ISS National Laboratory
CENTER FOR THE ADVANCEMENT OF SCIENCE IN SPACE

ISS National Laboratory Q4FY21 Report

Quarterly Report for the Fiscal Year 2021 Period July 1, 2021 – September 30, 2021

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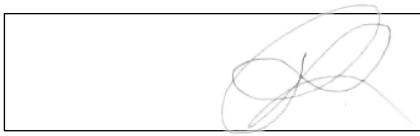

Q4FY21 Metrics

FUNDAMENTAL SCIENCE	ACTUAL Q1	ACTUAL Q2	ACTUAL Q3	ACTUAL Q4	ACTUAL FY21	TARGET FY21
External Funding from Other Government Agencies Supporting Fundamental Science Users	--	--	--	--	$4M	$10M
Fundamental Science Payloads Delivered	12	2	3	4	21	10
IN-SPACE PRODUCTION APPLICATIONS						
New Roadmaps Developed for In-Space Production Applications	0	0	0	3	3	3
TECHNOLOGY DEVELOPMENT						
Funds Raised Postflight by Startup Companies with Flight Projects	$30.4M	$28.7M	$75.8M	$388M	$522.9M	$15M
Technology Demonstration Payloads Delivered	5	3	5	3	16	10
COMMERCIAL SERVICE PROVIDERS						
Umbrella Agreements Signed with All Current Commercial Facility Managers	92%	92%	98%	100%	100%	100%
Pioneer Allocation Resource Utilization	N/A	N/A	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	2,658,945	192,911	3,721,815	1.5M
Total Audience of ISS National Lab Online Education Products	1,848,878	1,289,818	1,221,455	3,431,682	7,791,833	3.5M
CORE ISS NATIONAL LAB RESOURCE UTILIZATION METRICS						
Crew Time (*Actual vs. increment pair-3 months allocation)*	60%		90%			100%
Upmass	100%		47%			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	13	6	8	14	41
Education and Outreach Payloads Delivered	4	0	1	1	6
In-Space Production Applications Payloads Delivered	3	1	0	0	4
Total ISS National Lab Payloads Delivered	37	12	17	22	88
New ISS National Lab Proposals Received	7	3	122	53	185
New ISS National Lab Projects Selected	1	3	6	32	42
By New/Returning Type					
ISS National Lab Return Users	1	1	2	11	18
ISS National Lab New Users	0	2	4	21	27
By User Type					
Commercial	1	2	2	12	17
Academic/Nonprofit	0	0	4	19	23
Government Agency	0	1	0	1	2
Number of Days from Solicitation Close to Announcement	52	52	76	72	72
New Commercial In-Orbit Facilities Added	0	0	0	1	1
Commercial In-Orbit Facilities (cumulative)	17	17	17	18	18
Ascent Flight Resources					
Upmass	149%		62%		81%
Cold Stowage	53%		77%		67%
Big Bags	90%		29%		63%
Powered Lockers	29%		18%		22%
Facility Resources					
Commercial Facilities	50%		50%		50%
JEM Airlock	100%		100%		100%
Life Science Glovebox	16%		67%		50%
Microgravity Science Glovebox	120%		50%		90%

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

FINANCIALS

Business Status Report (unaudited)

Expenses	Q4 Actuals	Q4 Budget	Variance	Actual YTD FY21	Budget YTD FY21	Variance YTD FY21
Direct Labor	$1,453,178	$1,998,868	$(545,690)	$6,559,359	$7,857,557	$(1,298,198)
Subcontracts	$305,114	$157,000	$148,114	$1,151,056	$933,570	$217,486
Other Direct	$223,183	$891,099	$(667,916)	$765,424	$1,693,528	$(928,104)
Travel	$24,757	$292,332	$(267,575)	$58,568	$444,041	$(385,473)
Office Supplies and Equipment	$92,192	$44,626	$47,566	$273,590	$254,245	$19,345
Grants & Mission-Based Costs	$719,065	$1,748,333	$(1,029,268)	$3,463,808	$6,865,158	$(3,401,350)
Total Expenses	**$2,817,489**	**$5,132,258**	**$(2,314,769)**	**$12,271,805**	**$18,048,099**	**$(5,776,294)**

