SIRIUS

ASGARDIA
THE SPACE NATION

ИМБП

ASGARDIA
in the SIRIUS-21 isolation experiment

A Space Researcher's Diary

ASGARDIA IS THE FIRST DIGITAL SPACE NATION IN THE HISTORY OF HUMANKIND

SPACE NETWORK

Space Phones

Launchers

Space Ports

Mission Control Centre

Manufacturing

Protective Space Platform

Asgardia National Ark (ANA)

Moon Settlements

Asgardia Moon Ark (AMA)

Asgardia Star Ark (ASA)

Lunar Orbit State Satellites

Earth Orbit State Satellites

Asgardia's motto is: "One Humanity – One Unity!"

Asgardia's Mission is: to provide for infinite continuity of humans as a biological species in the Universe by achieving the birth of the first human child in space

We are steadily moving towards our main goal – the birth of the first human child in space!

Igor Ashurbeyli,
Asgardia the Space Nation founder and Head of Nation, Doctor of Engineering

The Mission of Asgardia, the Space Nation that I announced on 12 October 2016, is the birth of the first human child in space to ensure the infinite continuation of the human species in the Universe.

This global goal defines a number of specific scientific and technological objectives, which need to be solved for humanity to leave its earthly cradle and fully explore outer space. In particular, these include the creation of technologies for artificial gravity and protection against space radiation. Space embryology and the protection of women's health from all the risks associated with being in space also play an important role in our research.

Only by globalising space science, by uniting the efforts of scientists, entrepreneurs and ordinary people over the borders of countries on planet Earth can humankind achieve real progress in the exploration of deep space. Asgardia will support and initiate international space projects that bring its main mission closer.

The influence of spaceflight factors specifically on the female body has so far received little attention in space science. The Institute for Biomedical Problems (IBMP) of the Russian Academy of Sciences is one of the few research centres in the world that is purposefully addressing this issue in order to accumulate sufficient statistical data to develop specialised medicines, technologies and methodologies. Asgardia's participation in the international isolation experiment SIRIUS-21, based at IBMP, is a big step towards the birth of the first human child in space.

The Institute of Biomedical Problems is a world leader in space medicine. It employs an entire galaxy of famous scientists. They are mentors and successors of those who were involved in preparing the groundwork for the first human spaceflights. Asgardia signed an Agreement with the Institute in 2021, when humanity was celebrating the 60th anniversary of the Vostok-1 mission. This was very symbolic of the beginning of a long-term and productive collaboration.

Asgardia marked its sixth anniversary by releasing the first results of its research activities: the SIRIUS-21 experiment implemented a programme to assess the impact of isolation as a risk factor in spaceflight on the female body. We are making progress towards our main goal.

Oleg Orlov,
Director of the Institute for Biomedical Problems of the Russian Academy of Sciences, Doctor of Medicine

A framework collaboration agreement between Asgardia and IBMP was signed in 2021. The Institute appreciates the prospects of this agreement; it should provide a platform for the continuous exchange of experience and ideas, enriching contacts between scientists and experts involved in space biology and medicine. Asgardia's participation in the SIRIUS project is the first practical stage of our collaboration.

The birth of a human child in space during an Earth orbit mission requires extensive and fundamental research into the reproductive function of the individual under the various factors of spaceflight. In addition, we need to be sure that a baby born in space conditions will be able to develop normally. Then we can consider that the goal has been achieved.

The SIRIUS-21 experimental programme is devoted to studying the adaptation processes that occur in the human body, including the female body, when simulating the complex of factors of a spaceflight in isolation in a containment unit with an artificial environment. We are moving towards our goal.

SIRIUS-21 scientific partner logos in the IBMP booklet for the third phase of the international SIRIUS science project

Mark Belakovsky,
Chief Manager of the SIRIUS International Scientific Project, PhD in Medicine

The international scientific SIRIUS project, comprising a series of isolation experiments lasting 17 days, 4 months, 8 months and 12 months, is directly related to Asgardia's main mission, the birth of a human child in space. Its results will help us prepare for the main experiment we will be conducting in the future.

In the isolation experiments, we primarily study the 'human factor', human relationships and psychophysiology. The overall programme of SIRIUS-21 included 88 experiments, both biomedical and technical.

We are studying the effects of zero gravity on the body in a separate series of experiments with dry immersion. In the case of space radiation, there are no experiments involving volunteers. Nevertheless, it is one of our main areas of study, and we deal with it in a comprehensive way. So far, it is not humans who are involved in such research, but other biological specimens — micro-organisms, insects and animals. And not just on Earth. Nowadays, so-called biological satellites are widely used.

The topic of a possible experiment with childbirth in space is a common theme in the global space community today. Everyone understands that humanity must advance into deep space, but to do so without haste, step by step, and consistently solving problems.

The birth of a baby in space is undoubtedly a very, very important task for future human spacefaring. But the future comes to us today, so we carefully study the female body under the influence of various factors of spaceflight, obtain complex scientific knowledge, generalise it, systematise it and move forward. I think this is an achievable task.

Floris Wuyts,
Asgardia's Minister of Science, Head of the University of Antwerp's Space Laboratory

Right now, only a handful of research groups in the world are doing great scientific work in the area of the future of procreation in space. Asgardia first brought them together at its Science and Investment Congress in Darmstadt, Germany, in 2019, offering them a dedicated platform to share the results of their work and bring the topics of artificial gravity, space radiation protection and space embryology to the fore. For a long time, these problems had not been addressed as deeply and seriously as required.

And that was just the beginning.

Now, we are no longer just creating a unique space to share experiences and ideas, we are moving space science forward. Asgardia has begun to put its scientific missions into practice by joining the international SIRIUS-21 project. The Institute of Biomedical Problems, the initiator and experimental base for this project, is a reputable and respected research centre in the global space community and we expect fruitful results from this collaboration.

The IBMP RAS ground test facility where the SIRIUS-21 isolation experiment took place. The space volumes and ergonomics of the five modules are as close as possible to space station conditions

Female physiological research – in the spotlight

The isolation part of the SIRIUS-21 experiment ended on 3 July 2022. Pictured: Asgardian resident physician Viktoria Kirichenko is the first to emerge from the isolation unit of the IBMP RAS ground test facility, where she spent eight months

Scientists from 14 countries took part in the international science project SIRIUS

The researchers spent 240 days in isolation during the international experiment SIRIUS-21 from 4 November 2021 to 3 July 2022

On 4 November 2021 an international crew of six — Oleg Blinov, crew commander (Russia), Ashley Kowalski, flight engineer (USA), Victoria Kirichenko, crew doctor (Asgardia), William Brown, researcher (USA), Saleh Omar Al Ameri, researcher (UAE), Ekaterina Karyakina, researcher (Russia) — started global research at the unique ground test facility of the Institute of Biomedical Problems. They were to stay in isolation for eight months (240 days), in an environment as close as possible to the conditions of the International Space Station. During this time they were subject to appropriate restrictions on movement, communication and receiving information from the outside. Cosmonauts experience a similar environment during space missions. Like cosmonauts, the ground explorers were also engaged in an extensive scientific programme.

The purpose of the experiment was to comprehensively study the impact of isolation on physical health, mental state, performance and communication skills, and to identify all associated stress factors. It is no coincidence that many cosmonauts consider isolation to be an even greater risk than zero gravity. As many participants in isolation experiments have noted, when you are in isolation for a long time, in silence, you begin to hear your own blood flow. Noises and rustles around you intensify, everything that happens zooms in, and circumstances that you do not pay attention to in everyday life become significant.

