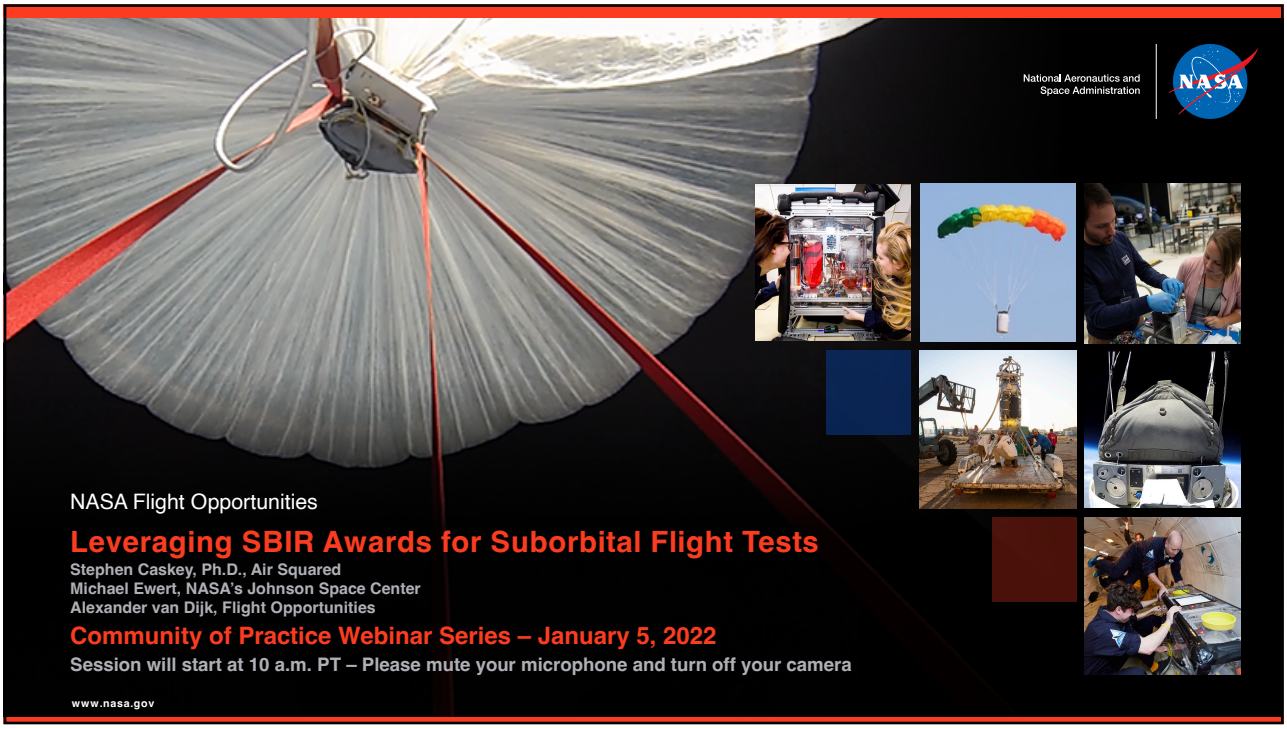

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NASA FLIGHT OPPORTUNITIES

National Aeronautics and Space Administration

NASA

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 session will be posted on the Flight Opportunities website
- Please engage!
  - Use the chat throughout the session to ask questions

2

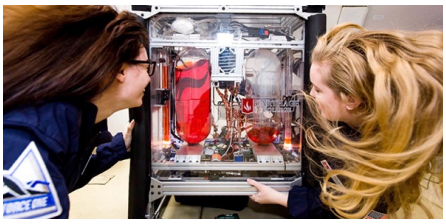
2

NASA FLIGHT OPPORTUNITIES

National Aeronautics and Space Administration

Flight Opportunities Mission

The Flight Opportunities program facilitates **rapid demonstration** of promising technologies for space exploration, discovery, and the expansion of space commerce through **suborbital testing with industry flight providers**.



