

ROSCOSMOS

# INTERNATIONAL SPACE STATION

## Utilization Statistics

Expeditions 0 – 58

*December 1998 – March 2019*



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 2019. 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 Expeditions 55/56 Feb 2018 – Oct 2018	ISS Expeditions 57/58 Oct 2018 – Mar 2019	ISS Expeditions 0-58 Dec 1998 – Mar 2019
Total Investigations	356	303	2775
New Investigations	140	93	-
Completed/Permanent Investigations	103	79	2098
Number of Investigators with Research on the ISS	975	851	4022
Countries/Areas with ISS Investigations	58	49	108

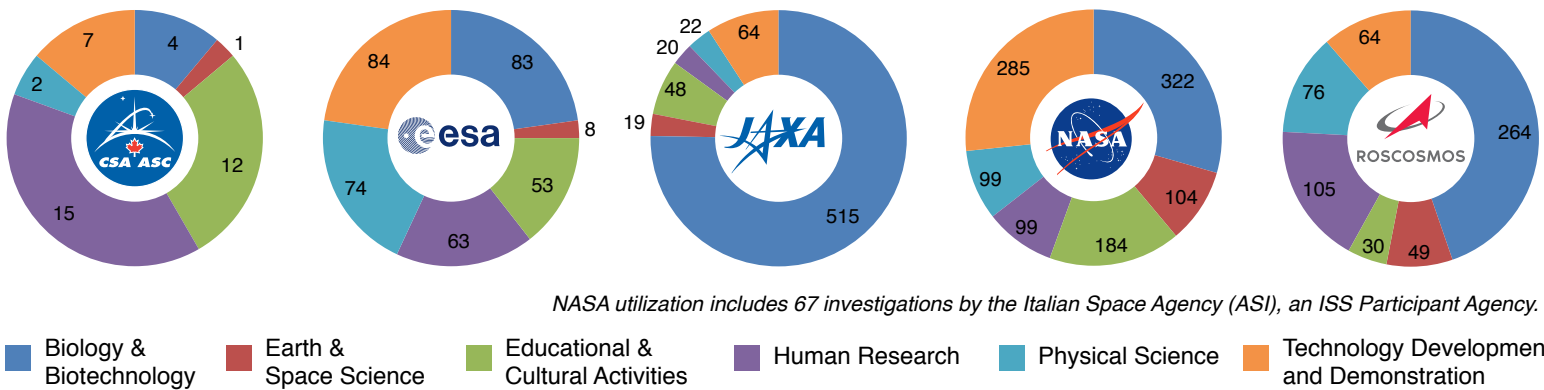
<i>Research Resources</i>	ISS Expeditions 55/56 Feb 2018 – Oct 2018	ISS Expeditions 57/58 Oct 2018 – Mar 2019	ISS Expeditions 0-58 Dec 1998 – Mar 2019
Upmass	4114 kg	2814 kg	78514 kg
Downmass	1064 kg	833 kg	23559 kg
Crew Time	2997 hrs	1144 hrs*	43099 hrs

<i>Number of Current Investigations on the International Space Station ‡</i>	ISS Expeditions 59/60 Mar 2019 – Sep 2019
Total Investigations	388
New Investigations	139
Number of Investigators with Research on the ISS	982
Countries/Areas with ISS Investigations	36