Breakout of ISS National Lab Grants Payments

	Q1FY21	Q2FY21	Q3FY21	Q4FY21	FY21 YTD Total
Academic	$369,997	$382,625	$363,176	$279,585	$1,395,383
Commercial	$639,564	$446,291	$343,187	$382,400	$1,811,442
Other Government Agency	-	-	$59,996	$11,668	$71,664
Mission-Based Costs	$43,912	$43,912	$52,083	$45,412	$185,319
Total	**$1,053,473**	**$872,828**	**$818,442**	**$719,065**	**$3,463,808**

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	$172,471	$1,079,500	$4,117,006	$5,368,977

** Grants include awards to projects and programs as well as modifications and extensions. The 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%	52%	49%	50%
Indirect	21%	21%	21%	22%	21%
Grants	31%	29%	27%	29%	29%

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.

- ISS National Lab Implementation Partners Alpha Space and MEI Technologies announced the merger of the two companies to form Aegis Aerospace, Inc.
- ISS National Lab Commercial Service Provider Redwire Space, parent company of Made In Space, closed its merger with Genesis Park Acquisition Corporation, making Redwire a publicly traded company.
- BioServe's Space Automated Laboratory Incubator (SALI), which will be used to incubate biological experiments in space, was launched and validated, becoming the 18th commercial facility on the ISS.
- The ProXopS Faraday Research Facility, a multipurpose facility for research and technology development, launched to the ISS for validation.
- The "Space Explorers: The ISS Experience" virtual reality series, produced by Felix & Paul Studios in association with TIME, continued filming on the ISS and captured footage of a spacewalk. The series won a Primetime Emmy for Outstanding Interactive Production at the 73rd Annual Emmy Awards.
- The ISS National Lab held the second FY21 Implementation Partner workshop, which included 40 participants from more than 20 companies.

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.

- Seven peer-reviewed fundamental science articles were published in Q4:
  - Adam JA, Middlestead HR, Debono NE, et al. Effects of Shear Rate and Protein Concentration on Amyloidogenesis via Interfacial Shear. J Phys Chem. 2021;124(36):10355-10363. https://doi.org/10.1021/acs.jpcb.1c05171
  - Cho S, Lee C, Skylar-Scott MA, et al. Reconstructing the heart using iPSCs: Engineering strategies and applications. J Mol Cell Cardiol. 2021;157:56-65. https://doi.org/10.1016/j.yjmcc.2021.04
  - Kennedy Z, Newberg J, Goelzer M, et al. Modeling stem cell nucleus mechanics using confocal microscopy. Biomech Model Mechanobiol. 2021. [published online ahead of print Aug 23, 2021] https://doi.org/10.1007/s10237-021-01513-w
  - Liu R, Sun F, Armand LC, et al. Chronic Ethanol Exposure Induces Deleterious Changes in Cardiomyocytes Derived from Human Induced Pluripotent Stem Cells. Stem Cell Rev. 2021. [published online ahead of print Sept 25, 2021] https://doi.org/10.1007/s12015-021-10267-y
  - Nishiga M, Qi LS, & Wu JC. CRISPRi/a Screening with Human iPSCs. Methods Mol Bio. 2021;2320:261-281. https://doi.org/10.1007/978-1-0716-1484-6_23
  - Orozco GA, Eskelinen A, Kosonen JP, et al. Shear strain and inflammation-induced fixed charge density loss in the knee joint cartilage following ACL injury and reconstruction: A computational Study. J Orthop Res. 2021. [published online ahead of print Sept 17, 2021] https://doi.org/10.1002/jor.25177
  - Rau A, Knott K, & Lu K. Porous SiOC/SiC ceramics via an active-filler catalyzed polymer-derived method. Mat Chem Front. 2021;5(17):6530-6545. https://doi.org/10.1039/D1QM00705J

- An investigation to develop a tissue-engineered model of sarcopenia (age-related muscle loss) launched in Q4. This marks the first NSF-funded project to launch to station as part of the NSF/CASIS collaboration to support tissue engineering research on the orbiting laboratory.
- During operations on the ISS, a project funded through an NSF/CASIS joint solicitation focused on transport phenomena discovered unusual "cool flames." Results could help advance future engine production on Earth.

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.

- A perspective paper was published in *Preprints* discussing the goals and outcomes of a Biomanufacturing in Space Symposium co-hosted by the ISS National Lab. The symposium gathered thought leaders in regenerative medicine and space-based R&D as a first step in developing a roadmap to establish a sustainable biomanufacturing market in LEO.
- Two ISS National Lab Research Announcements (NLRAs) closed in Q4: one focused on tissue engineering and biomanufacturing and one on advanced manufacturing and materials. Awards are expected Q1FY22.

