November 2024 - Issue 147

ORBIT

Astro Space Stamp Society

100 Years of Planetariums

In this issue

Space Planes

The Northern Lights from the Isle of Man

Polaris Dawn

US mail on the Moon

The Journal of the Astro Space Stamp Society

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Editorial

Welcome to the latest issue of Orbit. We have another full packed issue for you.

Did you know that it was a 100 years ago the the first planetarium was built. Renato Dicati takes us on a journey of the past 100 years of the planetarium.

Nik Steggall continues with the space planes and also he has a look at some of the Astronauts and Cosmonauts Deceased in 2024.

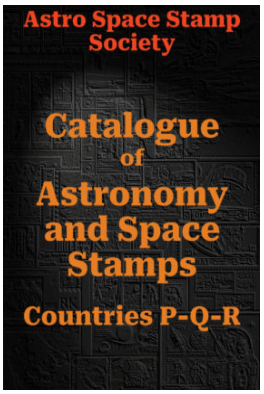
Umberto Cavallaro looks at Kathleen Rubins: a laboratory microbiologist turned astronaut and Nik also has a report of Polaris Dawn.

I have finished the Catalogue of Astronomy and Space Stamps Countries P-Q-R. The link is on the right and I hope to have Countries S ready for the next issue (January) of Orbit.

Is there any member out there who would like to keep the website and blog site up to date, it's only about an hour a week just to keep it up to date, if you can please get in touch.

We have no competition this month but we will have one in the next issue.

Derek



For the Catalogues of Astronomy and Space Stamps - Female Astronauts - Star Trek and Star Wars

Link one (Playbook): **Click Here**

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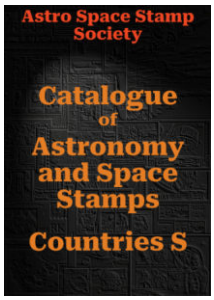
In the January issue of Orbit.

Catalogue of Astronomy and Space Stamps Countries S



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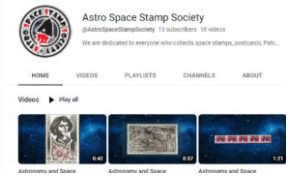

For the Astro Space Stamp Society website

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BLOG

Kathleen Rubins: a laboratory microbiologist turned astronaut

By Umberto Cavallaro

This article first appeared in AD*ASTRA # 47 (December 2020)

A microbiologist in space: quite an unconventional educational path! A doctor in cancer biology, Rubins was the first researcher to sequence DNA in space.

"A space-based DNA sequencer would be an important tool to help protect future explorers' health during long duration missions. – NASA stated – With a way to sequence DNA in space, astronauts could diagnose an illness, or identify microbes growing in the International Space Station or in the spacecraft, and identify DNA-based life forms beyond Earth, and determine whether or not they represent a health threat."

Kathleen Hallisey "Kate" Rubins *(above)* was born in Farmington, Connecticut on 14 October 1978, in the year when NASA opened the space programme to female applicants. Only one woman had flown in space at the time.

"There's never been a time when I was a kid that I couldn't remember wanting to be an astronaut. It was always my standard 'little kid' answer when I was four, five, six, eight, twelve years old. I wanted to be an astronaut, a biologist and a geologist,"

Always fascinated with science and exploring our world, from microbes to the solar system as a kid she was an avid reader of Sky and Telescope magazine, and recalls learning the constellations with her dad and going to local science museums in the San Francisco Area.

Space Camp

Raised in Napa, California, she graduated from Vintage High School in 1996. In seventh grade to earn her trip to Space Camp she helped completing chores around the house. She left camp knowing she needed to apply herself with dedication to math and science if she wanted her dream come true.

In high school, fascinated with molecular biology and viruses, she started working on public health prevention of HIV, and in 1999 she

DNA in space for the first time.

earned her Bachelor of Science degree in Molecular Biology from the University of California, San Diego. Her research focused on HIV-1 integration, and she continued along that path for more than 10 years. She conducted her undergraduate research in the Infectious Diseases Laboratory at the Salk Institute for Biological Studies in San Diego, where she analyzed the mechanism of HIV integration, including several studies of HIV-1 integrase inhibitors and genome-wide analyses of HIV integration patterns into host genomic DNA.