Eighty-eight experiments were carried out as part of the scientific programme of the international SIRIUS-21 isolation experiment

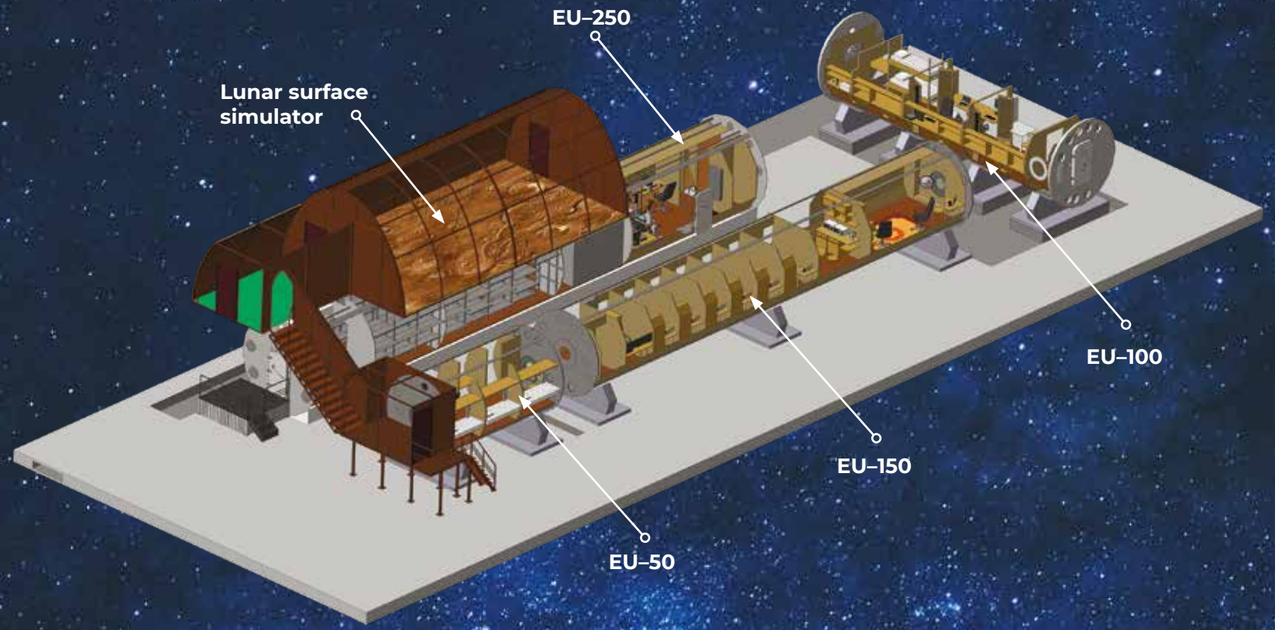
IMBP Ground Test Facility Control Room - from here SIRIUS-21 crew communications and test crew observations were carried out from 4 November 2021 to 3 July 2022

Research under the SIRIUS-21 scientific programme was conducted in the following areas: psychological and psychophysical research; physiological research, immunity and metabolic research; microbiological and sanitary-hygienic research; and telemedical research

For the entire 240 days, the research subjects were under the close scrutiny of doctors and psychologists. Their conditions were recorded daily in special questionnaires and video recordings, and biomaterial was taken regularly to study the changes that occurred in their bodies during isolation. The result was data that would be used to develop prevention methods and medicines to make it easier for people to stay in space for long periods of time.

Thanks to Asgardia's science programme, special attention was given to research of the female body. Physician Viktoria Kirichenko became the first ever research subject from the Space Nation. On the SIRIUS-21 crew, she was responsible for the implementation of a joint **scientific programme between Asgardia and the IBMP of the Russian Academy of Sciences, entitled 'Effect of 8-Month Isolation on the Microbiological and Immunological Status and Mineral Bone Metabolism in the Female Body'.**

General view of the ground test facility where the SIRIUS-21 isolation experiment took place



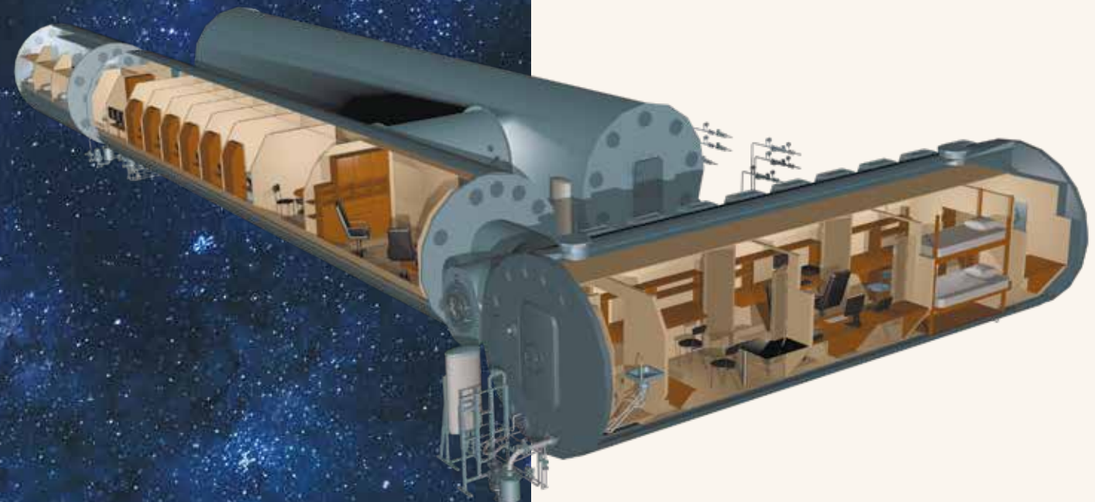
The test facility consists of five modules: experimental unit 50 (50 cubic metres) simulating a landing module; experimental unit 100 (100 cubic metres) for medical and psychological experiments; experimental unit –150 (150 cubic metres) — living module; experimental unit 250 (250 cubic metres) — warehouse; experimental module 'Moon Surface Simulator' (1200 cubic metres).

Scientists responsible for implementing the programme on the IBMP side:

Sergey Ponomarev, Head of Physiology of the immune system Laboratory, SIRIUS Project Executive Director, PhD in Medicine, member-correspondent of the International Academy of Astronautics;

Daria Komissarova, deputy Head of the Nutrition Gastroenterology and Hygienic Control Laboratory, PhD in Biology;

Galina Vasilyeva, Head of Bone and Metabolic effects of micro gravity Research Laboratory, PhD in Medicine, Full member of the International Academy of Astronautics.



First Asgardian Researcher

Victoria Kirichenko is an Asgardian resident, a surgeon (specialising in general surgery, radiology and endovascular surgery), a junior researcher in the department of operational management of spaceflight medical support, a PhD student at IBMP RAS in the field of basic medicine, aerospace and maritime medicine. As a researcher she participated in several experiments: 'female' dry immersion, 'Algometria', international project SIRIUS.

For her participation in the SIRIUS-21 isolation experiment and her personal contribution to the development of science in Asgardia, Victoria was awarded the Certificate of Recognition of the Head of the Space Nation established by Decree No. 61 of 5 July 2022 (18 Leo 0006 — by Asgardian calendar) and became the first recipient of this national award.

Victoria Kirichenko in a three-day experiment with 'female dry immersion', 2020. In an immersion bath, a person is in a state of near weightlessness

Asgardia resident Victoria Kirichenko and Head of Space Nation Dr Igor Ashurbeyli, 6 July 2022

The presentation took place on 6 July 2022, three days after the completion of the 240-day isolation experiment. Attached to the Certificate of Recognition was the Space Child badge, symbolising a breakthrough in space science and the path to immortality for the human species in the universe, discovered by the Space Nation.

Victoria plans to test her capabilities on a short-arm centrifuge. "Being a tester is really my thing!" she says.

"Being a tester is really my thing!" says Victoria Kirichenko

Lena De Winne,
Prime Minister of Asgardia,
joint Asgardia-IBMP Project gate-keeper

All my life I have admired (and, frankly, been jealous of in a friendly way), people who have an inner drive for pioneering. Their willingness to step into the unknown, to experience what the vast majority can only speculate about, enables humanity as a whole to advance.

Participants in long-term isolation experiments are subject to the same psychological and emotional challenges as spacecraft crews. Physical deprivation for many months, albeit under terrestrial gravity, is a very serious burden.

Conducting experiments in such a situation, that expand the scientific database on the female body is particularly valuable, as today women are still far less likely than men to be in space and to be the subjects of specialised biomedical research.

Viktoria Kirichenko,
an Asgardian resident, space physician, participant in SIRIUS-21 experiment

The space industry is very active at the moment, I can feel this progress. Of course, we will not find ourselves in deep space tomorrow. The movement is progressive, step by step, but there will be a breakthrough; I believe that. Both rocket production news and the results of international research attest to this. SIRIUS is an international project, and the participation of many countries in it shows that there is collaboration, and that the space industry is uniting, no matter what is going on in the world. This unification, the exchange of scientific data, is very important to achieve a common goal. Development goes on, boundaries and stereotypes are gradually breaking down, it can be seen even in the way the role of women in cosmonautics and space science is changing.