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 CNN article discussed published findings from the student-led Genes in Space-6 project that leveraged CRISPR gene editing technology for the first time in low Earth orbit.
- Several student-led experiments launched to the ISS in Q4, including:
  - Three experiments from the Making Space for Girls Challenge funded by SpaceKids Global in partnership with the Girl Scouts of Citrus Council and with support from ISS National Lab Implementation Partner ProXopS.
  - The student-led Genes in Space-8 experiment aimed at evaluating the gene expression of liver proteins in space. This project is using the Genes in Space Fluorescence Viewer, a tool that enables visualization of biomolecules, for the first time in low Earth orbit.
  - Six experiments from the Student Spaceflight Experiment Program (SSEP): four on germination techniques, one on aluminum corrosion in space, and one on tardigrade adaption to spaceflight.
- Space Station Explorers partner program updates:
  - Genes in Space announced the 2021 winner of the program's annual competition: a high school student from San Jose, CA, who will test a new technique for detecting waterborne pathogens in space.
  - Amateur Radio on the ISS (ARISS) held three events with Girl Scout groups, one of which included more than 15,000 participants.
  - ISS-Above social media content resulted in almost 3.5 million online impressions in Q4.
  - Story Time From Space YouTube content received more than 110,000 views in Q4.
- In Q4, the Space Station Ambassador program gained 189 new members.
- Space Station Ambassador Sian Proctor was one of four civilians that flew on the Inspiration4 mission to low Earth orbit, the world's first all-civilian orbital mission.

- An NLRA focused on enabling digital engagement and higher education closed in Q4. Awards are expected in Q1FY22.

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.

- Crew members completed operations for an investigation from global consumer care company Colgate-Palmolive, the first private-sector oral health care investigation to the ISS. Results could help the company develop more effective products for consumers on Earth.
- The annual solicitation for the Technology in Space Prize in partnership with Boing and the MassChallenge (Boston) startup accelerator program closed in Q4. Awards are expected in Q1FY22.
- An NLRA focused on technology advancement and applied research closed in Q4. Awards are expected in Q1FY22.

Additional Updates

- CASIS announced that Ramon (Ray) Lugo will serve as the principal investigator and acting chief executive officer to lead the organization.
- In Q4, 32 new projects were selected, the most awarded projects ever in a single quarter; 11 were to return customers and 21 were to new customers. Of the selected projects, 7 were awarded through an NSF/CASIS joint solicitation focused on transport phenomena; 4 were through an NLRA focused on advanced materials; 3 were through an NLRA focused on tissue engineering and biomanufacturing; 9 were through an NLRA focused on digital engagement and higher education; and 9 were through an NLRA focused on technology advancement and applied research.
- Two Commercial Resupply Services (CRS) missions launched in Q4, delivering a total of 22 ISS National Lab-sponsored payloads to the space station:
  - Northrop Grumman CRS-16 included an NSF-funded tissue engineering investigation, a Genes in Space student-led project, and a new research facility for validation. For more information, see the mission overview page.
  - SpaceX CRS-23 included two investigations leveraging the MISSE Flight Facility, multiple student-led investigations, a drug delivery technology development project, and a new research facility for validation. For more information, see the mission overview page.
- The 10th annual International Space Station Research and Development Conference was held virtually, with nearly 3,000 registrants. Keynote speakers included NIH Director Francis Collins, MD, Ph.D.; NASA astronaut Kate Rubins, Ph.D.; Ellen Stofan, Ph.D., under secretary for the Smithsonian Institution; Murali Nair, Ph.D., P.E., SBIR/STTR program director for NSF; and Emmy-winning education television personality Emily Calandrelli, among many other notable leaders and innovators.
- Investor updates:
  - The ISS National Lab Investor Network continued to expand, reaching 245 members in Q4. To date, CASIS has facilitated close to 1,000 capital introductions between startups and investors in the ISS National Lab ecosystem.
  - More than $380 million of private and public capital as well as grant funding was raised during Q4 by startups that have completed a flight project with the ISS National Lab.
  - The ISS National Lab hosted its sixth annual startup and investor networking event, “Space Investment 2021: Innovation at the ISS National Lab.”

Full Project Pipeline Details

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