ISS National Laboratory
CENTER FOR THE ADVANCEMENT OF SCIENCE IN SPACE

ISS National Laboratory Q2FY21 Report

Quarterly Report for the Fiscal Year 2021 Period January 1, 2021 – March 31, 2021

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Q2FY21 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	2			14	10
IN-SPACE PRODUCTION APPLICATIONS						
New Roadmaps Developed for In-Space Production Applications	0	0			0	3
TECHNOLOGY DEVELOPMENT						
Funds Raised Postflight by Startup Companies with Flight Projects	$30.4M	$28.7M			$59.1M	$15M
Technology Demonstration Payloads Delivered	8	6			14	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%	92%			92%	100%
Pioneer Allocation Resource Utilization	N/A	N/A			N/A	100%
EDUCATION AND OUTREACH						
Individuals Participating in ISS National Lab STEM Programs and STEM Grants Projects	203,633	666,326			869,959	1.5M
Total Audience of ISS National Lab Online Education Products	1,848,878	1,289,818			3,138,696	3.5M
CORE ISS NATIONAL LAB RESOURCE UTILIZATION METRICS						
Crew Time (*Actual vs. increment pair-3 months allocation)*	60%					100%
Upmass	100%					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	3			14
Education and Outreach Payloads Delivered	4	0			4
In-Space Production Applications Payloads Delivered	3	1			4
Total ISS National Lab Payloads Delivered	38	12			50
New ISS National Lab Proposals Received	7	2			9
New ISS National Lab Projects Selected	1	5			6
By New/Returning Type					
ISS National Lab Return Users	1	3			4
ISS National Lab New Users	0	2			2
By User Type					
Commercial	1	4			5
Academic/Nonprofit	0	0			0
Government Agency	0	1			1
Number of Days from Solicitation Close to Announcement	52	52			52
New Commercial In-Orbit Facilities Added	0	0			0
Commercial In-Orbit Facilities (cumulative)	17	17			17
Ascent Flight Resources					
Upmass	149%				
Cold Stowage	53%				
Big Bags	90%				
Powered Lockers	29%				
Facility Resources					
Commercial Facilities	50%				
JEM Airlock	100%				
Life Science Glovebox	16%				
Microgravity Science Glovebox	120%				

Note: Resource data is projected/estimated based on payload requirements in the queue at the start of FY2021.

FINANCIALS

Business Status Report (unaudited)

Expenses	Q2 Actual FY21	Q2 Budget FY21	Q2 Variance FY21	Actual YTD FY21	Budget YTD FY21	Variance YTD FY21
Direct Labor	$1,656,157	$1,942,591	$(286,434)	$3,420,294	$3,859,820	$(439,526)
Subcontracts	$258,000	$179,650	$78,350	$555,679	$570,370	$(14,691)
Other Direct	$183,524	$235,942	$(52,418)	$357,768	$467,507	$(109,739)
Travel	$11,447	$22,627	$(11,180)	$10,996	$24,082	$(13,086)
Office Supplies and Equipment	$25,058	$48,775	$(23,717)	$106,578	$156,294	$(49,716)
Grants & Mission-Based Costs	$872,828	$1,837,460	$(964,632)	$1,926,301	$3,619,296	$(1,692,995)
Total Expenses	**$3,007,014**	**$4,267,045**	**$(1,260,031)**	**$6,377,616**	**$8,697,369**	**$(2,319,753)**

Breakout of ISS National Lab Grants Payments

	Q1FY21	Q2FY21	FY21 YTD Total
Academic	$369,997	$382,625	$752,622
Commercial	$639,564	$446,291	$1,085,855
Other Government Agency	-	-	-
Mission-Based Costs	$43,912	$43,912	$87,824
Total	**$1,053,473**	**$872,828**	**$1,926,301**

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

	ACTUAL Q1	ACTUAL Q2	ACTUAL Q3	ACTUAL Q4	ACTUAL FY21
Total value of grants awarded*	$0	$0			$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%	50%			49%
Indirect	21%	21%			21%
Grants	31%	29%			30%

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.

- The ISS National Lab held the first of two FY21 Implementation Partner (IP) workshops, which included 40 participants from more than 20 companies.
- Redwire, parent company of ISS National Lab Commercial Service Provider Made In Space, announced it will go public by merging with Genesis Park Acquisition Corp.
- Axiom Space, an ISS National Lab Commercial Service Provider, announced the first private crew to visit the ISS, scheduled to launch in January 2022. The mission, dubbed Ax-1, will be led by former NASA astronaut and Axiom vice president Michael López-Alegría.
- ISS National Lab staff hosted a panel discussion on the future use of space for microgravity research at the NASA Commercial Space Symposium.
- Operations began on a Boeing project in collaboration with the University of Queensland to test an antimicrobial coating designed to reduce disease transmission on high-touch surfaces. Results could be useful in the aviation, spacecraft, and other industries where disease transmission is a concern.