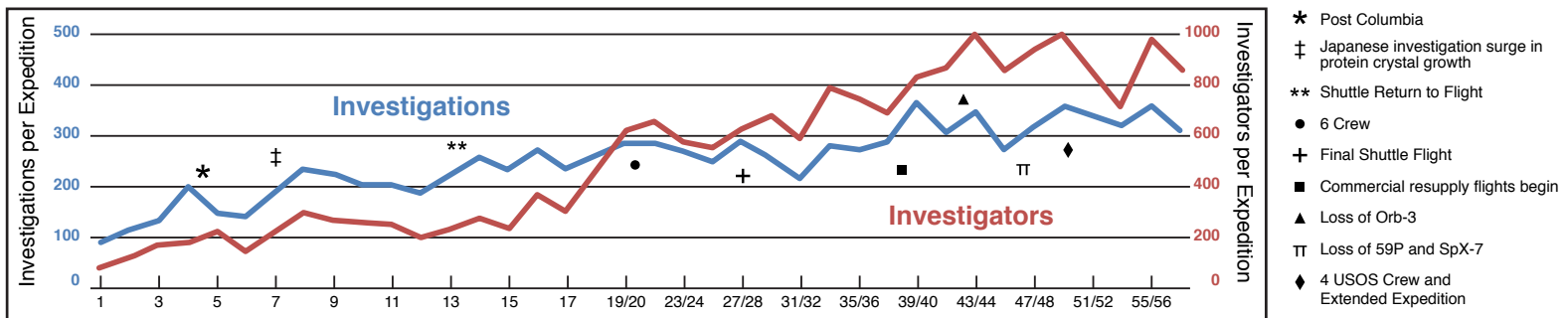
‡ The investigations statistics represented in the Current Investigations reflect research planned for Expeditions 59/60. Future utilization projections are expected to increase as new integration process allows later manifesting of experiments. The numbers of investigations actually performed will be reported after completion of the expeditions.

\* Expedition 57/58 crew time is lower than average due to the 56S launch anomaly and 3 crew on board.

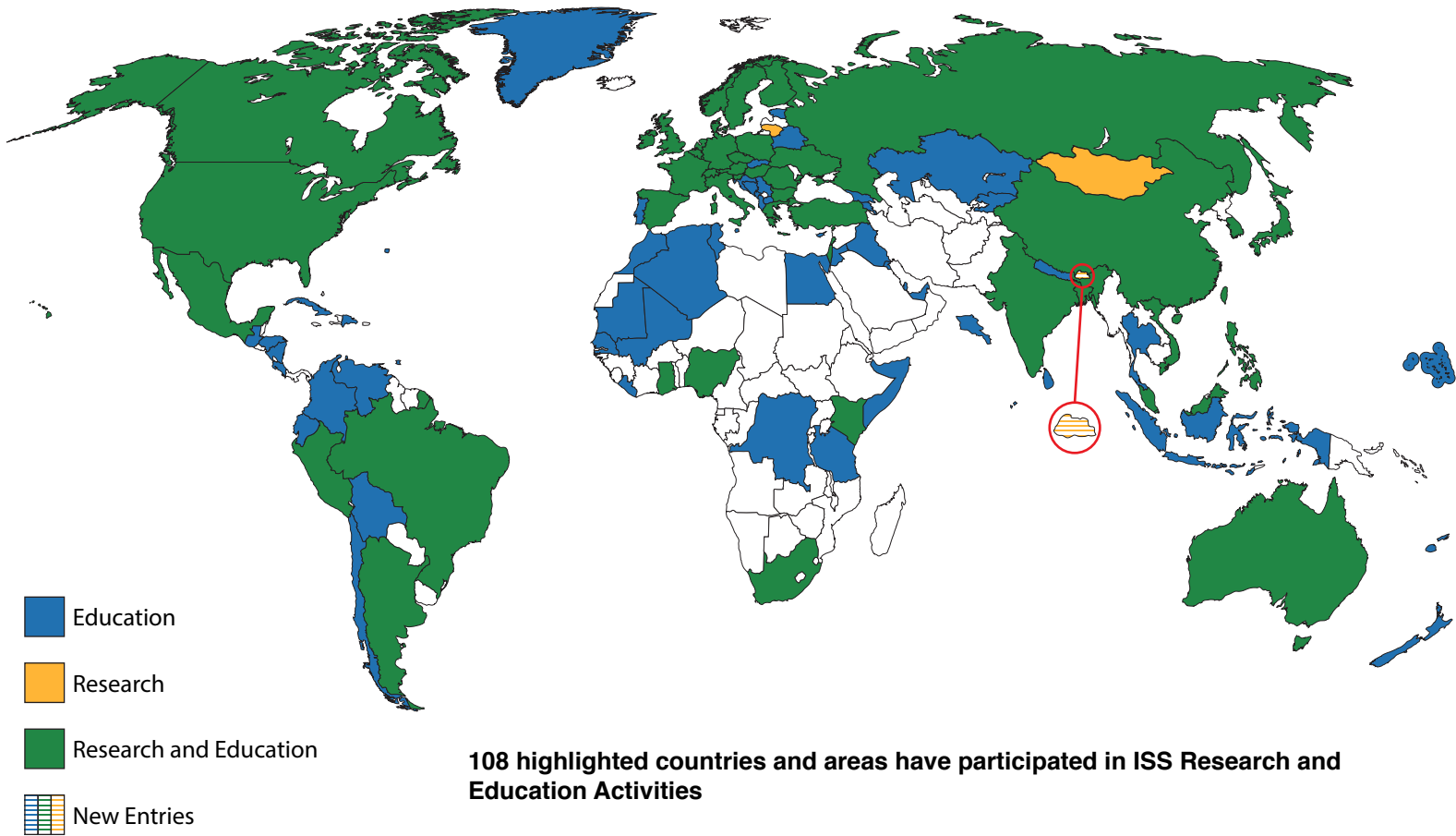
## RESEARCH DISCIPLINES OF INTERNATIONAL SPACE STATION INVESTIGATIONS BY PARTNER AGENCIES