Little statistical data has been accumulated to assess the impact of spaceflight factors on female bodies. It is wonderful that projects like SIRIUS and programmes such as Asgardia's and IBMP's specialised study, in which researchers and scientists focus specifically on the female body's exposure to spaceflight factors, are now being launched. It is highly appreciated that Asgardia has a special focus on this and is interested in advancing the research work.

November 11
2021

Getting the spaceship settled

Time is rushing by at an inexorable rate as we hit day 7 of our lunar mission. All week long, inbetween science experiments, we've been making ourselves at home aboard our spaceship, making the space around us cosy and liveable.

Three specific studies were carried out as part of a joint programme between Asgardia and IBMP. Scientists evaluated the effects of eight months of isolation as a factor of spaceflight on the immunological, microbiological status and mineral-bone metabolism in a female body

Crew captain Oleg Blinov's cabin is "the size of a night stand" bigger than other cabins — a statutory requirement

On board we were fed with canned and freeze-dried food, including food specifically developed for the SIRIUS project

Surprisingly, it does not feel tiny and cramped - there is enough room for all of us. One can always find some privacy if needed.

Also surprisingly, freeze-dried food is proving to be edible. Although quite often meals have similar flavours, in this particular case our gastronomic variety is sprinkled with meals created especially for the SIRIUS project. For instance, we're all in love with our vitamin beet salad, squash and pumpkin spread. All in all, there's plenty of food, albeit no frills.

We make freeze-dried berry drinks and whatnot desserts (using freeze-dried berries and no less freeze-dried cottage cheese). Weight, as opposed to time, is in its usual place, and working out is not allowed yet, so we will have to endure hypodynamia for the next few weeks. We get along well, learn languages, watch movies, and play board games in our free time. I'm really curious to see what happens next.

November
2021

10

The routine is gradually changing

Now, an important stage along the way in my morning routine is a tunnel: a sort of a bridge, an underground passage leading to the medical module. It feels like diving down a rabbit hole. I guess a science lab mouse would feel the same. Before it gets its breakfast, they have to check a whole bunch of its vitals first: measure its blood

In isolation, I manage to keep some important parts of my routine. Just like in my regular life, my day starts at around 6 am. I just carry on with my life. Yet, our experimental setting introduces its own adjustments, as one would expect.

Performing medical duties: drawing blood and monitoring the physical condition of crew members

pressure three times, find out its temperature and body weight, and do a daily stress level check.

When you get to see your vitals overview for the last couple of weeks, you start to pay closer attention to your body, listen to it, and study it. At this point, it's important to avoid getting paranoid. If the figures still make you feel anxious (a spike in blood pressure or your weight affecting your self-esteem) you can always relax doing yoga or stretching your sleepy bones.

Greetings from the transition section - moving from the sports module to the living module

A cognitive experiment. In the mouth, a strip test measuring levels of amylase (an enzyme in saliva that can be used to determine the degree of stress)

In those morning moments, music is my companion. It's an important part of my daily life. Sometimes, the melody sets my mood, and other times, my state of mind picks out the themes. For instance, Billie Holiday is singing to me at the moment.

November 25
2021

International crew is an ongoing exchange

There is a whole host of benefits to being an international crew member. On top of our daily language learning, there is a continuous non-stop exchange. We share our countries' cultural peculiarities. We discuss our families' gastronomic preferences.

Crew recreation, a game called 'Jackal'

Ashly at work

Time to do some 'snack research' — not part of the main programme, of course

In Oleg's hands, freshly baked interplanetary bread made from special mixes

Today, the crew is celebrating Thanksgiving. Holiday greetings reach our spacecraft by every means of communication available: we get ground mission control centre messages and letters delivered to us from home via the intranet by our Psychological Support Services. We have also come up with a special holiday menu to celebrate the occasion. Our food today is predominantly French but traditional American meals are also served. As is customary on this day, there is a turkey gracing the top of the table, but in this case, as pâté.

Group photo at a meal together. Special Thanksgiving menu

Sergey Ponomarev,
Head of Physiology of the immune system Laboratory, SIRIUS Project Executive Director, PhD in Medicine, member-correspondent of the International Academy of Astronautics

Various components of the immune system respond to prolonged isolation in different ways. Primarily the innate immunity is affected, and we observe a kind of asthenisation or weakening of immune system functions, which seems to be related to a less varied antigen load than that which the body receives in usual life. In general, isolation leads to a deterioration of the immune system - due to stress, lack of fresh air and other related factors. After all, the IBMP test station has an artificial environment for the crew, with its own microclimate, nothing from the outside gets in.

Unfortunately, the data is yet insufficient, as not many women were involved in such experiments - there were few research subjects. But according to the preliminary results, there are no significant differences between the immune systems of men and women. There are some differences related to hormonal status at a certain point in time, but I would not classify them as critical. Perhaps when there is more statistical data and we delve even deeper into the subject - for example, looking at rare cell subpopulations and their functional activity - the differences will become more noticeable and we may find that some prophylactics are more suitable for women than for men, and vice versa. But for now, this is just a theory.

December 02 2021

Neither dew nor rain matter

Ice flakes are falling onto Moscow's winter slush, trapping motorists and city residents, who dare make it to their destinations using ground transportation, in disappointing road forecasts.

SIRIUS-21 crew "is not afraid of either rain or slush": the temperature inside our sealed facility is stable showing only minor fluctuations.

Perhaps the greatest change has been observed in our habitat gas composition. Carbon dioxide levels go up significantly when we are physically active. As of December, we were done with hypodynamia and started working out. Yesterday, we tested our cycle ergometer using a submaximal load.

And today, we are going to get started exercising on our passive treadmill and an active one. Besides kicking off our workouts, we're celebrating the 50th anniversary of United Arab Emirates. The Mission Control Centre disguised the Ground Mission Control with our national flags. Our UAE colleague has been getting celebration greetings and treating us to his national candy. The delight is boundless (it sounds as sugary-sweet as the flavour of baklava).

Not just a treadmill run, but also a cognitive experiment during exercise

Cardiovascular study with capillary blood sampling at the peak of exercise

Top three risks in human spaceflight: Radiation, zero gravity, isolation. Ground-based experiments that simulate selected factors of spaceflight help to reduce the top risks for future deep-space missions.

December 09 2021

Any stress trigger is tripled

Ekaterina Karyakina during an experiment in psychological support for the crew using VR technology

We have one-third of December behind. Folks say we've only got six months left before the experiment is over. This is because the last month doesn't count: we'll be looking forward to our landing in the hustle and bustle of getting ready for it.

A few days ago, the cosmic abyss consumed our stalwart companion: we undocked one of our crew members. A strange feeling of emptiness in confined space emerged. Home, the 'barrel', became wider.

In fact, any stress trigger within these iron walls gets concentrated and multiplied by three. This is exactly what we're here for. To feel and test fit all the hardships of long-term isolation, in order to pass this experience on to future expeditions. Now we are forced to get used to the new environment.

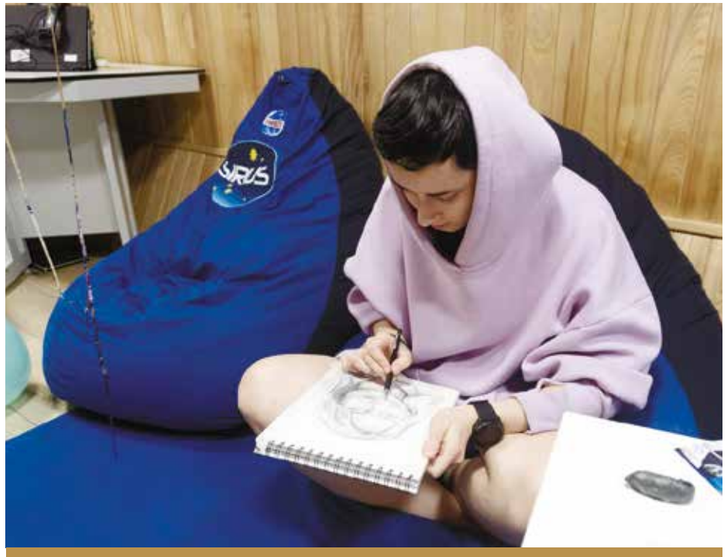
Redistributing our duties and resources to successfully proceed with our mission is paramount. Time keeps on its unstoppable race, rushing like crazy. And we go along with it, gradually getting used to the emptiness.

