



ISS National Laboratory Q1FY21 Report

Quarterly Report for the Fiscal Year 2021 Period October 1, 2020 – December 31, 2020

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Q1FY21 Metrics

FUNDAMENTAL SCIENCE	ACTUAL Q1	ACTUAL Q2	ACTUAL Q3	ACTUAL Q4	ACTUAL FY21	TARGET FY21
External Funding from Other Government Agencies Supporting Fundamental Science Users	--	--	--	--		\$10M
Fundamental Science Payloads Delivered	12					10
IN-SPACE PRODUCTION APPLICATIONS						
New Roadmaps Developed for In-Space Production Applications	0					3
TECHNOLOGY DEVELOPMENT						
Funds Raised Postflight by Startup Companies with Flight Projects	\$30.4M					\$15M
Technology Demonstration Payloads Delivered	8					10
External Funding from Other Government Agencies Supporting Technology Demonstration or Development Users	--	--	--	--		\$20M
COMMERCIAL SERVICE PROVIDERS						
Pioneer Allocation Agreements Signed with All Current Commercial Facility Managers	92%					100%
Pioneer Allocation Resource Utilization	N/A					100%
EDUCATION AND OUTREACH						
Individuals Participating in ISS National Lab STEM Programs and STEM Grants Projects	203,633					1.5M
Total Audience of ISS National Lab Online Education Products	1,848,878					3.5M
CORE ISS NATIONAL LAB RESOURCE UTILIZATION METRICS						
Crew Time (<i>Actual vs. increment pair-3 months allocation</i>)						100%
Upmass						100%

FULL ISS NATIONAL LAB UTILIZATION AND OPERATIONS TRACKING METRICS

	ACTUAL Q1	ACTUAL Q2	ACTUAL Q3	ACTUAL Q4	ACTUAL FY21
Commercial Service Provider Utilization Payloads Delivered	11				
Education and Outreach Payloads Delivered	4				
In-Space Production Applications Payloads Delivered	3				
Total ISS National Lab Payloads Delivered*	38				
New ISS National Lab Proposals Received	7				
New ISS National Lab Projects Selected	1				
<i>By New/Returning Type</i>					
ISS National Lab Return Users	1				
ISS National Lab New Users	0				
<i>By User Type</i>					
Commercial	1				
Academic/Nonprofit	0				
Government Agency	0				
Number of Days from Solicitation Close to Announcement	52				
New Commercial In-Orbit Facilities Added	0				
Commercial In-Orbit Facilities (cumulative)	17				
<i>Ascent Flight Resources</i>					
Upmass	152%				
Cold Stowage	56%				
Big Bags	130%				
Powered Lockers	29%				
<i>Facility Resources</i>					
Commercial Facilities	50%				
JEM Airlock	100%				
Life Science Glovebox	33%				
Microgravity Science Glovebox	120%				

Note: Resource data is projected/estimated based on payload requirements in the queue at the start of FY2020.

FINANCIALS

Business Status Report (unaudited)

Expenses	Q1 Actual FY21	Q1 Budget FY21	Q1 Variance FY21	Actual YTD FY21	Budget YTD FY21	Variance YTD FY21
Direct Labor	\$1,764,137	\$1,917,229	\$(153,092)	\$1,764,137	\$1,917,229	\$(153,092)
Subcontracts	\$297,679	\$390,720	\$(93,041)	\$297,679	\$390,720	\$(93,041)
Other Direct	\$174,244	\$231,565	\$(57,321)	\$174,244	\$231,565	\$(57,321)
Travel	\$(451)	\$1,455	\$(1,906)	\$(451)	\$1,455	\$(1,906)
Office Supplies and Equipment	\$81,520	\$107,519	\$(25,999)	\$81,520	\$107,519	\$(25,999)
Grants & Mission-Based Costs	\$1,053,473	\$1,781,836	\$(728,363)	\$1,053,473	\$1,781,836	\$(728,363)
Total Expenses	\$3,370,602	\$4,430,324	\$(1,059,722)	\$3,370,602	\$4,430,324	\$(1,059,722)

