

# NEW DISCOVERIES

Compiled by the ISSNL UAC  
Technology Development Subcommittee  
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# SUMMARY: FREE-FLYER CAPTURE IN MICROGRAVITY WITH ASTROBEE & REACCH

## What is being investigated

- Physics interactions of a free-flyer attempting to physically grapple an uncontrolled, unprepared, free-floating object
  - Material interactions when securing objects having different surface materials, finishes, and overall geometries
  - Robotic control authority when subjected to 6DOF
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## Why it is important

- Many current and future space assets require external servicing at end of life, necessitating secure grapple and relocation, whether prepared or unprepared
- Continued growth of space industry exacerbates the need for in-space servicing, assembly, manufacturing, and general asset relocation capabilities
- Accurately testing and demonstrating technologies involving multiple objects moving in 6DOF is extremely difficult and cost-prohibitive on the ground as opposed to in orbit

# SUMMARY: FREE-FLYER CAPTURE IN MICROGRAVITY WITH ASTROBEE & REACCH

Number of Flights: 1 flight to ISS

Number of Projects: 6 technical demonstration sessions

Launch Flight Date: November 4, 2024

Return Flight/Date: Scheduled May 22, 2025

## Why it is important:

Increased need for in-space servicing, assembly, and manufacturing including general relocation of assets in space highlights the need to demonstrate technologies capable of grappling both prepared and unprepared objects in microgravity

## Summary findings:

1. Valuable insight into variations between motion profile of hardware in 1g vs in microgravity, allowing extrapolated prediction of future iterations
2. Study of different approach angles, velocities, alignments, tumble rates, and the impact of each upon success of capture
3. Determination of possibility to affect capture efficacy via parameters controlled via software vs hardware

## Implications for long-duration space travel and or implications for life on earth

- Preservation of space-based assets that enable technologies used on the ground (weather prediction, positioning and navigation, communications, financial transactions)
- Maintenance of orbital freedom to move by preventing cluttering of derelict assets and debris objects

# EXAMPLE: MEDICINE IN SPACE

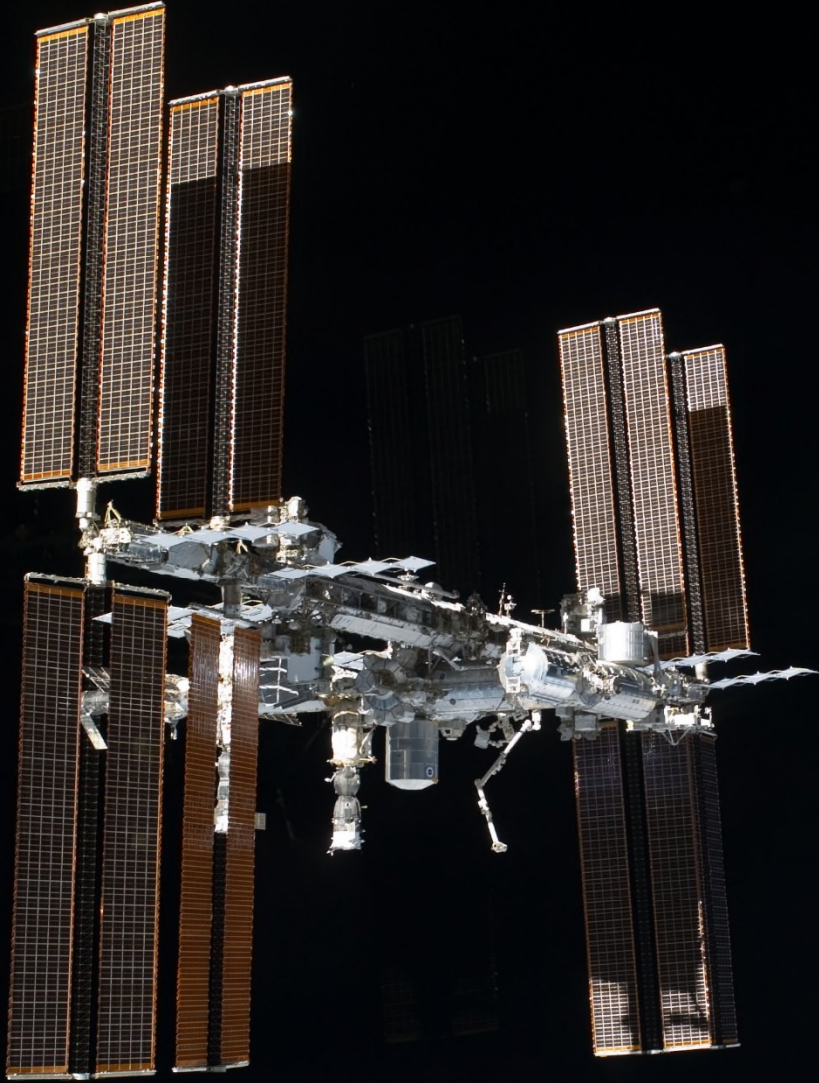
## What is being investigated

- Vision science and neuroscience in space; spaceflight-associated neuro-ocular syndrome
- Muscle and bone loss in LEO
- Cancer biology in LEO
- Cell assembly in space

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## Why it is important

- Cell signaling behavior is affected in LEO changing astronauts' disease susceptibility
- Drug efficacy on earth and LEO are different
- Space medicine advances are needed for long duration space travel



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# SUMMARY: SOCCER IN SPACE

## What is being studied and why it is important

- Spin rate degradation in still air – an impossible measurement on Earth
  - Spin axis stability
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## Why it is important

- Unique datapoint to ground and contextualize a series of Earth-based wind tunnel measurements
- Observing and quantifying effects of imbalanced angular inertia supports development of soccer balls with extra payloads.