Oleg Blinov and Ekaterina Karyakina — coffee break

December 16 2021

Meeting yourself in an unusual environment

Having the opportunity to take up to 5 kilos of carry-on is one of the pleasant aspects of taking part in our isolation experiment. The items I took on the lunar expedition include: a tiny Brodsky poetry book, my favourite mug, and a cap, which travels with me around the world participating in every single space mission.



Sometimes there is time for arts

Blinov's cabin again, but this time with handmade decorations and a laptop holder modelled by hand on a 3D printer

All this sweet stuff is absolutely important, but one can certainly survive without it. The most valuable cargo is our own selves. Quite often, we have to get to know ourselves in unusual circumstances.

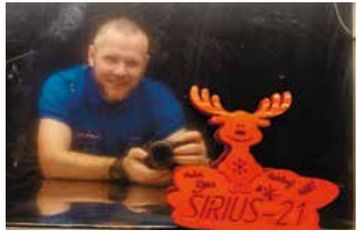
Perhaps I should also mention a personal list of close contacts among our local valuables. This is a list of your favourite people to 'talk in whispers to' in a private message exchange. It feels like thin threads connecting your isolated science-experimental everyday life to reality and simply helps you not to 'jump out of your mind.' And it takes very little to break the tenuous rope bridges.

Unfortunately, we ran into the imperfection of our communications. The other day, our team formally requested improving our psychological support system. Yes, things like that do happen too.

December
2021
23

New Year celebration in isolation

Giant Christmas lights stained the city's high streets in LED gold and silver, while a new COVID strain ominously labelled "Omicron" is also getting ready for the holidays. In here, we're out of reach of this new variant, the frosty freshness, and the city's festive lights. Only minor bits and pieces of the holiday winter spirit reach our information vacuum though letters from home.



Today, our first preparations for the upcoming festivities commenced. The Commander will 3D print out some Christmas decorations, and then we'll go ahead and adorn our New Year's tree. I'm busy decorating the medical module cutting out paper snowflakes, just like back in my school days of old. Shortly, I will come up with our next festive menu. Crew members have already gone through our foodstuffs. We are expecting our cargo ship to be here in a week. We're going to face sleep deprivation.

Unloading the cargo craft at midnight doesn't sound scary when you know your gifts are there!

New Year celebrations on board: New Year's menu, greetings from ground services, gifts, New Year's supplementary delivery and lots of other goodies

January
2022
06

Whilst colleagues are on the Moon

Ashley Kowalski. A cardiovascular experiment

I confess, I'm confused. I don't know if I should say, it's ALREADY been two months or JUST two months. We have spent the past week in a flurry of events. We celebrated the New Year, Orthodox Christmas and two other birthdays. We sent three members of our crew for a 'walk' on the Moon, preceded by strenuous preparations. For a few days now, our colleagues have been staying in the lunar module on the lunar surface while the two of us look out for the orbital station in lunar orbit.

Oleg and Saleh in the lunar module

During the extravehicular activity (EVA), supported by the virtual reality (VR) system, the crew practised a number of actions to be carried out in a real space mission environment in the not-too-distant future. The crew piloted a lunar rover, executed a series of actions on an outboard system which simulates lunar gravity, and performed a series of physical exercises.

There was no boredom on the orbital station: we were busy supporting the EVA, we filled out our favourite psychological questionnaires, performed cognitive tests, looked after our space garden, and I had another boxing training session. And certainly, another episode of Twin Peaks won't watch itself. To cut it short, we were adjusting to a new environment and a new rhythm. We're looking forward to the next EVA in the spring. And we'll be expecting our pioneers home by tomorrow evening.

January
2022
15

Cosmonauts need rest too

Crew members resolve a contingency — a 'surprise' from the CTC

While Moscow is drowning in snow, we are enjoying a well-deserved day off with a Washed Out album and a mug of hot chocolate. Cosmonauts need their rest, too.

For the past week, the SIRIUS-21 crew, loaded to the brim, has been actively performing its science and space duties.

Ugh! What a rhythm, I say! Over the past week, we worked on the Gagarin Cosmonaut Training Centre's onboard simulators. We experimented in the field of space robotics. We studied geological materials in the Human Research Programme (HRP) glovebox. Worked on NASA's HRP rover programming. Took retina images and investigated the cardiovascular system on Mohammad Bin Rashid Space Centre (MBRSC) machines. Collected microbiological samples from the skin and mucous membranes of our space bodies, as well as from our environment, for the IBMP RAS. We worked on ESA simulators.

Of course, we couldn't avoid hundreds of our favourite psychological questionnaires. Too bad there are only 24 hours in a day. Just kidding. Nevertheless, it's Saturday today, and another space piloting session has already been completed. A treadmill run is up next. Next movies to watch are: Apollo 11 and Tarkovsky's masterpiece, Stalker. And, of course, I'll finish reading the book about genetics that aims to explain why we are still such animals after millions of years of evolution.

William during a simulated docking with the orbital module

December 23
2021

The 80th day of lunar mission

Virtual docking with the ISS. Models of the ISS and Soyuz spacecraft in the foreground

Day off! Today, is the 80th day of our lunar mission. During the working week, I picked my totem animal. I opted for a lab mouse. One can get by without a shower (use antibacterial wipes, for example, or, my favourite one, after a good jog, soak a towel in hot water and sponge myself down).

Space greenhouse

It's tough to get by without days off, though. I got 10 hours of sleep today. All in all, it's been a great day off! Ernst Gombrich talked about the birth of art in Ancient Greece. There was plenty of exercise involving a passive treadmill, circuit training, and boxing. A Sunday shower. Checked out a digest of space industry events over the past week. One hour for a quarter of Tristan and Isolde. I had enough time to respond to one letter (one out of 30 … the ice was broken).

"I am Mr Onion", "I am a fragrant bazelike plant". To have a good harvest, you have to animate the plants and treat each one with respect

Got a gift from our Commander — a 3D-printed Soyuz rocket. Next up is the final episode of Twin Peaks. By the way, we started adding fresh onions grown in our space garden to our meals. What an amazing day!

January 29
2022

The main thing is not to become covered by a shell of indifference

When I get on a transatlantic flight, I have a detailed view of my final destination. This way, my trip no longer seems so lengthy, tedious, and far away.

I enjoy watching a movie, reading a book, socialising. But this time, my flight is a little farther away and a bit longer. Still focused on the end goal. Still enjoying the process. According to 'our new' Psychological Support Service person, any group interaction undergoes several stages on its way to developing interpersonal relationships.

We are now at the point where all the roles and positions within the group have been distributed and taken. We keep on trying to connect with the MCC. Currently, the thickness of my skin is exceeding all imaginable expectations. I guess the main thing is not to grow a shell of indifference by the end of the mission. After all, in any situation, whether on the ground or in the sky, no matter what happens, it is important to remain human.

Medical experiments: study of the gas composition of exhaled air, bacterial flora and muscle strength

February
2022
06

Values do change

Our lunar mission has passed the three-month mark. The days are so full that it feels like much more time has passed. The previous crew spent four months in isolation. I can imagine it: one more month of training, and then we are ready to disembark. Thus far, I did not feel any major changes or revelations. But I did notice some important things.

Chess tournament

Over the analogue simulator for docking with the ISS

Testing 'space' toothpaste

Firstly, I took a new look at communication with people close to me. Their support is of great value. In general, I think a lot about how conversations, meaningful letters and, as a consequence, people are devalued at a frantic pace.

Secondly, it reinforced the view that material things only make it harder to move about in life. The idea that you need a very modest amount of luggage to live fully was reaffirmed in practice. And, gosh, how important social hygiene is!

Break between techniques

Thirdly, I really miss nature. I thought it would be great to wait out the off-season and the cold in the 'barrel' and then break into Moscow's 'coolest' season. I was mistaken! Now, when they send me photos of snow-covered city streets, I can literally smell the thick frosty air, feel the crunch and creak of snow. I miss the slush, the cold rain, and when my fingers freeze.

I want to watch the changing trajectory of falling snow in the yellow cone of lamplight. I want to feel the first signs of spring, when there are still snow piles everywhere, but when you already know that the thaw is inevitable, and the blood rushes in impatient anticipation. I want to wake up in the early morning to the tinkling of nightingales. With the arrival of the long summer day, I want to feel the scorching sun burning my skin with its warmth. Every time I come home at night, I want to tip my head up, making sure the Great Bear is still in its place.

Nevertheless, there is still a long way to go. I do not feel bored. Nor that I am wasting time.

