

INTERNATIONAL SPACE STATION

Utilization Statistics | Expeditions 0 - 68
December 1998 - March 2023

This is a product of the ISS Program Science Forum comprised of representatives from the ISS Partner Agencies: Canadian Space Agency (CSA), European Space Agency (ESA), Japan Aerospace Exploration Agency (JAXA), National Aeronautics and Space Administration (NASA) and the State Space Corporation ROSCOSMOS (ROSCOSMOS) and the ISS Participant Agency: Italian Space Agency (ASI).

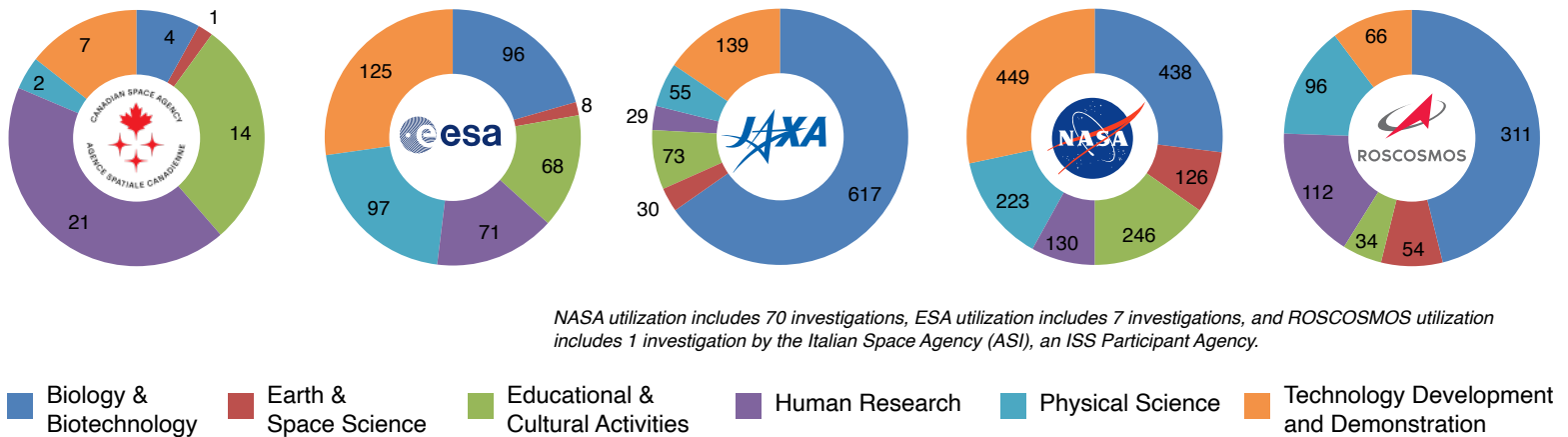
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NUMBER OF INVESTIGATIONS PERFORMED ON THE INTERNATIONAL SPACE STATION

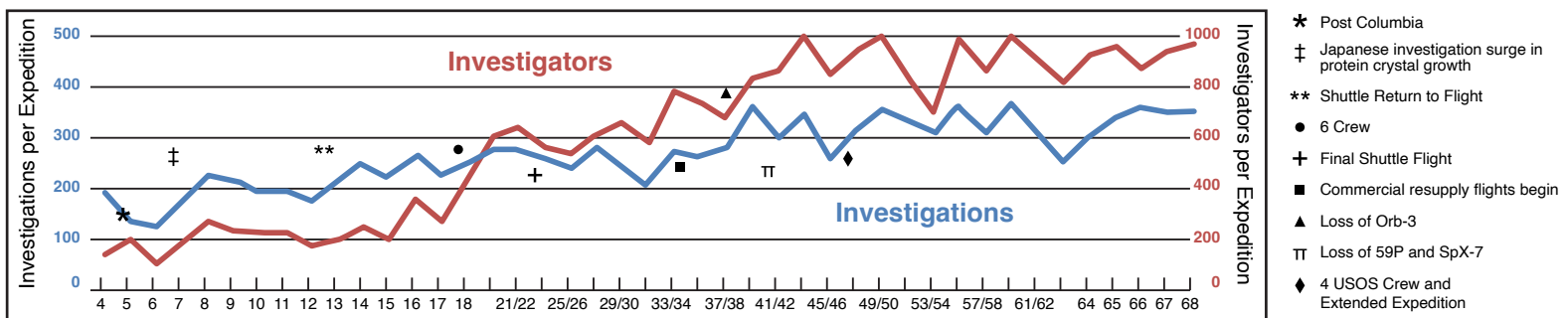
The information below provides an overview of ISS utilization up to the end of March 2023. An Expedition pair reflects the 6-month period used by the ISS Program for planning and execution of its activities. The utilization reflects activities of all of the ISS International Partners: CSA, ESA, JAXA, NASA, and ROSCOSMOS. An investigation is defined as a set of activities and measurements (observations) designed to test a scientific hypothesis, related set of hypotheses, or set of technology validation objectives. Investigators include the principal investigator(s) and co-investigator(s) that are working to achieve the objective of the investigation.