She obtained her Ph.D. in Cancer Biology in 2005 from Stanford University Medical School Biochemistry Department and Microbiology and Immunology Department in Palo Alto, California.

U.S. Army Medical Research Institute

With the U.S. Army Medical Research Institute of Infectious Diseases and the Centers for Disease Control and Prevention, she was part of the team that developed the first model of smallpox infection, and developed a complete map of the poxvirus transcriptome and studied host-pathogen interactions using both in-vitro and animal model systems, focusing on a number of very famous filoviruses (such as Ebola and Marburg), and and arenaviruses (such as Lassa). In addition, she conducted collaborative projects with the U.S. Army to develop therapies for Ebola and Lassa viruses.

From 2007 to 2009 she worked at the Whitehead Institute for Biomedical Research at MIT in Cambridge, Massachusetts, where she started her own research lab as Fellow/Principal

Soyuz MS-01 Spacecraft Mission Patch.

Investigator leading a team of 14 researchers studying viral diseases that primarily affect Central and West Africa. She traveled to the heart of the rainforest in the Democratic Republic of Congo to conduct research and supervise study sites. After this experience she was involved with health care/medical supply delivery to Africa and started a non-profit organization to bring supplies to Congo.

Her work was published in several scientific journals and presented in numerous papers at international scientific conferences. In 2009 she was selected by "Popular Science" magazine as one of its "Brilliant 10".

NASA's Call For Astronauts

It was while she was at the Whitehead Institute – when Kate was pretty intent on running her lab and being a faculty member for the rest of her life – that she knew about the NASA's call for astronauts. *"They had astronaut applications online – she recalls – It was a childhood dream of mine, to be an astronaut, biologist and a geologist. I didn't think I had a chance, but I did apply!"*

Encouraged by one of her co-Principal Investigator she applied for the NASA programme, and she was selected in July 2009 as one of 9 members of the 20th NASA astronaut class, also known as "The Chumps", chosen from over 3500 applicants.

She confesses being stunned, humbled and overwhelmed when she knew she was selected: *"There were so many truly amazing candidates during the interview process; I was counting myself lucky just to get to interact with them."*

She completed her training in November 2011, officially becoming available for future flight assignments. This was the first group of astronauts selected for the post-Space Shuttle era, and not trained to fly the Shuttle.

International Space Station

In September 2013 together with the astronauts Joseph Acaba (NASA), Andreas Mogensen (ESA) and Soichi Noguchi (JAXA), she participated in SEATEST II (Space Environment Analog for Testing EVA Systems and Training), the 4-days NASA underwater mission – in the Aquarius laboratory – formerly known as NEEMO XVII, focused on engineering evaluations of new technologies for extravehicular activities (EVAs), testing crew procedures that might be used on the International Space Station and practising spacewalks underwater.

Cover for the newly upgraded Soyuz MS-01 spacecraft.

Kate was assigned to Expeditions 48/49 on the International Space Station and was launched on July 7th, 2016, from the Baikonur Cosmodrome in Kazakhstan aboard Soyuz MS-01, the first flight of the newly upgraded Soyuz MS-01 spacecraft.

Together with the international crew on the ISS, she conducted or participated in more than 275 different scientific experiments, including tests to study the effects of weightlessness and combat the loss of bone and muscle mass during longterm space flight. Many of the tests were designed to prepare for a mission to Mars, a journey of several months that would far exceed any manned flight in microgravity to date.

Biomolecule Sequencer

One of the most publicized experiments during this mission, was the NASA's *"Biomolecule Sequencer"* experiment performed in August 2016: a technology demonstration of a new tiny device called the MinION™, developed by Oxford Nanopore Technologies that was already being used to sequence DNA on Earth.

The investigation's objective was to evaluate the operability of the DNA sequencer in the International Space Station's microgravity environment to see if DNA could be sequenced and analyzed in real-time, allowing for fast results in space environments.