Cognitive test completed "perfectly"

Me, Ashley and a photo of Ashley's ocular fundus

Ultrasound of the calcaneal bone mineral metabolism assessment programme

And, in spite of everything, I enjoy the feeling of being in this space, in this environment, in this work, in this project.

February
2022
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All types of deprivation in one 'barrel'

Our bodies are experiencing all the 'joys' of deprivation. Being in the belly of the iron dragon, we are surrounded by all sorts of deprivation.

Information deprivation means restrictions on the incoming and outgoing flow of information. All communications with the MCC occur during communication sessions. Every hour and a half there is a 30-minute communication window. Within this short period of time, we get radiograms and video messages regarding ongoing experiments.

We don't have direct access to information, we can't use the Internet to google a question of interest. Instead, we do have access to the crew's internal media website. We request all the media content we are interested in through the Psychological

Electroencephalography in a space experiment

Support Service. We just send out our preference lists. Pretty much any movie, magazine, book or music album is available to us. Life is liveable. There is one downside, though: active downloading shrinks once the official day off is there.

Social deprivation means a lack of direct communication with our family and friends. We have no phones, no direct contact with the world. We may only get letters and videos from home twice a day on weekdays and once over the weekend during those communication sessions I mentioned. The hardest part is to wait for a weekend session. You're up sipping your freshly brewed coffee, and the emails are coming only four hours from now.

Sleep deprivation is our favourite. You are not allowed to sleep for 36 hours straight!

In the meantime, you wear weird devices that turn you into a bizarre monster. There's a face hugger covering your face, just like in the Alien movie. You're all wrapped up in duct tape, wires, and electrode sensors. That looks just stunning. There's a pulse oximeter strapped to your index finger, which is always in the way when you carry boxes.

While studying sleep

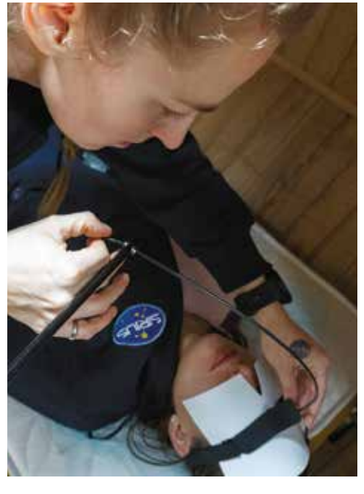
Cocoa break, cocoa cooked using the brand isolation recipe

The main thing is not to fall asleep: stocktaking in the warehouse during deprivation

Another isolation trick is hypodynamia. Our test subject bodies are deprived of their usual activity. That's why no one skips workouts here.

Plus, sensory deprivation on top of the above. Sounds, colours and smells become monotonous. So, in four and a half months, we're in for a sensory-cacophonic outburst.

Oh yeah, unloading the docked cargo vehicle at night is a mandatory part of the programme. By the way, our next cargo ship should be coming shortly. This resupply will include scientific equipment, clothes, personal items, and food. All of the resupply cargo is planned for the remaining four months. The list of items to be resupplied needs to be thought through in advance. Next, this list will absolutely undergo a rigorous review process on the part of the 'delivery service'. Limited nutrition is another deprivation trick. All the food is either freeze-dried or canned. You can't have whatever you want available on tap.



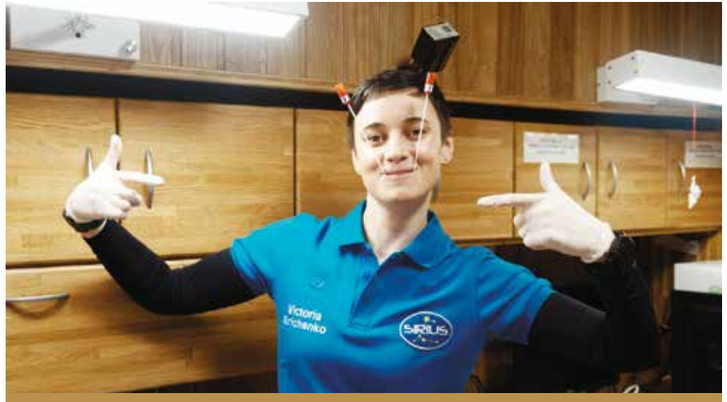
The crew's favourite pastime is board games

Blood microcirculation experiment

February
2022
20

How I became a bloodsucker

Our dear scientists are closely monitoring the changing composition of our test subject bodies. Hence, one of our duties is to collect a wide range of biosamples. We cut hair off the back of our heads for cortisol research. We regularly submit saliva samples into lab flasks of various diameters. We do blood work several times a month. I already have a nickname – 'Bloodsucker' (I will be Dracula next Halloween).



Experiments on the bacteriological composition of test bodies

Once a month, we perform a 24-hour urine collection. We spend the whole day pouring 'honey nectar' into jars. And our stool got codenamed 'nuts'. We do 'nut hunting' far more often. And once all these treats are collected, up until our airlocking day, we store them in the fridge where we also keep some of our groceries.

My personal amusement is the collection of bacterial samples from the surface of the skin and mucous membranes. It's about as much fun as getting tested for COVID. In the morning hours, there is nothing more invigorating than a doctor's bacterial raid on the quarters of our dear crew members.

February
2022
27

Sleepless insanity

This time, sleep deprivation ended up being much harder on me, both physically and mentally. Physically, since I had not been able to get enough rest and sleep the night before. Mentally, because of global events. Yet, on the other hand, we already knew for sure what to do and what to expect from deprivation.

Next, you spend your entire morning doing check-ups and examinations. The schedule is busy: doing bloodwork, saliva sampling, taking blood pressure and heart rate in several positions, ECG, plus my favourite surveys. But perhaps the toughest part of the experience is being both sleepy and hungry (alas, nocturnal gluttony is prohibited at this time).

What do you do when you mustn't sleep? Sorting out cargo and taking stock of the warehouse. Hauling boxes — time is running out!

The big question that arises during this time of sleepless insanity is: How do I kill my time? A few night hours unloading the cargo vehicle that arrived are a real lifesaver. You just dash back and forth carrying boxes. The night goes by unnoticed. And then it turns out that the dawn has taken you by surprise and it's time for your cognitive test.

the head, like a trained sea animal, remained afloat and, trying to save the drowning consciousness, kept on making ripples on the water over the poor thing to no avail.'

I passed out at 9 p.m. as scheduled. And next day, there's a sub-maximal treadmill test on our schedule.

Morning work gradually turns into brunch. And then, before you know it, letters from home start coming in. Every time, we really look forward to those precious 30 minutes.

You're lucky if deprivation falls on your bathing day. A shower feels refreshing, it gives you some energy even with the rest of your sleepless hours. By the way, this time the MCC entertained us with a new trick: if you spend more than 15 minutes in your cabin, you get a call from the ground control centre (we used to do this in elementary school, dialling numbers from the phone book). By the end of our deprivation period, there were hardly any phones left on.

Your date time with Morpheus is clearly spelled out in the cyclogram. 'The body was pierced through with fatigue, and only

Cardiovascular experiment, the subject being the doctor themselves

Preparing for a sleepover on the Moon

Ashley seals the airlock to the lunar module

Mission day 120. Our equator. The MCC was expecting us to celebrate. But we had no energy for a party. Except our meals were festively delicious. We have the same amount of time left to go! We are going to celebrate once we get through the second half. In our video message, we did end up asking the SIRIUS-19 crew this question: "Why only four months? Why such a short time?"

Going to the Moon with William and Ashley

"The Moon Dream Team"

All week long, we've been doing our endless monthly test experiments. We were getting ready for the upcoming EVA. The scenario was that three crew members were to land on the Moon: the crew physician, the flight engineer and mission specialist-1. It felt like the three of us were going on a short minivan trip or just hiking. Our lists included everything: food (the key item was a couple of ramen noodle boxes), snacks for several weeks, critical equipment and gear — everything to take and nothing to forget. We undocked. We spent the night on the lunar surface.

March
2022

08

Part of the Moon team

International Women's Day. This is the day when my aunt usually has guests over for pancakes and manti. But this time my American colleague, flight engineer Ashley and I celebrated 8 March on the lunar surface. On this day, there were two elegant silhouettes on the Moon at once, hiding under protective spacesuits. Instead of traditional flowers and pancakes, there was lunar dust and lunar soil samples. You couldn't ask for more.