# [USE CASE] SUMMARY

Number of Flights:	1
Number of Projects:	1
Launch Flights/Dates:	CRS19, 2019
Return Flight/Date:	n/a

## Why it is important:

1 billion people watch the soccer ball in the World Cup. It's the central part of the world's most popular game and has significant value as a product and an icon for adidas. Knowledge gained with microgravity experiments enabled adidas to engineer electronic sensors into the modern ball.

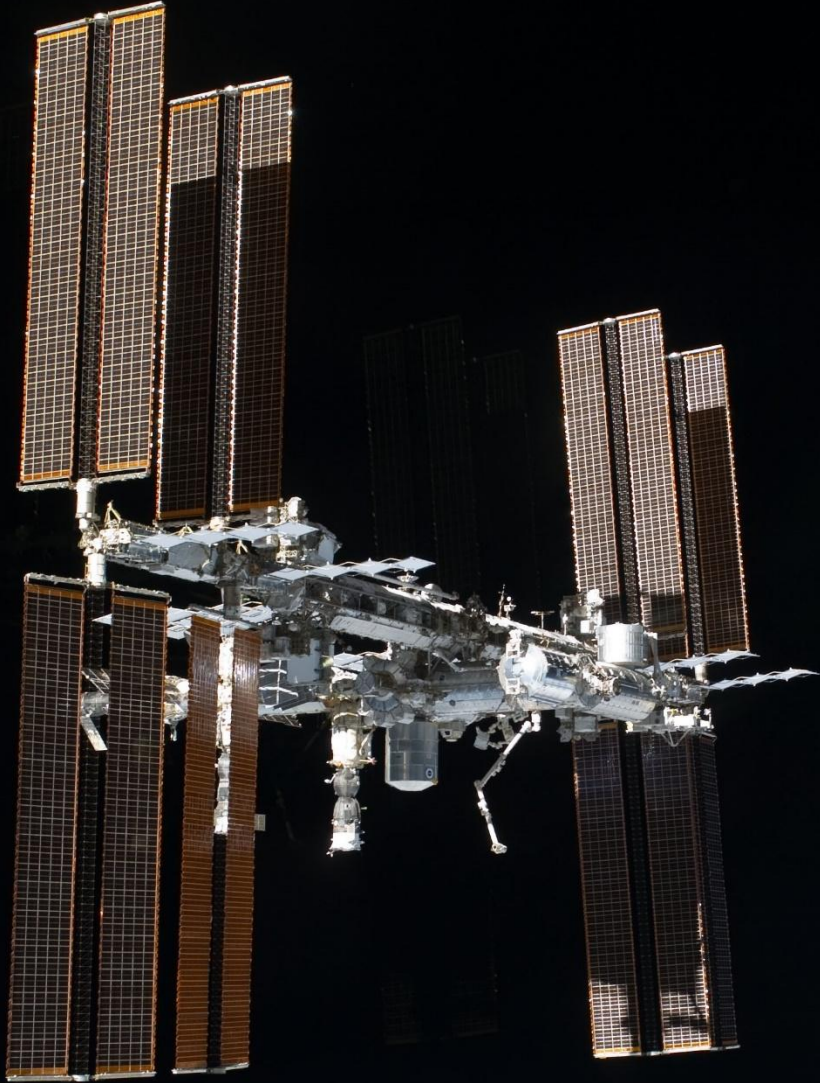
## Summary findings:

1. Spin rate degradation values for known panel shapes provide a clean reference point, uninterrupted by airflow or short flight times
2. Slight dynamic imbalance manifests in the Dzhanibekov effect

## Implications for life on Earth:

Advances in soccer ball engineering.  
Compelling sport-science-space examples for STEM activations to inspire students.





# NEW DISCOVERIES

Compiled by the UAC]  
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# SUMMARY: REGENERATIVE MEDICINE

## What is being studied

- How microgravity accelerates certain disease processes
  - How cells and cell signaling change in the absence of gravity
  - Why stem cells behave differently in space
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## Why it is important

- Age-related diseases are accelerated in astronauts in space
- Tissue engineering in space offers medical and commercial advantages
- Studies in microgravity offer new clues to mechanisms of disease

# EXAMPLES OF REGENERATIVE MEDICINE IN SPACE

- Vision science and neuroscience in space; spaceflight-associated neuro-ocular syndrome
- Muscle and bone loss in low earth orbit (LEO)
- Cancer biology in LEO
- Cell assembly in space

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## Why it is important

- Understanding astronauts' disease susceptibility and countermeasures
- Drug efficacy and action on earth and LEO are different
- Space medicine advances are needed for long duration space travel