<i>Research Investigations</i>	ISS Expedition 67 Mar 2022 — Sep 2022	ISS Expedition 68 Sep 2022 — Mar 2023	ISS Expeditions 0-68 Dec 1998 — Mar 2023
Total Investigations	347	350	3742
New Investigations	87	126	-
Completed/Permanent Investigations	150	179	3072
Number of Investigators with Research on the ISS	932	956	5308
Countries/Areas with ISS Investigations	52	54	116
<i>Research Resources</i>	ISS Expedition 67 Mar 2022 — Sep 2022	ISS Expedition 68 Sep 2022 — Mar 2023	ISS Expeditions 0-68 Dec 1998 — Mar 2023
Upmass	809 kg	1796 kg	98195 kg
Downmass	701 kg	662 kg	31000 kg
Crew Time	2438 hrs	2099 hrs	61181 hrs

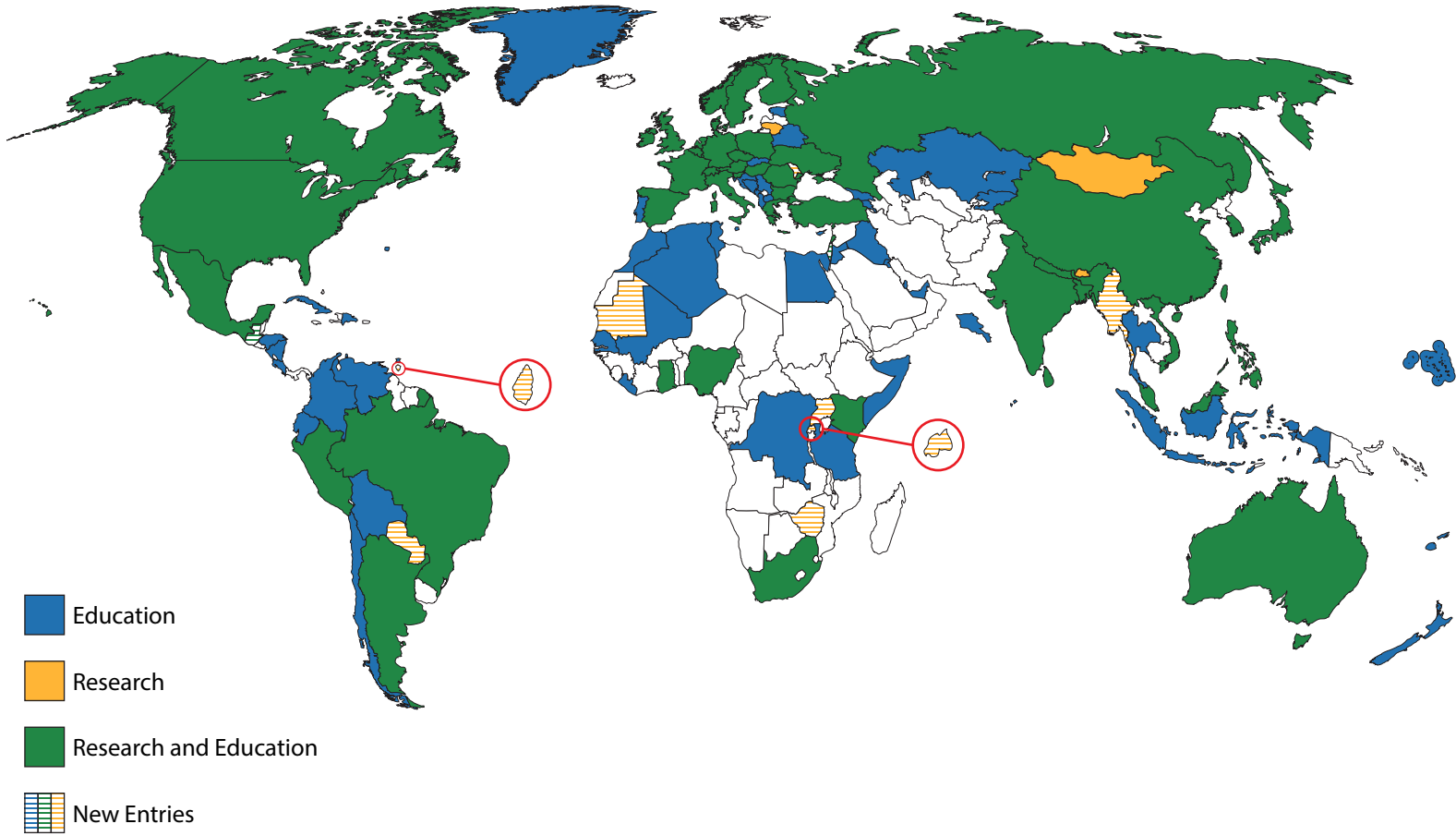
RESEARCH DISCIPLINES OF INTERNATIONAL SPACE STATION INVESTIGATIONS BY PARTNER AGENCIES