Studying the 'lunar soil' in the glovebox

Ashley's trying out 'lunar gravity'

'Moonwalking' is prefaced by thorough prep work. All of the upcoming procedures are discussed prior to the EVA, all of the upcoming activity is rehearsed. During our moonwalk, we were wearing 'smart suits' specifically designed for EVAs. The suit looks like thermal underwear, riddled with a network of wires with sensors. It's covered with a 'spacesuit', which looks like a regular work suit with an unusual design (but that's a separate topic). And it's incredibly hot, you feel like butter melting on a pancake. Hopefully, the next generation of smart suits includes a ventilation system, like in the Falcon space suit.

The overall scenario of SIRIUS-21 was based on a simulation of a long-term lunar mission with three landings on the lunar surface and included the testing of elements of a human mission to more distant space objects

Oleg in an experiment on robotic arms remote control supported by a VR system

Virtually every single activity on the lunar surface is practiced in the VR system. Our operator Will stays in the lunar module to coordinate several teams involved in the EVA. Ash and I are the lunar team. We perform all of the tasks narrated in our VR headphones step by step by the orbital module team.

There is non-stop communication between the crew members throughout the operation. Oleg and Saleh are keeping the EVA minutes in real time. The escort team are the EVA facilitators, a team of engineers. They monitor what's going on through numerous cameras and are ready to help anytime via a virtual chat. Everyone is busy. Yeah, this is the most unusual 8 March ever.

Practising on the lunar surface using the VR system

"Moon soil" sample

March
2022
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Savour the moment

Physician at their duties: capillary blood sampling at peak physical activity

It's Friday. I got to sleep in! I woke up so early that I needed to laze around in bed for another 30 minutes. After the traditional morning medical check-up, I lazily stretched my bones. I leisurely enjoyed a cup of coffee in the pre-dawn twilight. Its invigorating taste was followed with sweet dates as I was savouring my reading. Then my duties forced me to do some work. Bloodwork got done quickly.

When I got back, my armchair still preserved my body heat. I spent the rest of the day at a set, steady pace. It's especially nice to relax on a Friday, especially when your co-workers are still having a busy day at work. With our evening mail, we got a truly spring-like letter from our lost crew member Kate. I had no idea how much I missed her. Her sense of humour is amazing.

March
2022
25

100 days before undocking

Saleh holds up tubes of 'lunar soil'. During the experiment, researchers described the lunar soil samples just as cosmonauts would do on a lunar mission

After a hard day's work on the Moon

Mission day 140, or 100 days before our undocking. This morning our kitchen was transformed. It became warmer and cosier. Twelve people's faces are now displayed on the wall. All together. Our backups are part of ourselves, part of our crew. We are still in touch with some of them.

That reminds me of the observation times. Those were hard times, sometimes unpleasant, yet interesting. It felt like a real summer camp. We lived together for three weeks without leaving the confines of the second floor of Building 7. Two separate rooms for boys and girls. Two pantries and a kitchen area. And that was it in terms of our space.

So, our isolation actually started much earlier. We would often get together in the kitchen at the end of our work day. Every night, after a brief meeting, the delivery service would bring us something delicious for dinner. We were seeing off fall from our open balcony. We would feed local cats from that balcony. The cats were happy to be our neighbours, but never showed it.

March
2022
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Mesmerising take-off and landing

Throughout this past week, my heart has been out in the vast steppes of Kazakhstan. My colleagues were there as well, physically. I was watching them at launch and landing from the lunar orbit.

Analogue Robotic Arm Simulator

Ashley practises driving the lunar rover

There is no doubt that both activities (take-off and landing) are something to admire in the space industry. Watching a rocket take off is breathtaking. Every cell of your body vibrates to the beat of the roaring rocket engine. All the Earth trembles.

A no less breathtaking sight usually unfolds during landing. Once the capsule is in the sky, helicopters start waltzing around the soaring 'bell'. The stunning teamwork of a huge number of people representing various organisations is mesmerizing.

And one and all are united by space. I enjoyed working together with them. I'm looking forward to getting back on track. And, of course, I passed on my greetings to everyone.

A woman in a barbershop. It's hard to keep track of your hair during isolation, so take it down

April
2022
07

When it's springtime outside

Literally, my entire outside contact list says: "Spring has already taken its legal effect." Why is this expression so popular in Russia, and who has the copyright, who should it be attributed to? OK, Google. Just kidding, we don't have any Google here. I still hope the snow in Moscow melts by 4 July, though. In the meantime, club wheat has started to sprout in our space seedbeds, and the first tomatoes have ripened.

My hair is growing, but I still have to hide under the hood (the back of my head keeps on freezing under the air duct, long hair is warmer after all).

I regularly visit our local hair salon. We call it Alain Ducasse, after the manufacturer of our French canned food served in isolation. The haircuts are fancy, not too pricey at all.

I'm starting to feel the impact of isolation. Time has turned into a gooey bubblegum. The body craves consistent long hours of sleep and candy.

I no longer feel awake at 6 am at my morning yoga class. I take vitamins. The body noticeably lacks them, as opposed to candy. 'Everything is temporary in this life.' Or rather: 'Time heals all wounds.' OK, Google, time clichés.

During the isolation, 75 tomatoes, several harvests of green onions, arugula, basil, different types of lettuce, and leafy cabbage were harvested. The researchers grew a palm-sized coriander bush and several varieties of wheat, including dwarf wheat, the same one grown on board the ISS

April
2022
12

Off we go!

Off we go! Cosmonautics Day is a big day. A day that brings the whole planet together. And I really love this holiday. We were getting holiday greetings from all over the place. The crew had recorded and sent our holiday video beforehand.

We didn't celebrate it in any special way. Personally, I just had this space holiday in my heart. At night, rather unexpectedly, the three foodies (Ashley, Will, and I) got the munchies. After some deliberation, hesitation, and reflection, night-time ramen noodles were discovered and consumed. This is exactly the time of day when the meal hits its maximum flavour potential. It's hard to put into words how divine it was. The meal was accompanied by a heated discussion of our compelling needs, an evaluation of current events. We went to bed full and happy.

By the way, Katya warned us that once our isolation period is over, we need to be careful with the food we eat. There may be some digestive discomfort. But these warnings can't keep us from dreaming. After all, right across the street from our spaceship, they make probably the most delicious pizza in town, and about 150 m away, there's terrific shawarma waiting for us.

Shooting the official video for the UAE partners. The entire crew "in parade"

April
2022
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A human being consists of all humans

"A human being consists of all humans", Sartre wrote. "That human is equal to all of them, and all of them are equal to that one human being." Space changes. It can be stuffy and disturbing, or it can be free and cosy. These changes are especially evident when five people are crammed in a tiny tin can.

A tea party with freeze-dried strawberries

Putting the moon together, literally, out of 'splinters'

Each participant brings their own self, their own experiences and habits into this space. And it's amazing how one single person can change the existing ecosystem. Electrify the air with a casual word or relieve the tension with a meek smile. There is an interaction, a mutual exchange. Symbiosis. A stable homeostasis is formed. We give parts of ourselves and get something in return. We work on our own environment all the time.

But it's not that simple, actually, there are more details involved.

There are other participants sprouting into this interdependent ecosystem: our MCC, our families and friends, journalists, society at large, and world events. Everyone in this system matters, has their own place, and has an impact on our tiny world. Sometimes, it takes a lot of energy to get our sustainable balance back.

Perhaps balance and a healthy ecosystem are important for any productive relationship. Especially when it comes to long-term space missions.

April
2022

28

How to deal with the monotonous life of a laboratory animal

Oleg on the active treadmill, with a preset programme

Exercising is a great remedy against hypodynamia and despair both on Earth and in space. Just like the ISS cosmonaut and astronaut cyclogram, our schedule allocates about two hours for daily workouts. Despite certain major flaws in the current isolation workout system, it definitely has some positive impact.