Fundamental Science

Peer-reviewed science that will lead to new discovery and knowledge, or advance our current understanding of 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.

- Four peer-reviewed articles were published in Q2:
  - Camberos V, Baio J, Mandujano A, et al. The Impact of Spaceflight and Microgravity on the Human Islet-1+ Cardiovascular Progenitor Cell Transcriptome. Int J Mol Sci. 2021;22(7):3577.
  - Lidberg KA, Annalora AJ, Jozic M, et al. Antisense Oligonucleotide Development For The Selective Modulation Of CYP3A5 In Renal Disease. Sci Rep. 2021;11:4722.
  - Rampoldi A, Jha R, Fite J, et al. Cryopreservation and CO_2-independent culture of 3D cardiac progenitors for spaceflight experiments. Biomaterials. 2021 Feb;269:120673.
  - Shin YJ, Shafranek RT, Tsui JH, et al. 3D Bioprinting Of Mechanically Tuned Bioinks Derived From Cardiac Decellularized Extracellular Matrix. Acta Biomater. 2021;119:75-88.
  - Zamarioli A, Campbell ZR, Maupin KA, et al. Analysis Of The Effects Of Spaceflight And Local Administration Of Thrombopoietin To A Femoral Defect Injury On Distal Skeletal Sites. NPJ Microgravity. 2021 Mar 26;7(1):12.
- The following research solicitations are now closed (open in Q1; awards expected in Q3):
  - 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
- Several fundamental science projects were completed on station in Q2, including:
  - The first of two National Institutes of Health (NIH)-sponsored Tissue Chips in Space investigations from Stanford University to evaluate whether engineered heart tissues exposed to microgravity mimics weakened heart muscles, for use in screening potential new drugs to treat heart conditions.
  - An Illinois Institute of Technology project aimed at synthesizing new types of semiconductor crystals that are nontoxic and can be grown at a faster rate than other semiconductor materials.

- *Scientific American* published a comprehensive feature on a first-of-its kind ISS microbial survey that "swabbed" multiple locations within the ISS to understand the distribution of microbes and their metabolites (chemicals produced by bacterial growth). A Boeing-sponsored microbial investigation was also cited in the *Scientific American* piece and featured in a United Press International (UPI) story.
- The ISS National Lab assisted with the coordination of NASA astronaut Kate Rubins' live downlinks with leaders from NIH, the National Science Foundation (NSF), and the Centers for Disease Control and Prevention (CDC). Rubins highlighted ISS research she has supported and discussed the potential impacts results could have on future therapeutics and patient care on Earth and beyond.
- The ISS National Lab participated in several fundamental science events in Q2, including roadmapping activities with the NASA Office of the Chief Scientist; a Commercial Spaceflight Federation career panel; an American Institute of Aeronautics and Astronautics career panel; a presentation at the University of California, San Francisco; a panel at the University of Pittsburgh McGowan Institute for Regenerative Medicine (MIRM); and the Biomanufacturing in Space Symposium hosted by the ISS National Lab and MIRM.

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.

- Two in-space production applications research announcements were released in Q2:
  - Advanced Manufacturing and Materials (NLRA 2021-5)
  - Tissue Engineering and Biomanufacturing (NLRA 2021-6)
- One patent was filed by Emulate, Inc. related to the company's Intestine-Chip system, developed in conjunction with their NIH-sponsored Tissue Chips in Space investigation examining microgravity's effects on immune response to disease-causing bacteria.
- Made In Space's Industrial Crystallization Facility (ICF) launched on Northrop Grumman CRS-15. ICF is a commercial in-space manufacturing facility designed for the growth and formulation of large (centimeter-scale) single crystals and other exotic materials of industrially relevant size and quality. The ICF was developed by Redwire in partnership with NASA's Small Business Innovation Research program.
- The Physical Optics Corporation project to produce high-quality ZBLAN optical fibers in microgravity using the company's Orbital Fiber Optic Production Module was completed in Q2.
- ISS National Lab staff participated in a webinar hosted by the Materials Research Society that focused on in-space production applications.

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.

- A STEM education and outreach research announcement was released in Q2 in support of programs, products, and public-private partnerships focused on educational objectives:
  - Leveraging the ISS National Lab to Enable Digital Engagement and Higher Education (NLRA 2021-4)
    - This first solicitation cycle resulted in the submission of 45 concept summaries, with more than 90% of submissions from new potential ISS National Lab users. Invited proposals are due in Q3.