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



# International Participation on ISS



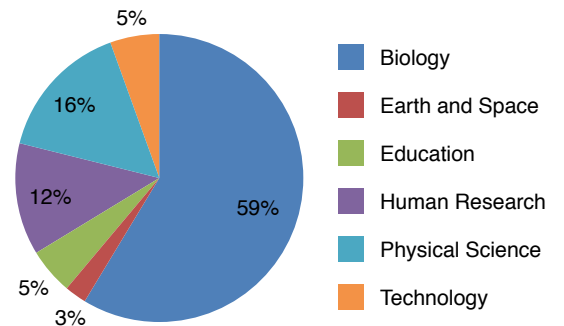
# International Collaboration on ISS

ISS Benefits Increased Through International Collaboration

Partner Agency	Agency Only	Collaboration (Hosting)	Investigations Implemented	Collaboration (Participating)	Total Agency Impact	% Increase Through Collaboration
CSA	31	10	41	33	74	80%
ESA	273	92	365	320	685	88%
JAXA	442	246	688	157	845	23%
NASA*	880	213	1093	113	1206	10%
ROSCOSMOS	329	259	588	277	865	47%
<b>Totals</b>			2775	900	3675	32%

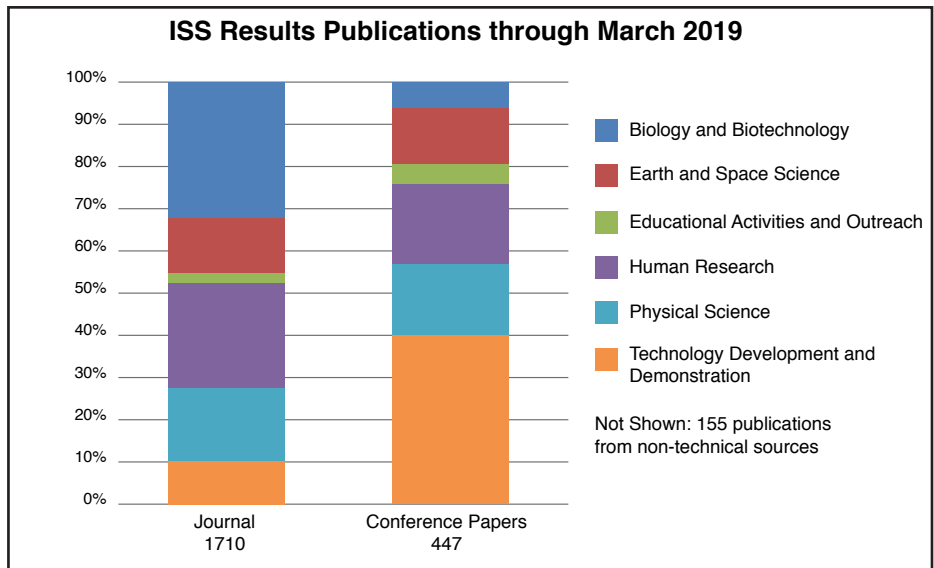
\*NASA utilization includes 67 investigations by the Italian Space Agency (ASI), an ISS Participant Agency