Number of Investigations and Investigators with Research on the ISS per Expedition



International Participation on ISS



116 highlighted countries and areas have participated in ISS Research and Education Activities

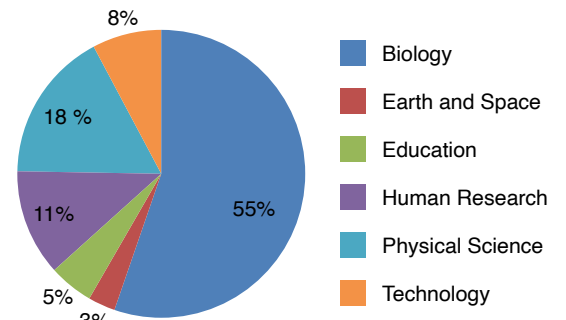
International Collaboration on ISS

ISS Benefits Increased Through International Collaboration

Partner Agency*	Agency Only	Collaboration (Hosting)	Investigations Implemented	Collaboration (Participating)	Total Agency Impact	% Increase Through Collaboration
CSA	36	13	49	51	100	104%
ESA	358	107	465	386	851	83%
JAXA	686	257	943	203	1146	22%
NASA	1329	283	1612	140	1752	9%
ROSCOSMOS	343	312	673	288	943	44%
Totals			3742	1068	4792	29%

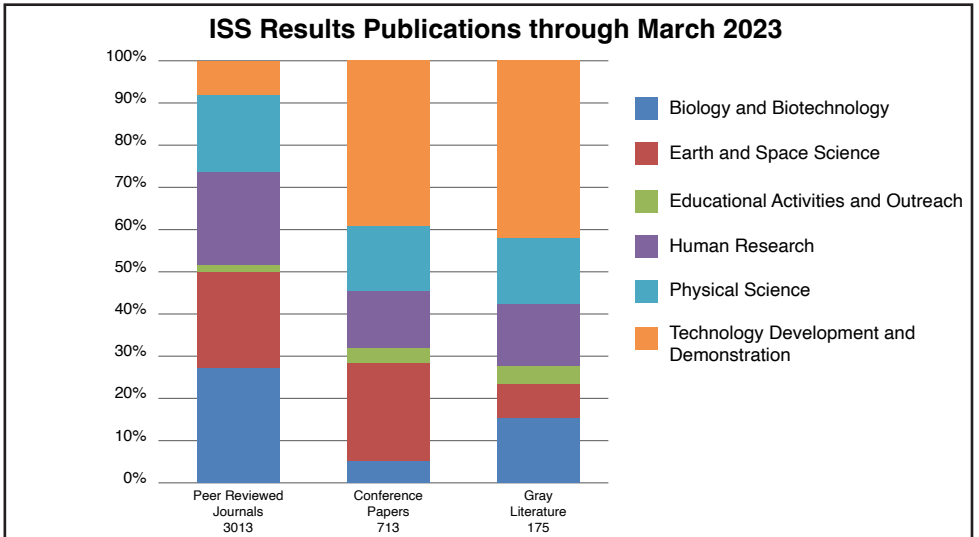
*NASA utilization includes 70 investigations, ESA utilization includes 3 investigations, and ROSCOSMOS utilization includes 1 investigation by the Italian Space Agency (ASI), an ISS Participant Agency.