Breakout of ISS National Lab Grants Payments

	Q1FY21	FY21 YTD Total
Academic	\$369,997	\$369,997
Commercial	\$639,564	\$639,564
Other Government Agency	-	-
Mission-Based Costs	\$43,912	\$43,912
Total	\$1,053,473	\$1,053,473

Total Value of Grants Awarded (i.e., funds committed toward future projects)

	ACTUAL Q1	ACTUAL Q2	ACTUAL Q3	ACTUAL Q4	ACTUAL FY20
Total value of grants awarded*	\$0				

* Grants include awards to projects and programs as well as modifications and extensions. Ability to award new grants will be dependent on availability of additional funding for the ISS National Lab.

Breakout of Cooperative Agreement Funding

	Q1FY21	Q2FY21	Q3FY21	Q4FY21	FY21 YTD Total
Direct	48%				48%
Indirect	21%				21%
Grants	31%				31%

Program Activities

Commercial Service Provider Utilization

An allocation of ISS National Lab crew time and upmass resources that will be utilized by Commercial Service Providers for the purpose of promoting, enabling, and facilitating their respective commercial demand-generation efforts, thereby contributing to the growth and development of the broader LEO market economy.

- Startup [Spire Global raised \\$24 million](#) this quarter, following its [flight projects](#) through Nanoracks, which tested constellations of remote-sensing satellites to monitor weather as well as global aviation and maritime traffic.
- Startup [Lynk raised \\$4.8 million](#) this quarter, following its [flight projects](#) through SEOPS, which focused on rapid prototyping and development of smallsat constellations to enable anywhere-anytime communications across the world using standard phones.
- The U.S. portion of the ISS received its first-ever commercial airlock: The [Nanoracks Bishop Airlock](#) will increase access to airlock use for diverse customers and is about five times larger in volume than the JAXA airlock, which will increase the capacity of the ISS to host external instruments and accommodate larger satellites. Self-funded, built, and operated by Nanoracks, Bishop is expected to increase capabilities for both space-based research and development (R&D) as well as station operations.
- Nanoracks also supported Mission 14 of the [Student Spaceflight Experiments Program](#), representing almost 30 experiments from 129 students across 16 states and internationally. This year's full programming engaged more than 23,000 students.
- The Nanoracks CubeSat Deployer deployed four satellites that were commanded from the ground.
- In a [unique collaboration](#) between two commercial service providers (Space Tango and Alpha Space), researchers from the University of Adelaide are developing micro-flow spacelabs for in-orbit pharmaceutical formulation and manufacturing.
- [Seeker](#) featured the Additive Manufacturing Facility from Made In Space, highlighting in video form “How 3D Printing in Space Could Revolutionize Manufacturing.”
- One new agreement was signed (Nanoracks) and two were updated (Alpha Space and Bioserve Space Technologies), ensuring that these companies have continued and streamlined access to the ISS National Lab's Pioneer Allocation.
- Several Commercial Service Providers authored [essays as part of a CASIS-hosted series](#) on visions for the next 20 years of commercial development in low Earth orbit.

Fundamental Science

Peer-reviewed science that will lead to new discovery and knowledge, or advance our current understanding or knowledge, in various scientific disciplines through the use of microgravity, the extreme environments of space, or the unique vantage point of the ISS. Economic output from results is not required.

- There were two open research solicitations in Q1:
 - NSF/CASIS [2021 Collaboration on Transport Phenomena Research](#) on the ISS to Benefit Life on Earth
 - NSF/CASIS [2021 Collaboration on Tissue Engineering and Mechanobiology](#) on the ISS to Benefit Life on Earth
- Two new peer-reviewed journal articles were published (*for the full list of peer-reviewed journal publications related to the ISS National Lab, [click here](#)*):
 - Li Y, Liao Y-TT, Ferkul P. [Numerical Study of the Effects of Confinement on Concurrent-Flow Flame Spread in Microgravity](#). J. Heat Transfer, 2020. 142(11):111301.