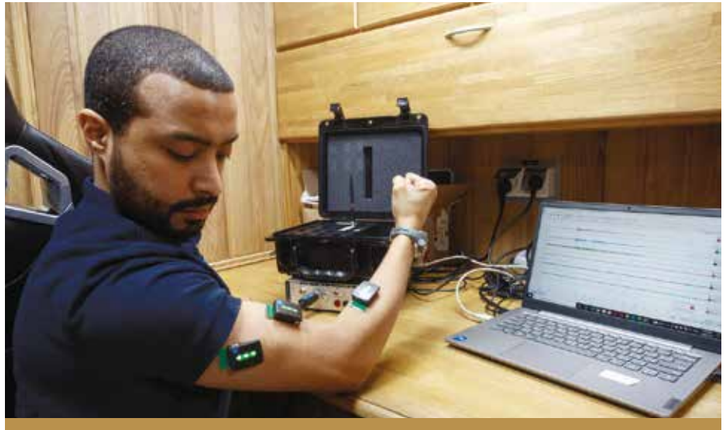
We have both an active and a passive treadmill, and two weight machines, the Advanced Twin Lifting and Aerobic System or ATLAS (NASA HRP) and the CMT (IBMP). Yet there are other methods as well. Each of us has already figured out their own way of dealing with despair, insanity, and the monotonous life of a test animal. But perhaps planning is at the top of the list. Personally, I detail my schedule for the coming day. Work tasks are my top priority. There is also a separate to-do list. Apart from that, communication with the outside world helps.

Saleh exercises on the Atlas weight machine

Ashley pushes a passive treadmill

I still find the lack of up-to-date information, the latest space industry news to be my biggest challenge. On the other hand, it can be considered some sort of reset, like a detox. No news, no unnecessary and shallow information, no social media. No calls or text messages. I caught myself thinking that I can't remember what my phone looks like.

Ashley was on the passive treadmill for a reason



Saleh is an Atlantean who isolationist hypodynamia cannot cope with

William's turn to take a physical fitness test

Saleh is wearing a blood pressure cuff, ECG sensors, a pulse oximeter and a mask that records the composition of exhaled air

But what's really interesting to think about is how our readjustment will go once we undock. The first phone call. Messages to friends. The first post. I'm horrified imagining the flood of information bearing down on us in just a few months.

Daria Komissarova,
deputy Head of the Nutrition Gastroenterology and Hygienic Control Laboratory, PhD in Biology

In the course of the isolation experiment, samples were taken from the upper respiratory tract, skin, and additionally female microflora samples were taken from women. Our task is to study changes in different biotopes before, during and after isolation.

Currently, the role of women in human spaceflight is increasing, but analogue studies involving them are relatively new, so there is little information on the effects of conditions simulating certain factors of space flight on the female body. Studies of the female microflora made in isolation experiments and dry-immersion experiments have shown negative changes. The global aim of all these experiments is to develop autoprobiotic agents which, ideally, female researchers or future cosmonauts should use from the first days of the experiment or flight to maintain microflora stability.

May
2022
05

It's raining in my heart

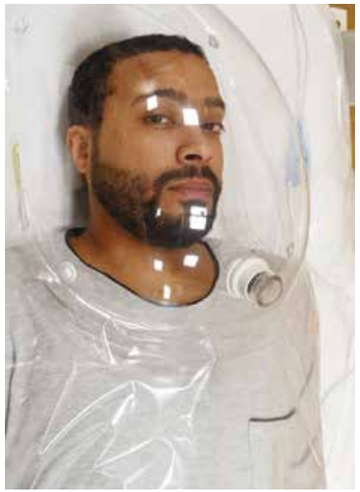
Preparing for the jogging test

...But the weather forecasts promise a temperature rise and fair weather in two months. The last three days have been exhausting: a series of monthly experimental sessions has been launched. Time to explore the body's energy consumption with eight hours of sleep and rest.

Experiment 'Study of gas energy expenditure at rest'

Over this time period, the research operator (that's me) experiences neither one or the other: they monitor the process. The research equipment looks cosmically hilarious: you lie under a transparent dome for 20 minutes and breathe in recycled energy.

I dug through our local hard drive looking for something new. I check it out occasionally. Two terabytes of storage space for movies, shows, and music. Black Sabbath was the one that added a new vibe to my day.



May
2022
13

Nothing terrifying or mystical in isolation

Time for another EVA. By chance our crew split into two gender groups. The male crew landed on the lunar surface. Ashley and I were assigned to guard our orbital home from space invasions and any other emergencies.

Ashley's back 'home' from the moon mission

A hatch to the moon

So, we were following the EVA from the orbital module.

We spent the first ten minutes after the airlock closed lying on the floor in the community room. Shaped like starfish, we were enjoying the enchanting silence, soaked in the taste of our imaginary freedom. On Friday 13th, we ordered the classic horror movie from our IT service: Friday the 13th. Who would have guessed that this film genre was forbidden during the experiment? Even The Shining and The Exorcist were not allowed on this mystical isolation Friday.

Apparently, our Psychological Support Service is afraid of us having a 'Texas chainsaw massacre'. You can't help it, a rule is a rule. On this quiet Friday night, we were shaking with fear to A Quiet Place.

May
2022
20

Earth news from the Moon

Saleh, the apple and gravity

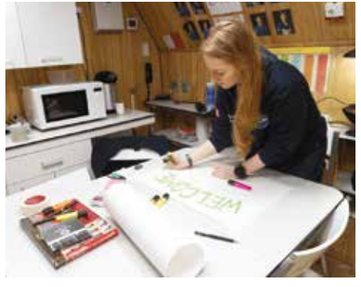
In the blink of an eye, our short 'vacation' was over. It was time for the crew to be reunited. We greeted our colleagues with our 'Welcome Back Home' posters. Saleh brought great news to us from the Moon. He became a daddy! We were congratulating him. Exchanging our impressions. And making plans for the future.

A lot has happened over this past week. It was a busy, efficient, and incredibly productive time. We worked hard and rested hard.

Group selfie in the sports module

Waiting for men from the Moon

Ashley and I spent several gigabytes of film on everyday experience movies about scientific life in isolation. During those days, I recharged my battery for the remaining few months. I literally got filled with creative energy. Every single day, a new piece of art would emerge from my watercolour brush.



May
2022
26

Isolation birthday cake

Today we got to the next milestone. Ashley's birthday. Accompanying the celebratory mood was a whole bunch of inflatable balloons. A unique recipe was used to bake the isolation birthday cake, which, of course, had candles. Candles, though without flame (safety rules), are an essential part of any birthday cake. After all, how else does one make a wish?

Ashley was happy: it was, without exaggeration, her best birthday ever

We divided all of the eight isolation months into chunks. Pieces that are not that hard to 'swallow'. A kind of stopping point between important and bright events of our lives in isolation. National holidays, New Year's Eve and Christmas, supplemental delivery and sleep deprivation, EVAs and birthdays, one month anniversary, four months anniversary, the 100th day before the undocking.

And so, when all the wishes were made, and the cake was finished, it was time for gifts. There were a lot of presents. And the festive photo shoot lasted until one o'clock in the morning. Ashley later confessed that it was her best birthday ever.

We decided not to remove the holiday decorations. It's like a Christmas tree that lives with you until spring because you don't want to say goodbye to the holiday spirit in your house. It's the end of May. We're just over a month away from completing our mission. And we've mapped out new transition points.

June
2022
03

I had to confess to my shenanigans

E-30 (Egress-30) or 30 Days to Go. Another Robinson Crusoe notch. We wanted to spend today in a special way. Particularly festive mood during routine tasks. Preliminary recap. Delicious breakfast (for an isolation experiment). Dessert was cooked according to a special recipe from the chef aka the crew physician.

Practising docking with the Martian orbital station. Operator - Saleh, assistant operator – Ashley

Branded cake to mark the E-30 (Egress-30)

Ashley has completed the sub-maximal load experiment and is happy

We were shooting our daily routine on GoPro. And we also played a trick on the flight engineer. She got an email with a great offer. Of course, Ashley had no idea that the prank letter was carefully crafted by her crew. When third parties outside got involved in the story, we had to confess to the shenanigans. We laughed together. We laughed until we cried.

June
2022
10

Study of sleep without sleep

The study of sleep without sleep. That's what I call it. The study may be interesting, but it is physically difficult, and psychologically not the most pleasant. The bottom line is that we are experiencing the effects of fragmented sleep. This means that starting at 1:00 in the morning, every hour, we interrupt sleep for five minutes: turn on the light, sit in bed, fill out a questionnaire on subjective evaluation of the condition. And so until 7 am.

The device's cables entangle the legs, head, and torso of the body like vines. It's that bizarre face hugger device that clings to your face with a deadly grip in the Alien movie. The small recorder records periods of sleep and wakefulness by means of ECG, photoplethysmography (PPG), actigraphy and single-channel electroencephalogram.