This operation was planned for a long time, with a team that included scientists at NASA's Johnson Space Center, NASA's Goddard Space Flight Center, NASA's Ames Research Center, Weill Cornell Medical College, the University of California San Francisco and Oxford Nanopore Technologies. *"It was so exciting to be able to do the experiment, get the reaction, and see the data come through in real time.* – Rubins said – *It was such a great moment for all of the researchers that worked so hard for so many years on this project."*

The experiment demonstrated the feasibility of quickly assessing genetic material of a sample in space. *"We really wanted to look at anything to get a real-time answer while sequencing information,* – Rubins explained. – *Transferring*

data back down via spacecraft can take months. If you want an answer about infection or environmental sample [in space], now we can do that in real time".

Infectious Disease

Real-time analysis on the space station or on Mars could identify microbes, diagnose infectious disease, and collect any form of genomic and genetic data concerning crew health, measure the impact of spaceflight on the human body, inform medical interventions and define the effectiveness of countermeasures.

During the long investigation, crew members sequenced over 2 billion base pairs of DNA of bacteria, including E. coli bacteria bacteriophage (a virus that infects and replicates within a bacterium) and rodents from samples prepared on Earth that have known genomic characteristics.

The Soyuz MS-17 mission patch marked Russia's first use of dye-sublimation.

Researchers on Earth also were running synchronous ground controls to evaluate how well the hardware was working in microgravity. Kate also grew heart cells (cardiomyocytes) in cell culture, and performed quantitative, real-time PCR and microbiome experiments in orbit.

In April 2016 Kate, with Jeffrey Williams, successfully captured SpaceX CRS-8, the tenth flight of a Dragon commercial resupply spacecraft that carried to the ISS over 3,100 kilograms of cargo, including the Bigelow Expandable Activity Module (BEAM), a prototype inflatable Space Station's Expandable Habitat which was attached to the ISS for two years of in-orbit viability tests.

Galactic Cosmic Radiation Levels

After BEAM was attached to the station, at the end of May it was expanded and correctly pressurised in an effort to test and validate expandable habitat technology. One of Kate's tasks was also to inspect the new module. Kate entered BEAM to install inside the module temporary monitoring equipments. Early results from monitors have shown that galactic cosmic radiation levels are comparable to those in the rest of the space station. *(see note 1)*

On October 16 Kate and crewmate Takuya Onishi using the station's robotic arm grappled Orbital ATK's Cygnus OA-5 resupply spacecraft, providing several tons of supplies and research experiments for future work on the orbital outpost.

International Space Station Expedition 48/49 astronaut Kate Rubins of NASA, Russian cosmonaut Anatoly Ivanishin and Japan Aerospace Exploration Agency (JAXA) astronaut Takuya Onishi.

Spacewalks

Kate conducted two spacewalks with veteran spacewalker Jeff Williams, totaling 12 hours and 46 minutes. During her first spacewalk, on 19 August 2016, they installed the first International Docking Adapter, a new docking port for U.S. commercial crew spacecraft being developed by SpaceX and Boeing. During the second, on 1 September 2016, they performed maintenance of the station external thermal control system and installed high-definition cameras, enabling never-before seen images of the planet and space station.

She returned to Earth on 30 October 2016 after 115 days in space and experienced the final stretch of the presidential election race won by Trump. *"The one thing that I'm pretty glad I'm missing, frankly, is the U.S. election season. It's a little nice to be off the planet right now."* she said before undocking.

Also it happened her to leave the hard-fought battleground and skip the final rush of the US bitter presidential campaign in 2020. She left almost three weeks before and cast her vote from space.

Soyuz MS-17

Her reassignment to a second flight came in fact unusually quickly for a NASA astronaut of the current Space Station-only era, at just under three years after her return from her first flight.

Soyuz MS-17 Cover.

NASA astronaut Kate Rubins prepares a run of Biomolecule Sequencer experiment, which sequenced DNA in space for the first time.

She was the first member of her astronaut group to fly in space twice. She was launched aboard the Russian Soyuz MS-17 from Baikonur on 14 October 2020, while celebrating her 42nd birthday.