- The Space Station Explorers Consortium gained a new partner in Q2:
  - Discovery Education, based in Charlotte, NC, is a Discovery Channel education effort for K-12 students and educators.
- The ISS National Lab's efforts in promoting workforce development and enhancing space-related STEM education are reflected in recent participant achievements:
  - One of the three astronauts selected for the world's first all-civilian mission, Inspiration4, is Space Station Ambassador Dr. Sian Proctor.
  - TIME magazine's first-ever "Kid of the Year" selected in 2020 was a participant in ISS National Lab programming, including Boeing's Genes in Space program and STEM Scouts.
- The ISS National Lab participated in several STEM events and activities in Q2:
  - Through a presentation at the Space Exploration Education Conference, the ISS National Lab unveiled Expedition: Space Lab, a new Space Station Explorers program to empower and equip teachers to better utilize available space-related STEM content. Space Station Ambassador James Falletti received the Cherri Brinley Outstanding Educator Award at the conference.
  - Other presentations included the North Carolina Space Grant Ambassadors meeting, a Space Foundation Partnership webinar, and participation in the notification of winners of the "Making Space for Girls Challenge Program," organized by the Girl Scouts of Citrus Council and Space Kids Global with support from ISS National Lab Commercial Service Provider ProXops.
- The first live Story Time from Space took place in Q2, with more than 18,000 unique connections, many of which were classrooms.

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.

- A technology development/demonstration research announcement was released in Q2 that focused the areas of applied research and development, translational medicine, technology readiness level maturation, and technology demonstration:
  - Technology Advancement Applied Research on the International Space Station (NLRA 2021-3)
    - This first solicitation cycle resulted in the submission of 72 concept summaries. Invited proposals are due in Q3.
- The MassChallenge business accelerator, which partners with CASIS and Boeing to sponsor the Technology in Space Prize (open in Q2), has expanded to include business accelerators throughout the country and achieve a broader national focus.
- The Consumer Electronics Show, the largest technology-related conference in the world, included a virtual panel session proposed by CASIS focused on technology development on the ISS. The session featured CNN's Rachel Crane as moderator, NASA astronaut Serena Auñón-Chancellor, and representatives from Lockheed Martin and ISS National Lab Commercial Service Provider Space Tango to discuss ISS capabilities.
- During Q2, we saw several funding and strategic successes by early-stage companies, including Lynk Global, Orbital Sidekick, and Redwire, that have leveraged the ISS National Lab toward development and maturation of their technologies.

- Hewlett Packard Enterprise's (HPE) Spaceborne Computer-2 (SBC-2), successor to Spaceborne Computer-1 that operated successfully on the ISS for more than 1.5 years, launched on Northrop Grumman CRS-15. SBC-2 will provide in-space processing capabilities, which could enable faster results and greater potential for iteration of research on the ISS. SBC-2 was featured in several space industry publications, and ISS National Lab staff members were invited to join a podcast hosted by HPE's chief technology officer.

Additional Updates

- Five new projects were selected in Q2; all five projects were self-funded, thus requiring no CASIS funding:
  - Three are fundamental science projects:
    - A project from Zin Technologies, Inc. will study how binary colloidal crystals form, for potential use in tuning material properties for applications in photonics, semiconductors, and spintronics.
    - Another study from Zin Technologies, Inc. aims to provide a better understanding of the structural evolution of colloidal gels, toward improving shelf life of consumer products.
    - A project from the Naval Research Laboratory will search for new melanin variants with novel properties as well as other useful biomaterials for applications both on Earth and in space.
  - Two are technology development projects:
    - A project from Zero-G Horizons Technologies, LLC will validate the Spacecraft On-Orbit Advanced Refueling and Storage system, demonstrating in-orbit refueling of satellites and spacecraft is possible.
    - A project from Northrup Grumman aims to advance understanding of emerging state-of-the-art satellite communications technology available as commercial off-the-shelf components.
- Northrop Grumman's 15th Commercial Resupply Services (CRS) mission launched in Q2, delivering 15 payloads to the ISS. For more information and payload highlights, see our mission overview webpage.
- The ISS National Lab User Advisory Committee, chaired by Dr. Douglas Matson, convened for its initial meeting to do general introductions and discuss concerning roles, responsibilities, expectations, and near-term action items and goals.
- The ISS National Lab Investor Network continued to expand, reaching 222 members in Q2. To date, CASIS has facilitated more than 870 capital introductions between startups and investors in the ISS National Lab ecosystem.
- CASIS released its 2020 Annual Report, highlighting not only the organizational accomplishments of the past fiscal year but also areas of opportunity and plans to advance future areas of strategic focus, such as in-space production applications.
- The World Design Organization released a report on an ISS National Lab-supported design challenge launched in FY20.

Full Project Pipeline Details

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