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NASA FLIGHT OPPORTUNITIES

National Aeronautics and Space Administration

Join us for future Community of Practice webinars!

Watch our website and newsletter for next month's topic

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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NASA FLIGHT OPPORTUNITIES

National Aeronautics and Space Administration

Today's Speakers

Stephen Caskey, Ph.D.
Thermal Systems Engineer
Air Squared

Michael Ewert
Engineer I Deputy Project Manager
NASA's Johnson Space Center

Alexander van Dijk
Technologist
Flight Opportunities

5

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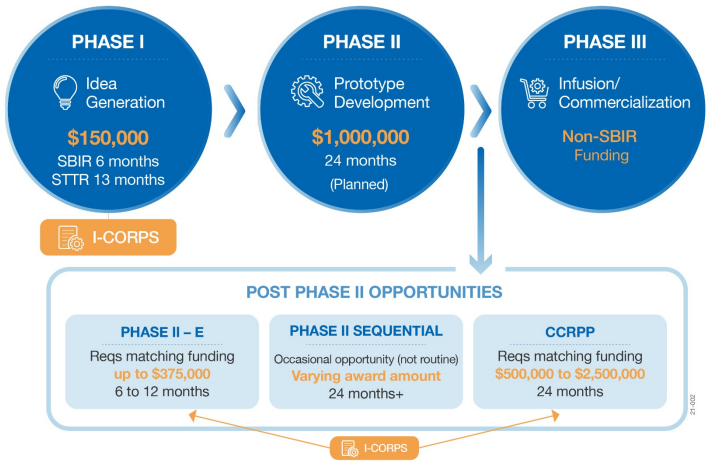
SBIR Overview - What exactly do I get?

Up to $1.15 million for Phase I and II and nearly $3 million or more for Post Phase II opportunities!



Note: The 2022 Phase II funding amount is planned to increase to $1 million from $750,000. This is dependent on the final budget appropriated by Congress.

NASA SBIR/STTR Program | **sbir.nasa.gov**

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How does it work?

Note: A Federal agency may enter into a Phase III agreement at any time with a Phase I or Phase II awardee.

Note: Dates are subject to change. For the latest dates, please visit our website's "Schedule & Awards" page.

NASA SBIR/STTR Program | **sbir.nasa.gov** 7

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2022 NASA SBIR/STTR Solicitations

January 6 – March 9, 2022

Changes from previous years:

- Phase I funding will increase from $125,000 to $150,000
- SBIR and STTR will be split into separate solicitations
- Phase II requirements will no longer be part of the Phase I solicitations
  - Phase II submissions details will be available to Phase I awardees toward the end of their period of performance

NASA SBIR/STTR Program | **sbir.nasa.gov** 8

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Whirlpool CORPORATION
Air squared
Herrick Laboratories PURDUE UNIVERSITY

NASA SBIR PHASE II-E

Vapor Compression Refrigeration System for Food Storage on Spacecrafts

NASA Flight Opportunities - SBIR/STTR Community of Practice

01/05/2022

Air Squared Inc | Purdue University | Whirlpool Corporation

1/10/22

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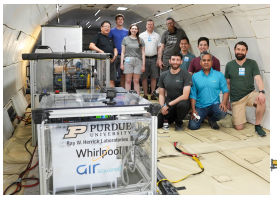
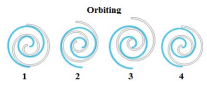
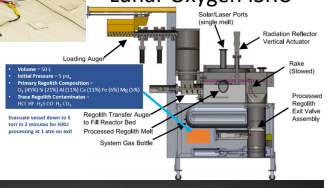
Overview of Parabolic Flight Tests

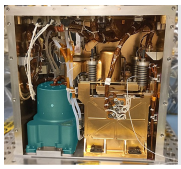
- Project Members
  - Air Squared – **SBIR Prime**
    - Oil-free scroll hardware
    - Prior NASA Projects
      - Phase I – 7 completed
      - Phase II – 4 completed
      - Phase II-E – 1 completed
    - ISS Demonstration Refrigerator
  - Purdue University – **SBIR subcontractor**
    - Liquid flooded evaporator investigation
    - Highly instrumented benchtop system
  - Whirlpool Corporation – **Phase II-E investor**
    - Supported ISS Demo design and any issues encountered during flights
  - Johnson Space Center – **Phase II-E investor**
  - Armstrong Flight Opportunities – **Phase II-E Investor**