- Hwang H, Liu R, Maxwell JT, et al. [Machine Learning Identifies Abnormal Ca²⁺ Transients in Human Induced Pluripotent Stem Cell-derived Cardiomyocytes](#). Nature; Sci Rep, 2020. 10(16977).
- A Cell Press [special collection](#) on the biology of spaceflight consisted of 23 articles, including several mentioning ISS National Lab R&D and one [authored by CASIS](#) on open-source spaceflight data.
- Crew performed a National Institutes of Health (NIH)-sponsored Tissue Chips in Space project to evaluate whether engineered heart tissues in microgravity mimic a terrestrial condition in which heart muscles are weakened due to heart disease. This research builds on previous flight research to observe microgravity's effects on heart cells derived from induced pluripotent stem cells. This translational biomedical research seeks to accelerate the development of tissue chips for drug screening and disease treatment.
- A project sponsored by the National Science Foundation (NSF) completed the last of seven planned experiment runs (coalescence tests on various substrates). Cornell University (which previously [published preflight data](#)) is studying the motion of liquid drops across a solid surface to better understand inertial spreading, with potential applications in medicine, agriculture, manufacturing, and industrial processes.

In-Space Production Applications

LEO-based applied R&D microgravity applications seeking to demonstrate space-based manufacturing and production activities that enable new business growth and capital investment, represent scalable and sustainable market opportunities, and produce reoccurring value with the potential to generate demand for and revenue from access to space.

- Manufacturing [fiber optic materials in space](#) has the potential to provide a higher-performance product, offering dramatically lower transmission losses. This can set the stage for improved imaging, remote sensing, and next-generation optical communications on Earth.
 - Physical Optics Corporation continued its fiber optics experiment, with crew performing multiple sample exchanges. The ground team used data from previous runs to refine the experiment parameters, allowing the team to draw longer fibers with better characteristics.
 - Fiber Optics Manufacturing in Space had its new fabrication module installed into the Space Fibers-2 facility.
- Crew installed the Turbine-Ceramic Manufacturing (T-CMM) Module into its EXPRESS rack location. This is the fifth Made In Space commercial facility to launch for validation and is designed to manufacture superior turbine components in microgravity with improved performance for aerospace applications.
- The ISS National Lab co-hosted a Biomanufacturing in Space Symposium with the University of Pittsburgh and the McGowan Institute for Regenerative Medicine. This multi-session symposium spanned several months, culminating in breakout sessions in December. A whitepaper is forthcoming.

STEM Education and Outreach

Programs, projects, and public-private partnerships that leverage the ISS and space-based research to advance U.S. leadership in space-based R&D and industry-related workforce development. These programs, projects, and partnerships will engage K-12 students and enhance higher education to promote diversity and outreach into underrepresented demographics.

- On the [third and final day of the 2020 International Space Station Research & Development Conference \(ISSRDC\)](#) held October 22, several Space Station Explorers (SSE) partners and a Space Station Ambassador presented their programs at the STEM Program Technical Session.
- TIME's ISS Experience with Implementation Partner [Felix & Paul Studios](#) continues to capture various astronaut experiences, including the arrival of Crew-1 as well as Russian cosmonauts eating, exercising, and performing experiments.

- Following the successful conclusion of Sally Ride Earth Knowledge Acquired by Middle Schools (EarthKAM) mission 72, more than 15,000 students from 29 countries had signed up to participate, and 4316 images had been downlinked and posted to the EarthKAM webpage.
- Story Time From Space reported a total of 8,286,900 reading minutes for calendar year 2020.
- Amateur Radio on the ISS (ARISS) website unique views increased 20% over the last quarter.
- The 2019 Genes in Space winning experiment launched on SpaceX Crew-1.
- The ISS National Lab has expanded its educational partnership with Museum Initiatives and added four new partners to the ISS National Lab's SSE's Consortium: Advancing X, Space Foundation, SpaceKids Global, and CAST. (For more information on STEM education partner organizations, [click here.](#))

Technology Development/Demonstration

Applied R&D, translational science, technology readiness level maturation, and technology demonstration to improve products and/or processes that will produce positive economic impact. All projects with an expressed commercial purpose or intent are included. Most of these will be sourced and/or serviced by Implementation Partners.