International Collaboration Percentage by Investigation Categories



International Space Station Publications Data

Clarivate Analytics® Ranks	Source (Number of Publications)
1	Nature Communication (5)
2	Scientific Reports (66)
3	Nature (9)
4	Science (5)
5	PLoS One (50)
6	New England Journal of Medicine (1)
7	PNAS (7)
9	Cell (2)
13	Physical Review Letters (53)
15	ACS Applied Materials & Interfaces (1)
17	Science of the Total Environment (1)
19	Science Advances (6)
21	International Journal of the Molecular Sciences (26)
25	Nature Medicine (1)
26	Cell Reports (7)
30	The Astrophysical Journal (107)
31	Monthly Notices of the Royal Astronomical Society (68)
32	Frontiers in Immunology (1)
33	Circulation (2)
38	Physical Review D (14)
43	Frontiers in Microbiology (21)
50	Astronomy & Astrophysics (22)
57	Geophysical Research Letters (10)
60	Journal of Alloys and Compounds (2)
65	Journal of Physical Chemistry (1)
70	Sensors (2)
78	Journal of Biological Chemistry (1)
82	Nutrients (1)
83	Optics Express (3)
87	Molecules (3)
89	Construction and Building Materials (1)
92	Frontiers in Plant Science (8)
96	Journal of High Energy Physics (1)
97	JAMA Network Open (2)
100	Chemistry - A European Journal (1)



Publications in Top 20 Global Journals from October 2022 - March 2023*

CAL researchers have gained the ability to precisely control Bose-Einstein Condensates (BECs) aboard the ISS using fast transport procedures. BEC is a dilute gas state of matter in which individual atoms become denser and come together. Researchers were able to move a cloud of neutral atoms in BEC over one millimeter and reduce the expansion energy of the quantum gas. This achievement demonstrated that it is possible to create and manipulate an atomic source in a quantum state. This research opens doors to future fundamental physics investigations in space and it may improve the processing techniques used in quantum information science (*Gaaloul, Nature Communications, 2022*).

JAXA Micro Monitor researchers developed a new framework to monitor microbes in potable water collected from the ISS. The methodology takes advantage of fluorescence naturally produced by cellular flavins to easily identify different microbial communities. The implementation of this new procedure on ISS would allow crew members to continuously monitor water quality to detect bacterial outbreaks (*Ichijo, Scientific Reports, 2022*).

Biotube-MICRO researchers assessing the effects of a high-gradient magnetic field on plant growth and metabolism in microgravity found that plants can perceive weightlessness and adjust their metabolism. Further investigation on the role of starch genes is necessary to develop an understanding of how space affects the chemical structure and physical rigidity of plants (*Hasenstein, Scientific Reports, 2022*).

Drop Vibration researchers studying droplet mechanics observed centimeter-sized drops, which are 10 times larger than what is typically observed in Earth-based experimental samples, with a 30-fold amplification in timescale of droplet movement. These results improve the understanding of wetting dynamics, contact line mathematics, and it influences the design of materials with controllable wetting properties. (*McCraney, Physical Review Letters, 2022*).

JAXA researchers used data from the **CALET** telescope to measure the ratio of boron flux to carbon flux from cosmic rays over a period of 6.4 years. Analysis showed similar spectral energy characteristics occurring at the same energy levels despite their differences in energy dependence. These results are consistent with AMS-02 data. The data provide clues towards a better understanding of cosmic ray origins and distributions in our galaxy (*Adriani, Physical Review Letters, 2022*).

Top 5 Most Cited ISS Results Publications Overall

AMS-02 has collected and analyzed billions of cosmic ray events, and identified 9 million of these as electrons or positrons (antimatter), providing data that may lead to the solution of the origin of cosmic rays and antimatter, increasing the understanding of how our galaxy was formed. (AMS Collaboration, *Physical Review Letters*, 2013. Times Cited = 790)

NICER estimated the mass and radius of the isolated 205.53 Hz millisecond pulsar PSR J0030+0451 using a Bayesian inference approach to analyze its energy-dependent thermal X-ray waveform. Neutron stars are of great interest to astrophysicists and nuclear physicists because their attributes can be used to determine the properties of the dense matter in their cores. (Miller, et al., *Astrophysical Journal Letters*, 2019, Times Cited = 602)

Subregional Bone found that the greatest space-induced bone loss occurs in pelvis, hip, and leg bones, which should be the focus of countermeasures and surface activities designed for crew members on future missions beyond low Earth orbit. (Lang, et al., *Journal of Bone and Mineral Research*, 2004. Times Cited = 560)

MAXI was the first payload attached to JAXA's module KIBO. With multiple advanced cameras, MAXI provides an all-sky X-ray image for every ISS orbit. This publication summarizes the technical details of the payload and its objectives (Matsuoka, et al., *Publications of the Astronomical Society of Japan*, 2009. Times Cited = 535)

VIIP describes clinical findings and examines possible causes of ophthalmic conditions discovered in crew members after space flight. Data from surveys documented a degradation in distant and near visual acuity. Scientists hypothesized that vision changes may result from cephalad fluid shifts induced by prolonged microgravity exposure. (Mader, et al., *Ophthalmology*, Times Cited = 404)

*There were 9 papers with ISS Results published in the Top 20 Globally Ranked Journals from October 2022 – March 2023.