International Collaboration Percentage by Investigation Categories



# International Space Station Publications Data

Clarivate Analytics® Ranks	Source (Number of Publications)	
ISS Publications in Top 20 Sources	1 PLOS ONE (44)	
	2 Nature (3)	
	3 Science (3)	
	4 PNAS (4)	
	5 Nature Communications (1)	
	7 Scientific Reports (30)	
	8 New England Journal of Medicine (1)	
	9 Physical Review Letters (37)	
	15 Advanced Materials (1)	
	16 The Astrophysical Journal (12)	
	18 Chemical Communications (1)	
	20 Journal of Biological Chemistry (2)	
	ISS Publications in Top 100 Sources	21 RSC Advances (1)
		25 Monthly Notices of the Royal Astronomical Society (3)
26 Applied Physics Letters (1)		
29 Journal of Neuroscience (1)		
42 Astronomy and Astrophysics (3)		
46 Optics Express (2)		
48 Chemistry - A European Journal (1)		
51 Geophysical Research Letters (6)		
63 NeuroImage (1)		
67 The Journal of Chemical Physics (5)		
77 Physical Review E (2)		
89 Langmuir (3)		
94 Biomaterials (1)		
96 The Astrophysical Journal Letters (7)		



### Publications in Top 20 Global Journals from October 2018 - March 2019

The student-designed **Genes in Space – 4** investigation used a miniaturized thermal cycler system for DNA extraction to create complementary DNA (cDNA) to study gene expression in space. The procedures expand the molecular biology capabilities of the ISS, enabling new analysis of genetic changes during spaceflight missions (Montague TG, *PLOS ONE*, 2018).

**NICER** measured the x-ray spectra of the stellar black hole MAXI J1820+070 as its corona contracted from 100 miles to 10 miles high above the disk. Furthermore, the observed lag times between the soft and hard x-ray spectra of 6 to 20 times, shorter than previously seen, are attributable to the shrinking corona rather than to a reduction of the accretion disk radius (Kara E, *Nature*, 2019).

The **Manual Control** investigation assesses astronauts' sensorimotor and cognitive performance after spaceflight. Results show the root of astronauts' cognitive impairment is due to factors associated with spaceflight rather than simply fatigue alone or lack of practice, enabling the development of potential countermeasures (Moore ST, *Scientific Reports*, 2019).

**AMS-02** has collected over 1.5 million positrons with energies up to 1 TeV. This flux is consistent with the existence of a new source of high-energy positrons with a characteristic cutoff energy indicating dark matter or other astrophysical origins. These discoveries advance our understanding of new phenomena in the cosmos (AMS Collaboration, *Physical Review Letters*, 2019).

From March to June of 2018, the **MAXI J1820+070** was the second brightest star in the X-ray spectrum. It gradually increased in brightness over a 3-month period. Multiple optical and radio observatories conducted follow-up observations. Data reveal MAXI J1820+070 to be a binary star system consisting of a black hole and a normal star (Shidatsu M, *The Astrophysical Journal*, 2018).

### 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. (Aguilar-Benitez M, et al, *Physical Review Letters*, 2013. Times Cited = 582)

**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 space explorers on future missions beyond low Earth orbit. (Lang TF, et al, *Journal of Bone and Mineral Research*, 2004. Times Cited = 430)

**MAXI**, in coordination with the gamma-ray burst satellite Swift (USA), observed the instant that a massive black hole swallowed a star located in the center of a galaxy 3.9 billion light years away. This behavior had only been theorized before, and this first-ever observation contributes to a better understanding of the current state and evolution of the universe. (Burrows DN, *Nature*, 2011. Times Cited = 260)

**Microbe** implicated that the Hfq (RNA chaperone) protein acts as a major post-transcriptional regulator of Salmonella gene expression. (Sittka A, et al, *Molecular Microbiology*, 2007. Times Cited = 248)

**Astrovaksina** showed that the localization of the V-antigen in Yersinia plays a crucial role in the translocation process and its efficacy as the main protective antigen against plague. (Mueller CA, et al, *Science*, 2005. Times Cited = 252)