- Startup Orbit Fab raised \$1.6 million following its CASIS-sourced flight project, which successfully tested the company's Furphy tanker, demonstrating the ability to transfer propellant between two small satellites. Furphy is a compact system for refueling satellites while in Earth's orbit—thereby extending satellite operations. This new tanker technology has two patents pending, and the project went from concept to flight within one year. Leveraging its execution progress from this successful mission, the company previously raised more than \$3 million in venture capital.
- Crew performed microscopy observations on protein crystal growth experiment samples from Bristol Myers Squibb. This study is looking into protein crystallization kinetics in microgravity to improve drug delivery methods and treatments for diseases such as cancer.
- Crew activated the novel protein aggregation/degradation studies from GlaxoSmithKline, using the STaARS facility. The purpose of this project is to evaluate protein stability to improve biopharmaceutical drug development and the treatment of human diseases.
- Crew donned the [AstroRad Vest](#) (a Lockheed Martin project) for a period of time, completed a range-of-motion test, and then completed a general survey. Crew assessment of the vest continued through the remainder of the quarter. The purpose of this project is to test the performance of the radiation shielding vest, which protects organs most sensitive to radiation exposure.
- A project from Kernal Biologics, which was awarded a 2018 Technology in Space Prize (sponsored by Boeing and CASIS in partnership with MassChallenge), completed sample processing operations inside the Life Science Glovebox. This project aims to test candidate messenger RNA molecules and identify which are best able to distinguish between cancer cells and healthy cells, toward the development of new immunotherapy drugs to treat leukemia. The company's research was highlighted in Q1 by [Fierce Biotech](#).
- Crew set up hardware and performed microscopy observations on the Monoclonal Antibodies Protein Crystal Growth experiment samples as part of a Bristol Myers Squibb study looking into protein crystallization kinetics in microgravity to improve drug delivery methods and treatments for diseases such as cancer.
- The ISS National Lab and NASA co-hosted a [virtual International Destination Station](#). An all-female panel addressed 485 registrants from 16 countries.

Additional Updates

- The ISS National Lab Investor Network continued to expand, reaching 209 members. To date, CASIS has facilitated 869 capital introductions between startups and investors in the ISS National Lab ecosystem.

- In FY21 Q1, CASIS implemented a new assessment framework for peer review of proposals. All proposals seeking access to ISS National Lab in-orbit resources will now be submitted in response to ISS National Lab Research Announcements, wherein they will undergo an external peer review for evaluation and determination. Current opportunities can be viewed [here](#). While this new framework was developed and implemented, no new projects were awarded.
- The World Design Organization co-hosted an [ISS design challenge](#) with the ISS National Lab in late September 2020. Five global team presentations are being considered for further work in 2021 and potential flight projects.
- Two Commercial Resupply Services (CRS) launches delivered ISS National Lab payloads:
 - Northrop Grumman CRS-14 (October 1, 2020): Highlights included research from GlaxoSmithKline, student experiments in biology and remote sensing, and projects funded through NSF and Boeing. [Full details on Northrup Grumman CRS-14 ISS National Lab payloads](#)
 - SpaceX CRS-21 (December 5, 2020): Research highlights included three projects sponsored by NIH through the Tissue Chips in Space initiative, research from Sanofi Pasteur and Bristol Myers Squibb, and continued work on the in-space manufacturing of optical fibers. [Full details on SpaceX CRS-21 ISS National Lab payloads](#)

Full Project Pipeline Details

- For a full list of ISS National Lab projects and programs, including flight status, visit our [project pipeline database](#).