This Soyuz flight successfully attempted a new "ultrafast" two-orbit rendezvous method that allowed the fastest ever journey from Earth to the ISS, halving the time it previously took to get to the ISS: a time that was however a definite improvement if compared with the traditional 34 orbits flights prior to 2013, keeping the crew inside the small spacecraft for over two days.

This new flight profile was possible with the introduction into service of the new launch vehicle Soyuz-2.1a, which has performance and control system capabilities that enable high-precision orbital insertion of spacecraft.

This new improvement, in a re-ignited space race between the two countries after the relaunch of manned spaceflight from the United States with NASA's Commercial Crew programme, was of immense importance to Russia's space agency Roscosmos. *"A new record for flights to the International Space Station was set: for the first time in the world, a manned spacecraft docked to the ISS, having completed only two orbits around the Earth – In addition, a new record was set for flights to the International Space Station: the total time from launch to docking of the Soyuz MS-17 was three hours and three minutes"*, Roscosmos said in a statement.

Stringent Precautions

Kate was likely the last NASA representative to fly the Russian capsule. Due to the COVID-19 pandemic, stringent precautions were needed as the crew prepared for their journey to the Station, including tighter quarantine and mask-wearing before launch, in order to avoid any risk of infection on the ISS, although she was comfortable with personal protective equipment because of her "old life".

"It's been the best birthday I ever had" Kate said, replying to the wishes after entering the ISS.

The current long-duration Expedition 64 officially began on 21 October 2020 with the undocking and departure of Soyuz MS-16 and reached its full complement with the arrival of SpaceX Crew-1, the first operational flight of NASA's Commercial Crew Programme (CCP). As Crew-1 consists of a crew of four, Expedition 64 marks the beginning of operations for crews of seven on the ISS.

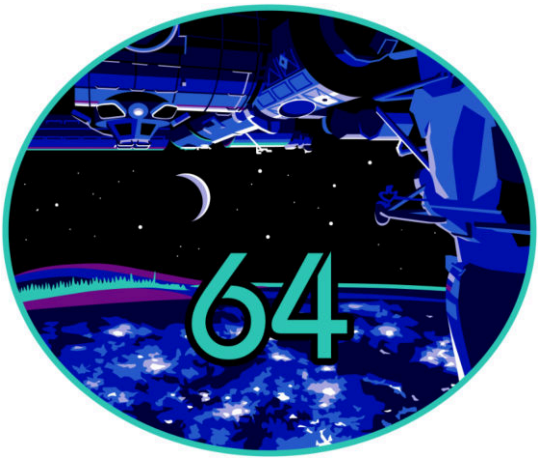
Hundreds of Experiments

Among some of the hundreds of experiments ongoing during her mission, Kate is conducting research using the Cold Atom Lab to study the use of laser-cooled atoms for future quantum sensors, work on a cardiovascular experiment that follows up on an investigation she worked on during her previous mission, and continue her study on the microbial environment of the Space Station as a whole (the ISS marked its 20th anniversary of continuous human presence on 2 November 2020).

"We're trying to understand the microbiological environment of space station. – Rubins said before leaving – *We normally carry bacteria with us all the time. We would expect that there is a lot of bacteria up here. The space station is a very nice and clean environment, but it's not a sterile environment. It has been separate from Earth for 20 years. How is it different? The space station is its own biome with its own resources, with humans coming and going. We want to see what these closed environments do when they've been separate for a long time. It's a huge opportunity that may not present itself again because nothing has ever been isolated from Earth for 20 years."*

Since her previous stay on the Station, there are now on board new high-resolution microscopes she can use to study cells. Experience gained on the orbiting lab will also support Artemis NASA's programme to go forward to the Moon and on to Mars.

(Note 1) After exceeding performance expectations, the two years test was then progressively extended, and now expanded to a planned 12-years, to become a core cargo storage module on the volume-constrained Station.



The International Space Station Expedition 64 crew patch was designed based on a photo (in the background) taken by NASA astronaut Kate Rubins when she was last aboard the orbiting outpost in October 2016.