There have been several such super caps that have had to be worn for quite some time. The aim is the following: to detect stress markers

The device is designed to evaluate the quality of sleep and its stages, breathing and movement during sleep, vegetative parameters. Then, we will spend the next night at rest in order to evaluate recovery during sleep. Sleeping in this equipment is extremely uncomfortable. That's why the study has been dubbed the "sleep study without sleep".

June
2022
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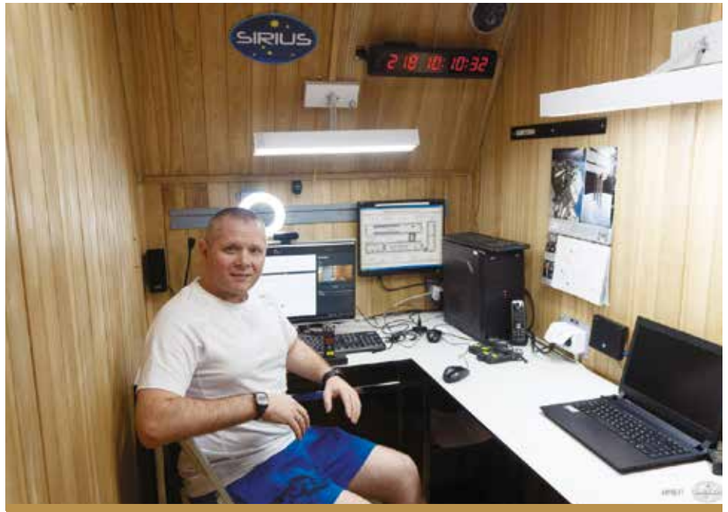
Final experiments

This time we are doing the final sessions of the monthly tests. Every day we do some kind of research for the last time. What can I say, it feels good. Getting ready to go out.

The 'To Do' list is overflowing. The other day we got a video with warm words from the Mohammed Bin Rashid Space Centre astronauts. And we also found out that Oleg Artemyev took the



Oleg at the communication room where the daily sessions with the control centre took place

unofficial emblem of SIRIUS-21 crew with him during EVA. It turns out that our names have already been to outer space. All that remains is to send my body there.

I reread the diaries from the beginning of our long isolation mission. All past events came to mind. My heart felt warm. It turns out that I will miss this project very much.

Ashley replaces the flasks in the device that measures gas composition of the lungs

Galina Vasilyeva,
Head of Bone and Metabolic effects of micro gravity Research Laboratory, PhD in Medicine, Full member of the International Academy of Astronautics

The programme of isolation experiments gives us detailed results on the effects of extreme conditions on the condition of bone tissue. When a person stays in isolation conditions in a sealed habitat with an absence of natural light, as they would during prolonged spaceflight, hypodynamia (a decrease in strength or power), chronic stress, etc. are simulated, which also have a significant effect on mineral and bone metabolism. Of course, it is of particular interest to study the effects of isolation experiment conditions on a female body. In previous short isolation experiments, we have obtained a number of data indicating changes occurring in the bone system. One of the interesting and unexpected results for us was the decrease in bone mineral content observed in all participants in the eight-day LUNA-2015 experiment. In the longer SIRIUS-19 experiment (120 days) using various prophylactic exercises, we also obtained data showing quite high risks to bone health under these conditions. In the SIRIUS-21 experiment (240 days), we continued our research. The experiment has only recently come to an end, and we have now started processing the data and carrying out a preliminary analysis. Although only two women took part in this experiment, the survey sessions were scheduled in such a way that all data obtained in the first 120 days are comparable with data from previous experiments mentioned above.

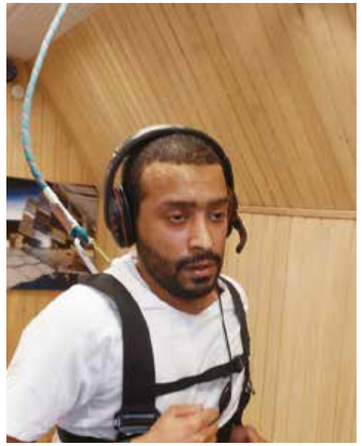
Entrance to the IMBP RAS ground test facility with logos of the isolation experiments undertaken here

June
2022
26

The most difficult month

The last month is the most difficult. It feels like it lasts as long as the previous seven combined. The schedule is packed to the limit. Today we are to undergo another sleep deprivation experiment. According to the terms of the experiment we are not allowed to sleep, take a nap, or stay in the cabin for more than 15 minutes. We can forget about a cup of refreshment for 38 hours, and our favourite face hugger is the cherry on top of this cake of happiness.

The study lasts five days. The first two days assess baseline performance under normal conditions and eight hours of sleep. Then 38 hours of deprivation. These trials are followed by a life-saving, incredibly sweet 10 hours of restorative sleep.



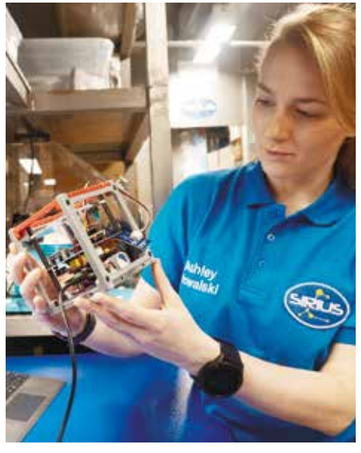
Physical activity test — the load is the highest in the whole time of isolation

And after 24 hours of complete recovery from sleepless torment, the experiment concludes with final data collection.

This is a comprehensive study in which we take saliva and venous blood samples for several days in a row, and measure average blood pressure levels while sitting and standing. We do echocardiography, to determine heart rate variability, cardiac output, and stroke volume.

There is also continuous data collection from our wristwatches. On the right arm, the Actiwatch, measures the level of light in the room and acceleration caused by wrist movements.

Ashley with a 3D printer. They used it to print parts for the lunar rover, for the satellite they built themselves, and for faulty appliances. You can't call a repair crew in space either, you have to do everything yourself



On the left, we wear an Actigraph. And there's no getting out of neurobehavioural testing.

Twice a day — after waking up and before going to bed — for five days. These are comprehensive tests that assess reaction time, memory, and include scales of subjective state assessment (feeling of sleepiness, fatigue, energy level and mood). The entire-pool of data collected, will help assess biomarkers of susceptibility and resistance to stress and acute sleep loss.

The pros of current deprivation are obvious. First of all, it's the LAST one! Secondly, the undeniable plus is that it eats up two whole days. And, when we wake up for the 233rd time (including the three deprivations) on the 236th day, there will only be four days left BEFORE. All in all, we enjoy the experience.

The first rule for successfully completing this challenge is to keep yourself busy. The plan is to do a couple of scientific experiments, including group tasks. Answer a few emails. Do some cleaning. Watch a TV series and a few movies.

Preparing to leave our space station. Signing the group photo as a memento

Cleaning up a spaceship is a demanding task

The second rule is to feed your exhausted body a delicious meal. It gives you energy and improves your mood. Today the Dream Team is unpacking instant ramen noodles for lunch. But the important thing is not to overeat. Otherwise, a siesta is assured. And even the shortest nap is forbidden.

The third rule is "don't fill out questionnaires while sitting". More than once I have fallen into these drowsy pits. In the end, I think I filled out something wrong and somewhere in the wrong place. Will did manage to fall asleep standing upright while measuring BP, though — he is a champ. So maybe this rule doesn't actually work.

One last thing. If you can't keep your eyes open anymore, go back to the first rule — get finally busy with something!

In Conclusion

Isolation for Victoria Kirichenko and her colleagues on the SIRIUS-21 crew ended on 3 July 2022. Scientists are now studying the resulting biomaterial, systematising the data, which will be published at the end of this year and in early 2023

Does gravity even matter?

"The experience gained in this experiment is unique, invaluable!" says Victoria. "The 240 days spent in the ground-based testing facility were intense, at times exhausting and, at the same time, incredibly interesting."

"I am very grateful to the Institute for Biomedical Problems of the Russian Academy of Sciences for the opportunity to participate in this project. I am grateful to Asgardia for trusting me to be the first Space Nation researcher. I am eternally grateful to my crew, we passed this test together. And together we have contributed to the advancement of space science. Although our experiment was performed on Earth, the data obtained will help humankind further advance in the study and exploration of outer space!"

Photos provided by the Institute for Biomedical Problems of the Russian Academy of Sciences, materials from Asgardia's state website asgardia.space, Dr Igor Ashurbeyli's personal website ashurbeyli.ru were used in preparing the publication.

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