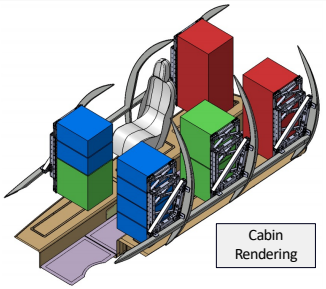
Payload Specifications

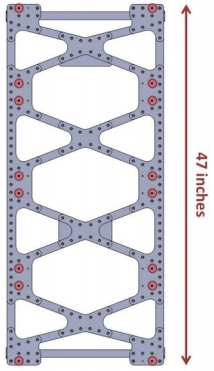


Cabin Rendering

Locker Parameters

Type	Locker Dimensions	Volume (MLEs)	Maximum Weight	Maximum Power
Single	18.50" W x 11.25" H x 21.50" D (47.0cm W x 28.6cm H x 54.6cm D)	1	50 lbs. (23 kg)	50W
Double	18.50" W x 23.00" H x 21.50" D (47.0cm W x 58.4cm H x 54.6cm D)	2	100 lbs. (45 kg)	100W
Triple	18.50" W x 34.75" H x 21.50" D (47.0cm W x 88.3cm H x 54.6cm D)	3	150 lbs. (68 kg)	100W
Quad	18.50" W x 46.50" H x 21.50" D (47.0cm W x 118.1cm H x 54.6cm D)	4	200 lbs. (91 kg)	200W

Payload Rack Hardware



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Previously Flown Research Payloads
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Research Process Summary
Pre-Contract
Post-Contract
Payload Information Form
NDA
SOW
Contract
General Information
Safety
Logistics
Engineering Review
Management Review
On-Site Inspection
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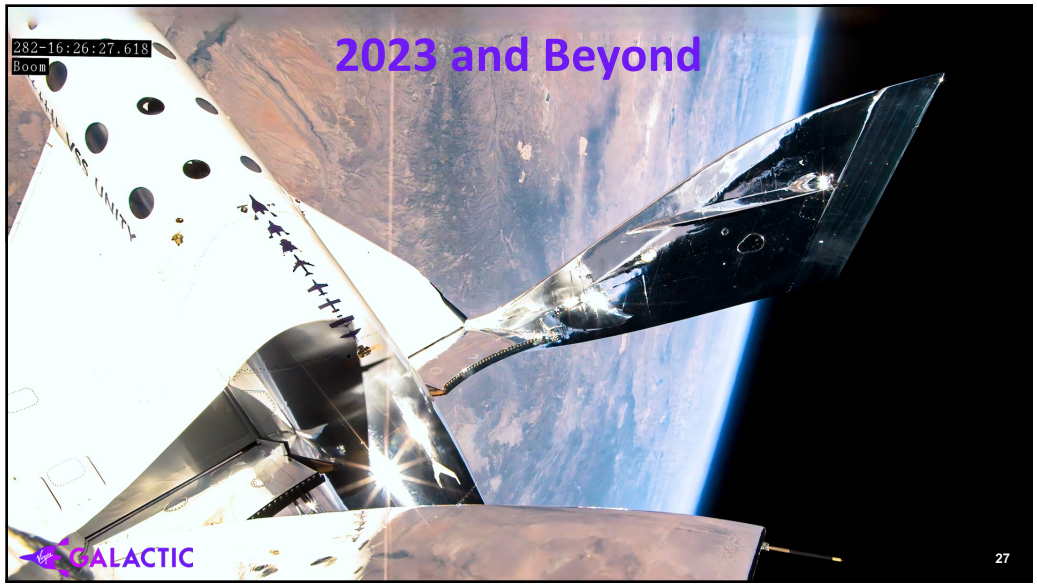
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Boom
2023 and Beyond
GALACTIC
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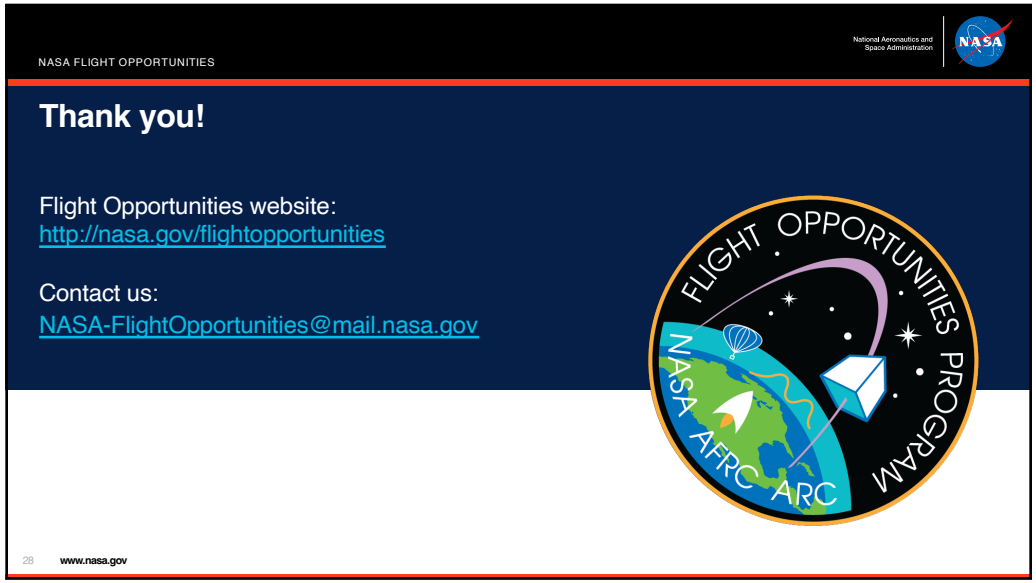
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