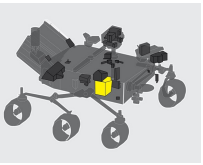




Lunar Oxygen ISRU







Mars 2020 Moxie

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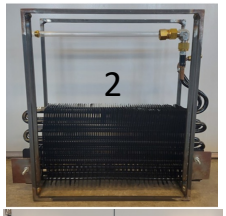
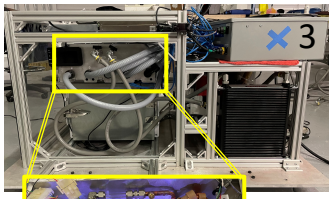
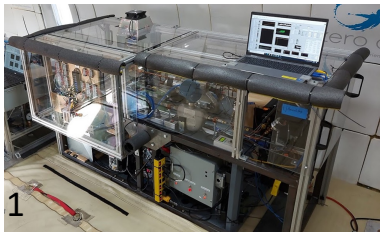
Overview of Parabolic Flight Tests

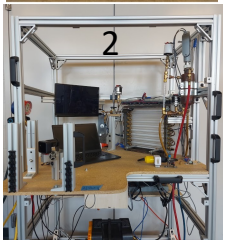
- Flew three separate experiments with three investments to create Phase II-E

1. Complete VCC
2. Transparent Evaporator
3. ISS Refrigerator









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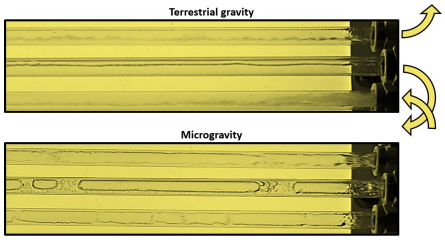
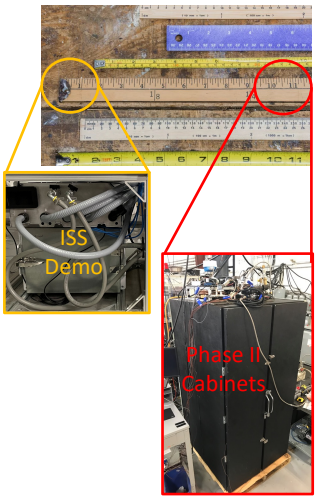
Vapor Compression Cycle Technology After Parabolic Flights

- Numerous (at least 4) journal publications generated sharing flight results
- Two-phase flow in evaporator transition into flow regime during microgravity and aids compressor ingesting only vapor
- Created VCC scaling approach to communicate requirements on larger storage volumes
- Seeking NASA contractor to support design iteration to fly small ISS refrigerator on station for continuous microgravity operation





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Key Lessons Learned

- Completed assembly with 80-20 flight structure
- Installing onto Zero-G Plane
- Completed installation with Purdue test stands in background

1/10/22

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Key Lessons Learned

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Key Lessons Learned

- Started Phase II-E plans early Q6 during Phase II
- RPP required for Zero-G
  - Engaging early was extremely beneficial
  - First experiments flown with pressurized refrigerant
- Ground fault circuit breaker caused issues with custom built stands
  - Should be removed on future flights
  - Replicate Zero-G flight equipment as much as possible when conducting ground tests

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Whirlpool CORPORATION

GIR squared

Herrick Laboratories PURDUE UNIVERSITY

Thank You!

Transition to Panel

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NASA FLIGHT OPPORTUNITIES

National Aeronautics and Space Administration

NASA

Thank you!

Flight Opportunities website:
http://nasa.gov/flightopportunities

Contact us:
NASA-FlightOpportunities@mail.nasa.gov

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